

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-18/0615**  
**of 4 September 2018**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Essve Injection system HY for concrete

Product family  
to which the construction product belongs

Bonded fastener for use in concrete

Manufacturer

ESSVE Produkter AB  
Esbogatan 14  
164 74 KISTA  
SCHWEDEN

Manufacturing plant

ESSVE Plant No. 671

This European Technical Assessment  
contains

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

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

EAD 330499-00-0601

**European Technical Assessment**

**ETA-18/0615**

English translation prepared by DIBt

**Page 2 of 25 | 4 September 2018**

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## Specific Part

### 1 Technical description of the product

The "Essve Injection system HY for concrete" is a bonded anchor consisting of a cartridge with injection mortar ESSVE HY 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 Ø8 to Ø32 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, C 5 |
| Characteristic resistance to shear load (static and quasi-static loading)       | See Annex C 1, C 3, C 5, C 7 |
| Displacements (static and quasi-static loading)                                 | See Annex C 8, C 9, C 10     |
| Characteristic resistance for seismic performance category C1                   | See Annex C 2, C 3, C 5, C 7 |
| Characteristic resistance and displacements for seismic performance category C2 | See Annex C 2, C 3, C 8      |

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

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

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

In accordance with the European Assessment Document EAD 330499-00-0601 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**

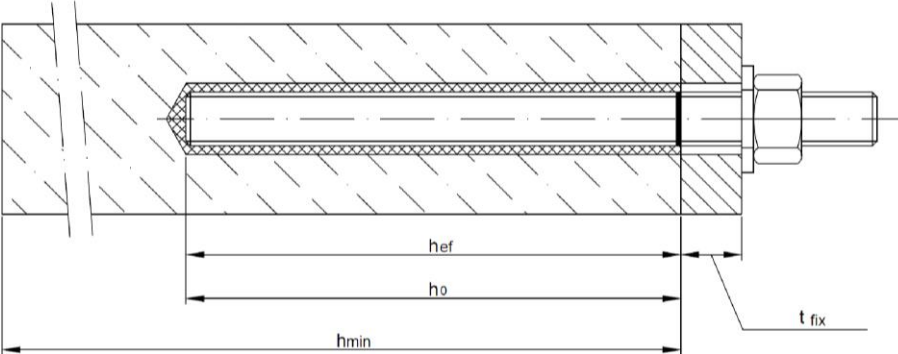
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 4 September 2018 by Deutsches Institut für Bautechnik

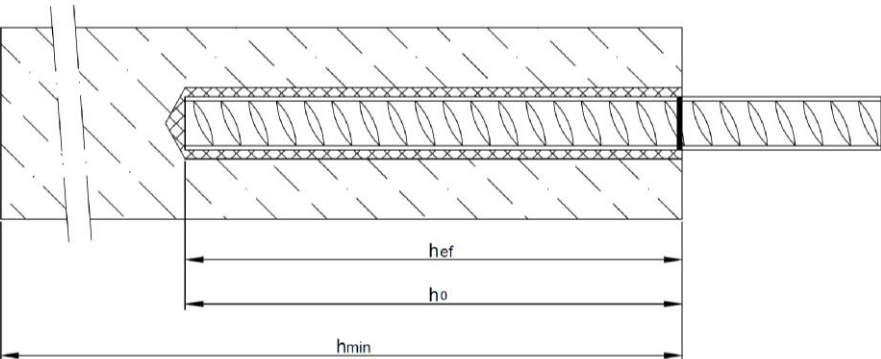
BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*beglaubigt:*  
Baderschneider

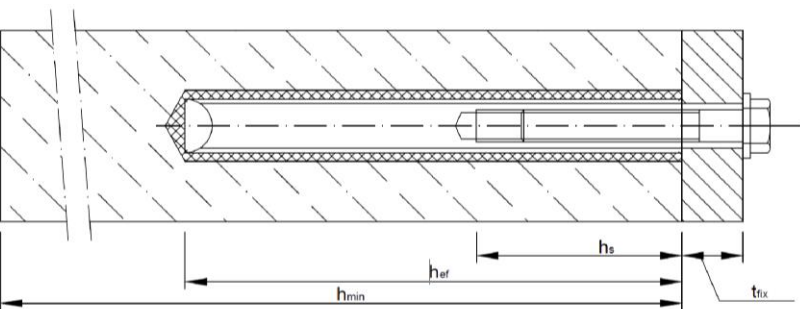
Installation threaded rod M8 up to M30



Installation reinforcing bar Ø8 up to Ø32



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

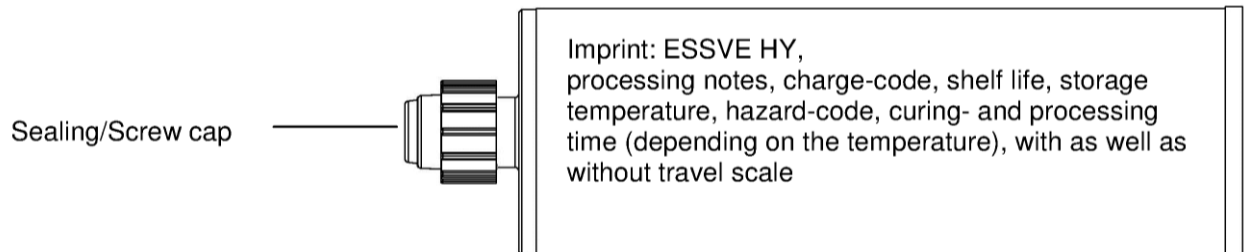
Essve Injection system HY for concrete

Product description  
Installed condition

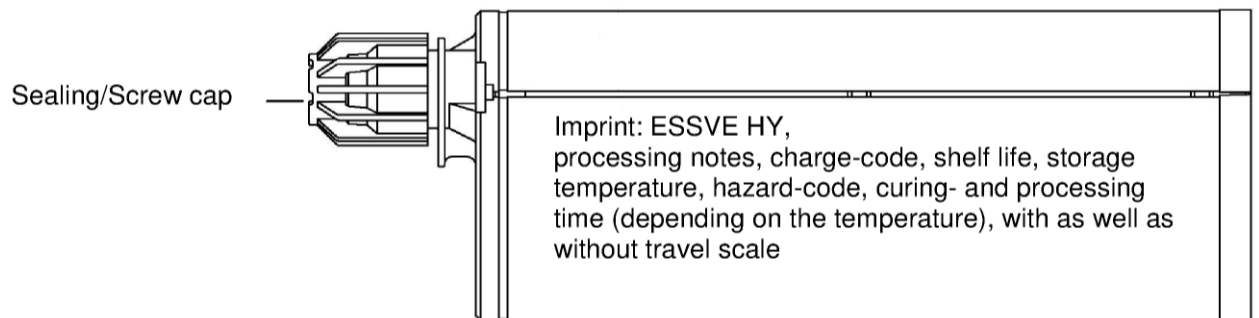
Annex A 1

### Cartridge: ESSVE HY

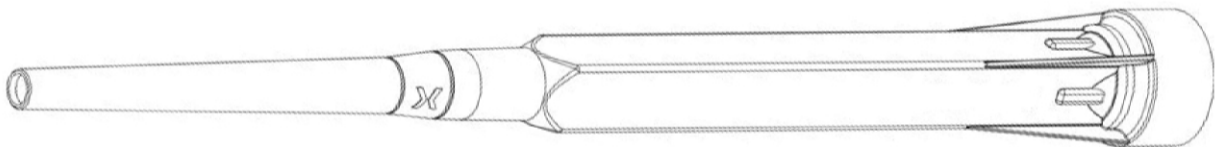
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)



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



### Static Mixer

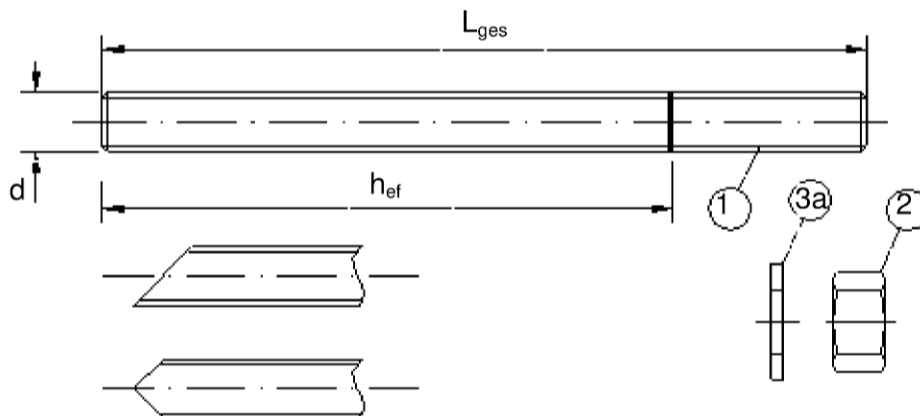


Essve Injection system HY for concrete

**Product description**  
Injection system

**Annex A 2**

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

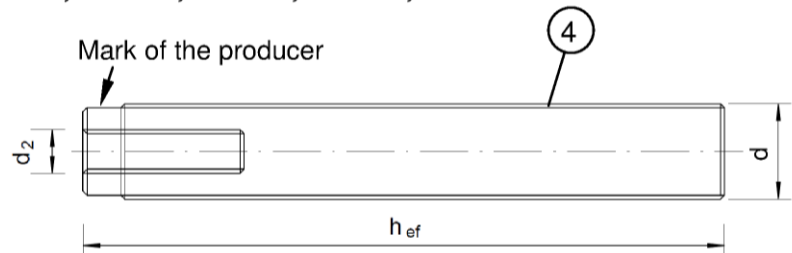
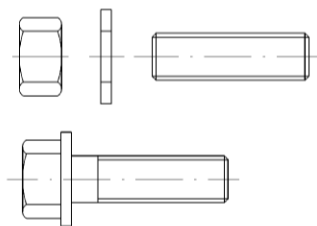


Commercial standard threaded rod with:

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

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

Threaded rod or screw



Marking: e.g.

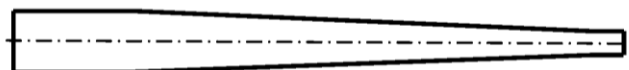
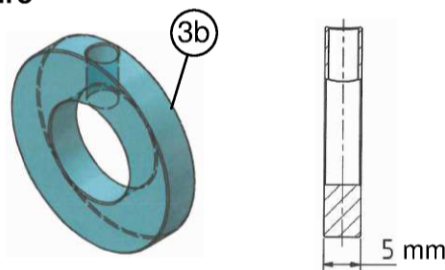


M8

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



Essve Injection system HY for concrete

Product description

Threaded rod, internal threaded rod and filling washer

Annex A 3



**Table A1: Materials**

| Designation                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                              | Material                                                                                                                                               |     |                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------------------------------|
| Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001)                                                                                                                                                                                                                                                                                                                                     |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 od hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or sherardized ≥ 40 µm acc. to EN ISO 17668:2016                                                                                                                                                                                                                     |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| 1                                                                                                                                                                                                                                                                                                                                                                                                     | Anchor rod                                                                                   | Property class acc. to EN ISO 898-1:2013                                                                                                               | 4.6 | $f_{yk}=400 \text{ N/mm}^2$ ; $f_{yk}=240 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 4.8 | $f_{yk}=400 \text{ N/mm}^2$ ; $f_{yk}=320 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 5.6 | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=300 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 5.8 | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=400 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 8.8 | $f_{yk}=800 \text{ N/mm}^2$ ; $f_{yk}=640 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
| 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,<br>(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 | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=400 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 8.8 | $f_{yk}=800 \text{ N/mm}^2$ ; $f_{yk}=640 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
| Stainless steel A2 (Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, acc. to EN 10088-1:2014)                                                                                                                                                                                                                                                                                                    |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| and                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)                                                                                                                                                                                                                                                                                                    |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| 1                                                                                                                                                                                                                                                                                                                                                                                                     | Anchor rod <sup>1)4)</sup>                                                                   | Property class acc. to EN ISO 3506-1:2009                                                                                                              | 50  | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 70  | $f_{yk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 80  | $f_{yk}=800 \text{ N/mm}^2$ ; $f_{yk}=600 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
| 2                                                                                                                                                                                                                                                                                                                                                                                                     | Hexagon nut <sup>1)4)</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,<br>(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<br>A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, EN 10088-1:2014 |     |                                                                                                            |
| 3b                                                                                                                                                                                                                                                                                                                                                                                                    | Filling washer <sup>5)</sup>                                                                 |                                                                                                                                                        |     |                                                                                                            |
| 4                                                                                                                                                                                                                                                                                                                                                                                                     | Internal threaded anchor rod <sup>1)2)</sup>                                                 | Property class acc. to EN ISO 3506-1:2009                                                                                                              | 50  | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 70  | $f_{yk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
| High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)                                                                                                                                                                                                                                                                                                                 |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| 1                                                                                                                                                                                                                                                                                                                                                                                                     | Anchor rod <sup>1)</sup>                                                                     | Property class acc. to EN ISO 3506-1:2009                                                                                                              | 50  | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 70  | $f_{yk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 80  | $f_{yk}=800 \text{ N/mm}^2$ ; $f_{yk}=600 \text{ N/mm}^2$ ; $A_5 > 12\%$ fracture elongation <sup>3)</sup> |
| 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,<br>(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  | $f_{yk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                        | 70  | $f_{yk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation                |
| <sup>1)</sup> Property class 70 for anchor rods up to M24 and Internal threaded anchor rods up to IG-M16,<br><sup>2)</sup> for IG-M20 only property class 50<br><sup>3)</sup> $A_5 > 8\%$ fracture elongation if <u>no</u> requirement for performance category C2 exists<br><sup>4)</sup> Property class 80 only for stainless steel A4<br><sup>5)</sup> Filling washer only with stainless steel A4 |                                                                                              |                                                                                                                                                        |     |                                                                                                            |
| Essve Injection system HY for concrete                                                                                                                                                                                                                                                                                                                                                                |                                                                                              |                                                                                                                                                        |     | Annex A 4                                                                                                  |
| Product description<br>Materials threaded rod and internal threaded rod                                                                                                                                                                                                                                                                                                                               |                                                                                              |                                                                                                                                                        |     |                                                                                                            |



## Reinforcing bar Ø 8, Ø 10, Ø 12, Ø 14, Ø 16, Ø 20, Ø 24, Ø 25, Ø 28, Ø 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<br>EN 1992-1-1:2004+AC:2010, Annex C | Bars and de-coiled rods class B or C<br>$f_{yk}$ and $k$ according to NDP or NCL of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |
| <div>Essve Injection system HY for concrete</div> <div>Product description<br/>Materials reinforcing bar</div> |                                            |                                                                                                                                          |
| <b>Annex A 5</b>                                                                                               |                                            |                                                                                                                                          |

## 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.
- Seismic action for Performance Category C2: M12 to M24 (except hot-dip galvanised rods).

### 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 +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- II: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °C)
- III: - 40 °C to +160 °C (max long term temperature +100 °C and max short term temperature +160 °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, wet concrete or flooded bore holes (not sea-water): M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- 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.

Essve Injection system HY 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 |
|---------------------------------------------------------|----------------------|--------------------------------------|------|------------------|-----------------|------|------|------|------|
| Diameter of element                                     | $d = d_{nom}$ [mm] = | 8                                    | 10   | 12               | 16              | 20   | 24   | 27   | 30   |
| Nominal drill hole diameter                             | $d_0$ [mm] =         | 10                                   | 12   | 14               | 18              | 22   | 28   | 30   | 35   |
| Effective embedment 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 <sup>1)</sup> | $d_f$ [mm] =         | 9                                    | 12   | 14               | 18              | 22   | 26   | 30   | 33   |
| Maximum torque moment                                   | $T_{inst}$ [Nm] ≤    | 10                                   | 20   | 40 <sup>2)</sup> | 60              | 100  | 170  | 250  | 300  |
| Minimum thickness of member                             | $h_{min}$ [mm]       | $h_{ef} + 30 \text{ mm}$<br>≥ 100 mm |      |                  | $h_{ef} + 2d_0$ |      |      |      |      |
| Minimum spacing                                         | $s_{min}$ [mm]       | 40                                   | 50   | 60               | 75              | 95   | 115  | 125  | 140  |
| Minimum edge distance                                   | $c_{min}$ [mm]       | 35                                   | 40   | 45               | 50              | 60   | 65   | 75   | 80   |

<sup>1)</sup> For application under seismic loading the diameter of clearance hole in the fixture shall be at maximum  $d_f + 1 \text{ mm}$  or alternatively the annular gap between fixture and anchor rod shall be filled force-fit with mortar.

<sup>2)</sup> Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

**Table B2: Installation parameters for rebar**

| Rebar size                  |                      | Ø 8                                  | Ø 10 | Ø 12 | 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] =         | 12                                   | 14   | 16   | 18              | 20   | 25   | 32   | 32   | 35   | 40   |
| Effective embedment depth   | $h_{ef,min}$ [mm] =  | 60                                   | 60   | 70   | 75              | 80   | 90   | 96   | 100  | 112  | 128  |
|                             | $h_{ef,max}$ [mm] =  | 160                                  | 200  | 240  | 280             | 320  | 400  | 480  | 500  | 560  | 640  |
| Minimum thickness of member | $h_{min}$ [mm]       | $h_{ef} + 30 \text{ mm}$<br>≥ 100 mm |      |      | $h_{ef} + 2d_0$ |      |      |      |      |      |      |
| Minimum spacing             | $s_{min}$ [mm]       | 40                                   | 50   | 60   | 70              | 75   | 95   | 120  | 120  | 130  | 150  |
| Minimum edge distance       | $c_{min}$ [mm]       | 35                                   | 40   | 45   | 50              | 50   | 60   | 70   | 70   | 75   | 85   |

**Table B3: Installation parameters for Internal threaded rod**

| Anchor size                               |                      | IG-M 6                               | IG-M 8 | IG-M 10 | IG-M 12         | IG-M 16 | IG-M 20 |
|-------------------------------------------|----------------------|--------------------------------------|--------|---------|-----------------|---------|---------|
| Internal diameter of sleeve               | $d_2$ [mm] =         | 6                                    | 8      | 10      | 12              | 16      | 20      |
| Outer diameter of sleeve <sup>1)</sup>    | $d = d_{nom}$ [mm] = | 10                                   | 12     | 16      | 20              | 24      | 30      |
| Nominal drill hole diameter               | $d_0$ [mm] =         | 12                                   | 14     | 18      | 22              | 28      | 35      |
| Effective embedment 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]       | $h_{ef} + 30 \text{ mm}$<br>≥ 100 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      |

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

**Essve Injection system HY for concrete**

**Intended Use**  
Installation parameters

**Annex B 2**

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

|  |  |  |  |  |      |                                         |  |                                                                                     |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------|-----------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Threaded Rod                                                                      | Rebar                                                                             | Internal threaded rod                                                             | d <sub>0</sub><br>Drill bit - Ø<br>HD, HDB, CA                                    | d <sub>b</sub><br>Brush - Ø                                                        |      | d <sub>b,min</sub><br>min.<br>Brush - Ø | Piston plug                                                                         | Installation direction and use of piston plug                                       |                                                                                     |                                                                                     |
| [mm]                                                                              | [mm]                                                                              | [mm]                                                                              | [mm]                                                                              |                                                                                    | [mm] | [mm]                                    |                                                                                     |  |  |  |
| M8                                                                                |                                                                                   |                                                                                   | 10                                                                                | RB10                                                                               | 11,5 | 10,5                                    | No plug required                                                                    |                                                                                     |                                                                                     |                                                                                     |
| M10                                                                               | 8                                                                                 | IG-M6                                                                             | 12                                                                                | RB12                                                                               | 13,5 | 12,5                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| M12                                                                               | 10                                                                                | IG-M8                                                                             | 14                                                                                | RB14                                                                               | 15,5 | 14,5                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
|                                                                                   | 12                                                                                |                                                                                   | 16                                                                                | RB16                                                                               | 17,5 | 16,5                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| M16                                                                               | 14                                                                                | IG-M10                                                                            | 18                                                                                | RB18                                                                               | 20,0 | 18,5                                    | VS18                                                                                | h <sub>ef</sub> ><br>250 mm                                                         | h <sub>ef</sub> ><br>250 mm                                                         | all                                                                                 |
|                                                                                   | 16                                                                                |                                                                                   | 20                                                                                | RB20                                                                               | 22,0 | 20,5                                    | VS20                                                                                |                                                                                     |                                                                                     |                                                                                     |
| M20                                                                               |                                                                                   | IG-M12                                                                            | 22                                                                                | RB22                                                                               | 24,0 | 22,5                                    | VS22                                                                                |                                                                                     |                                                                                     |                                                                                     |
|                                                                                   | 20                                                                                |                                                                                   | 25                                                                                | RB25                                                                               | 27,0 | 25,5                                    | VS25                                                                                |                                                                                     |                                                                                     |                                                                                     |
| M24                                                                               |                                                                                   | IG-M16                                                                            | 28                                                                                | RB28                                                                               | 30,0 | 28,5                                    | VS28                                                                                |                                                                                     |                                                                                     |                                                                                     |
| M27                                                                               |                                                                                   |                                                                                   | 30                                                                                | RB30                                                                               | 31,8 | 30,5                                    | VS30                                                                                |                                                                                     |                                                                                     |                                                                                     |
|                                                                                   | 24 / 25                                                                           |                                                                                   | 32                                                                                | RB32                                                                               | 34,0 | 32,5                                    | VS32                                                                                |                                                                                     |                                                                                     |                                                                                     |
| M30                                                                               | 28                                                                                | IG-M20                                                                            | 35                                                                                | RB35                                                                               | 37,0 | 35,5                                    | VS35                                                                                |                                                                                     |                                                                                     |                                                                                     |
|                                                                                   | 32                                                                                |                                                                                   | 40                                                                                | RB40                                                                               | 43,5 | 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  $d_s$   
Only in non-cracked concrete



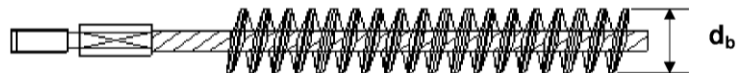
**CAC - Rec. compressed air tool (min 6 bar)**

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 RB**

Drill bit diameter ( $d_0$ ): all diameters

**Essve Injection system HY for concrete**

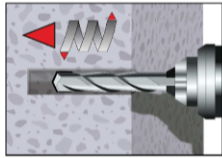
**Intended Use**

Cleaning and setting tools

**Annex B 3**

## Installation instructions

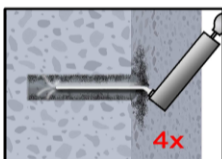
### Drilling of the bore hole



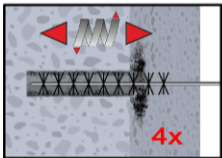
1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3), with hammer (HD), hollow (HDB) or compressed air drilling. The use of a hollow drill bit is only in combination with a sufficient vacuum permitted.  
In case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

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

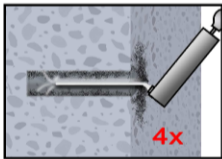
### MAC: Cleaning for bore hole diameter $d_0 \leq 20\text{mm}$ and bore hole depth $h_0 \leq 10d_{\text{nom}}$ (uncracked concrete only!)



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

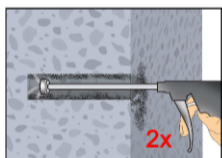


- 2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush  $> d_{b,\text{min}}$  (Table B4) a minimum of four times in a twisting motion.  
If the bore hole ground is not reached with the brush, a brush extension must be used.

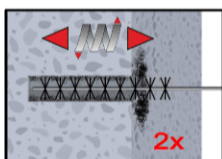


- 2c. Finally blow the hole clean again with a hand pump (Annex B 3) a minimum of four times.

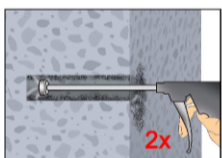
### CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete



- 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 two 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 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 compressed air (min. 6 bar) (Annex B 3) 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.**

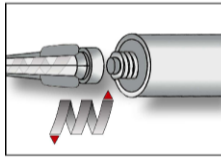
### Essve Injection system HY for concrete

**Intended Use**  
Installation instructions

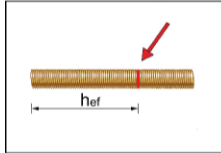
**Annex B 4**



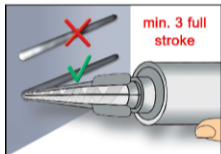
## Installation instructions (continuation)



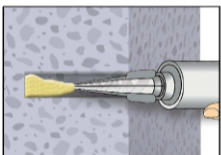
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.  
For every working interruption longer than the recommended working time (Table B5) as well as for new cartridges, a new static-mixer shall be used.



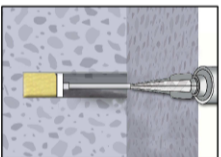
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



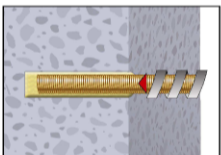
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour.



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. 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.

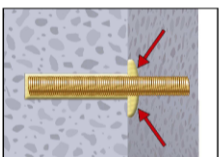


7. Piston plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
- Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit- $\varnothing d_0 \geq 18$  mm and embedment depth  $h_{ef} > 250$  mm
  - Overhead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

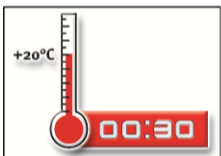


8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

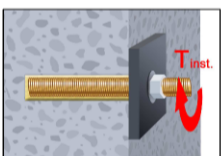
The anchor shall be free of dirt, grease, oil or other foreign material.



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).



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.

### Essve Injection system HY for concrete

#### Intended Use

Installation instructions (continuation)

### Annex B 5

**Table B5: Maximum working time and minimum curing time**

| Concrete temperature                   | Gelling working time | Minimum curing time in dry concrete | Minimum curing time in wet concrete |
|----------------------------------------|----------------------|-------------------------------------|-------------------------------------|
| 0 °C to + 4 °C                         | 25 min               | 3,5 h                               | 7 h                                 |
| + 5 °C to + 9 °C                       | 15 min               | 2 h                                 | 4 h                                 |
| + 10 °C to + 14 °C                     | 10 min               | 1 h                                 | 2 h                                 |
| + 15 °C to + 19 °C                     | 6 min                | 40 min                              | 80 min                              |
| + 20 °C to + 29 °C                     | 3 min                | 30 min                              | 60 min                              |
| + 30 °C to + 40 °C                     | 2 min                | 30 min                              | 60 min                              |
| Cartridge temperature                  | +5°C to +40°C        |                                     |                                     |
|                                        |                      |                                     |                                     |
|                                        |                      |                                     |                                     |
| Essve Injection system HY for concrete |                      |                                     | Annex B 6                           |
| Intended Use<br>Curing time            |                      |                                     |                                     |



**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 |      |
|-----------------------------------------------------------------|---------------------------------------------------|---------------------------------|---------|---------|---------|------|------|-----|------|------|------|
| Cross section area                                              | A <sub>s</sub>                                    | [mm <sup>2</sup> ]              | 36,6    | 58      | 84,3    | 157  | 245  | 353 | 459  | 561  |      |
| Characteristic tension resistance, Steel failure <sup>1)</sup>  |                                                   |                                 |         |         |         |      |      |     |      |      |      |
| Steel, Property class 4.6 and 4.8                               | N <sub>RFk,s</sub>                                | [kN]                            | 15 (13) | 23 (21) | 34      | 63   | 98   | 141 | 184  | 224  |      |
| Steel, Property class 5.6 and 5.8                               | N <sub>RFk,s</sub>                                | [kN]                            | 18 (17) | 29 (27) | 42      | 78   | 122  | 176 | 230  | 280  |      |
| Steel, Property class 8.8                                       | N <sub>RFk,s</sub>                                | [kN]                            | 29 (27) | 46 (43) | 67      | 125  | 196  | 282 | 368  | 449  |      |
| Stainless steel A2, A4 and HCR, Property class 50               | N <sub>RFk,s</sub>                                | [kN]                            | 18      | 29      | 42      | 79   | 123  | 177 | 230  | 281  |      |
| Stainless steel A2, A4 and HCR, Property class 70               | N <sub>RFk,s</sub>                                | [kN]                            | 26      | 41      | 59      | 110  | 171  | 247 | -    | -    |      |
| Stainless steel A4 and HCR, Property class 80                   | N <sub>RFk,s</sub>                                | [kN]                            | 29      | 46      | 67      | 126  | 196  | 282 | -    | -    |      |
| Characteristic tension resistance, Partial factor <sup>2)</sup> |                                                   |                                 |         |         |         |      |      |     |      |      |      |
| Steel, Property class 4.6                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 2,0     |         |         |      |      |     |      |      |      |
| Steel, Property class 4.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,5     |         |         |      |      |     |      |      |      |
| Steel, Property class 5.6                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 2,0     |         |         |      |      |     |      |      |      |
| Steel, Property class 5.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,5     |         |         |      |      |     |      |      |      |
| Steel, Property class 8.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,5     |         |         |      |      |     |      |      |      |
| Stainless steel A2, A4 and HCR, Property class 50               | γ <sub>Ms,V</sub>                                 | [-]                             | 2,86    |         |         |      |      |     |      |      |      |
| Stainless steel A2, A4 and HCR, Property class 70               | γ <sub>Ms,V</sub>                                 | [-]                             | 1,87    |         |         |      |      |     |      |      |      |
| Stainless steel A4 and HCR, Property class 80                   | γ <sub>Ms,V</sub>                                 | [-]                             | 1,6     |         |         |      |      |     |      |      |      |
| Characteristic shear resistance, Steel failure <sup>1)</sup>    |                                                   |                                 |         |         |         |      |      |     |      |      |      |
| Without lever arm                                               | Steel, Property class 4.6 and 4.8                 | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 9 (8)   | 14 (13) | 20   | 38   | 59  | 85   | 110  | 135  |
|                                                                 | Steel, Property class 5.6 and 5.8                 | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 9 (8)   | 15 (13) | 21   | 39   | 61  | 88   | 115  | 140  |
|                                                                 | Steel, Property class 8.8                         | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 15 (13) | 23 (21) | 34   | 63   | 98  | 141  | 184  | 224  |
|                                                                 | Stainless steel A2, A4 and HCR, Property class 50 | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 9       | 15      | 21   | 39   | 61  | 88   | 115  | 140  |
|                                                                 | Stainless steel A2, A4 and HCR, Property class 70 | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 13      | 20      | 30   | 55   | 86  | 124  | -    | -    |
|                                                                 | Stainless steel A4 and HCR, Property class 80     | V <sup>0</sup> <sub>RFk,s</sub> | [kN]    | 15      | 23      | 34   | 63   | 98  | 141  | -    | -    |
| With lever arm                                                  | Steel, Property class 4.6 and 4.8                 | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 15 (13) | 30 (27) | 52   | 133  | 260 | 449  | 666  | 900  |
|                                                                 | Steel, Property class 5.6 and 5.8                 | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 19 (16) | 37 (33) | 65   | 166  | 324 | 560  | 833  | 1123 |
|                                                                 | Steel, Property class 8.8                         | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 30 (26) | 60 (53) | 105  | 266  | 519 | 896  | 1333 | 1797 |
|                                                                 | Stainless steel A2, A4 and HCR, Property class 50 | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 19      | 37      | 66   | 167  | 325 | 561  | 832  | 1125 |
|                                                                 | Stainless steel A2, A4 and HCR, Property class 70 | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 26      | 52      | 92   | 232  | 454 | 784  | -    | -    |
|                                                                 | Stainless steel A4 and HCR, Property class 80     | M <sup>0</sup> <sub>RFk,s</sub> | [Nm]    | 30      | 59      | 105  | 266  | 519 | 896  | -    | -    |
| Characteristic shear resistance, Partial factor <sup>2)</sup>   |                                                   |                                 |         |         |         |      |      |     |      |      |      |
| Steel, Property class 4.6                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,67    |         |         |      |      |     |      |      |      |
| Steel, Property class 4.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,25    |         |         |      |      |     |      |      |      |
| Steel, Property class 5.6                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,67    |         |         |      |      |     |      |      |      |
| Steel, Property class 5.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,25    |         |         |      |      |     |      |      |      |
| Steel, Property class 8.8                                       | γ <sub>Ms,V</sub>                                 | [-]                             | 1,25    |         |         |      |      |     |      |      |      |
| Stainless steel A2, A4 and HCR, Property class 50               | γ <sub>Ms,V</sub>                                 | [-]                             | 2,38    |         |         |      |      |     |      |      |      |
| Stainless steel A2, A4 and HCR, Property class 70               | γ <sub>Ms,V</sub>                                 | [-]                             | 1,56    |         |         |      |      |     |      |      |      |
| Stainless steel A4 and HCR, Property class 80                   | γ <sub>Ms,V</sub>                                 | [-]                             | 1,33    |         |         |      |      |     |      |      |      |

<sup>1)</sup> Values are only valid for the given stress area  $A_s$ . Values in brackets are valid for undersized threaded rods with smaller stress area  $A_s$  for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.

<sup>2)</sup> in absence of national regulation

**Essve Injection system HY 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+C2)**

| Anchor size threaded rod                                                                                                                 |                                               |                                  |                                      | M 8                                                    | M 10 | M 12 | M 16 | M 20                          | M 24 | M 27 | M 30 |
|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------|--------------------------------------|--------------------------------------------------------|------|------|------|-------------------------------|------|------|------|
| Steel failure                                                                                                                            |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| Characteristic tension resistance                                                                                                        | $N_{Rk,s}$                                    | [kN]                             | $A_s \cdot f_{uk}$ (or see Table C1) |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          | $N_{Rk,eq,C1}$                                | [kN]                             | $1,0 \cdot N_{Rk,s}$                 |                                                        |      |      |      |                               |      |      |      |
| Characteristic tension resistance,<br>Steel, strength class 8.8<br>Stainless Steel A4 and HCR,<br>Strength class $\geq 70$               | $N_{Rk,eq,C2}$                                | [kN]                             | NPA                                  | $1,0 \cdot N_{Rk,s}$                                   |      |      |      |                               |      | NPA  |      |
| Partial factor                                                                                                                           | $\gamma_{Ms,N}$                               | [-]                              | see Table C1                         |                                                        |      |      |      |                               |      |      |      |
| Combined pull-out and concrete failure                                                                                                   |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| Characteristic bond resistance in non-cracked concrete C20/25                                                                            |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| Temperature range I:<br>80°C/50°C                                                                                                        | Dry, wet concrete<br>and<br>flooded bore hole | $\tau_{Rk,ucr}$                  | [N/mm <sup>2</sup> ]                 | 17                                                     | 17   | 16   | 15   | 14                            | 13   | 13   | 13   |
| Temperature range II:<br>120°C/72°C                                                                                                      |                                               | $\tau_{Rk,ucr}$                  | [N/mm <sup>2</sup> ]                 | 15                                                     | 14   | 14   | 13   | 12                            | 12   | 11   | 11   |
| Temperature range III:<br>160°C/100°C                                                                                                    |                                               | $\tau_{Rk,ucr}$                  | [N/mm <sup>2</sup> ]                 | 12                                                     | 11   | 11   | 10   | 9,5                           | 9,0  | 9,0  | 9,0  |
| Characteristic bond resistance in cracked concrete C20/25                                                                                |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| Temperature range I:<br>80°C/50°C                                                                                                        | Dry, wet concrete<br>and<br>flooded bore hole | $\tau_{Rk,cr} = \tau_{Rk,eq,C1}$ | [N/mm <sup>2</sup> ]                 | 7,0                                                    | 7,5  | 8,0  | 9,0  | 8,5                           | 7,0  | 7,0  | 7,0  |
|                                                                                                                                          |                                               | $\tau_{Rk,eq,C2}$                | [N/mm <sup>2</sup> ]                 | NPA                                                    |      | 3,6  | 3,5  | 3,3                           | 2,3  | NPA  |      |
| Temperature range II:<br>120°C/72°C                                                                                                      |                                               | $\tau_{Rk,cr} = \tau_{Rk,eq,C1}$ | [N/mm <sup>2</sup> ]                 | 6,0                                                    | 6,5  | 7,0  | 7,5  | 7,0                           | 6,0  | 6,0  | 6,0  |
|                                                                                                                                          |                                               | $\tau_{Rk,eq,C2}$                | [N/mm <sup>2</sup> ]                 | NPA                                                    |      | 3,1  | 3,0  | 2,8                           | 2,0  | NPA  |      |
| Temperature range III:<br>160°C/100°C                                                                                                    |                                               | $\tau_{Rk,cr} = \tau_{Rk,eq,C1}$ | [N/mm <sup>2</sup> ]                 | 5,5                                                    | 5,5  | 6,0  | 6,5  | 6,0                           | 5,5  | 5,5  | 5,5  |
|                                                                                                                                          |                                               | $\tau_{Rk,eq,C2}$                | [N/mm <sup>2</sup> ]                 | NPA                                                    |      | 2,5  | 2,7  | 2,5                           | 1,8  | NPA  |      |
| Increasing factors for concrete<br>(only static or quasi-static actions)<br>$\psi_c$                                                     |                                               | C25/30                           | 1,02                                 |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               | C30/37                           | 1,04                                 |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               | C35/45                           | 1,07                                 |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               | C40/50                           | 1,08                                 |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               | C45/55                           | 1,09                                 |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               | C50/60                           | 1,10                                 |                                                        |      |      |      |                               |      |      |      |
| Concrete cone failure                                                                                                                    |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| 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]                             | $2 c_{cr,N}$                         |                                                        |      |      |      |                               |      |      |      |
| Splitting                                                                                                                                |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| 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                                                                                                                      |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| for dry and wet concrete (MAC)                                                                                                           | $\gamma_{inst}$                               | [-]                              | 1,2                                  |                                                        |      |      |      | No Performance Assessed (NPA) |      |      |      |
| for dry and wet concrete (CAC)                                                                                                           | $\gamma_{inst}$                               | [-]                              | 1,0                                  |                                                        |      |      |      |                               |      |      |      |
| for flooded bore hole (CAC)                                                                                                              | $\gamma_{inst}$                               | [-]                              | 1,4                                  |                                                        |      |      |      |                               |      |      |      |
|                                                                                                                                          |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |
| Essve Injection system HY for concrete                                                                                                   |                                               |                                  |                                      |                                                        |      |      |      | Annex C 2                     |      |      |      |
| Performances<br>Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1+C2) |                                               |                                  |                                      |                                                        |      |      |      |                               |      |      |      |

**Table C3: Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1+C2)**

| Anchor size threaded rod                                                                                                                                                      |                    |      | M 8                                                       | M 10                                  | M 12 | M 16 | M 20 | M24       | M 27                             | M 30 |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|-----------------------------------------------------------|---------------------------------------|------|------|------|-----------|----------------------------------|------|--|
| Steel failure without lever arm                                                                                                                                               |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |
| Characteristic shear resistance<br>Steel, strength class 4.6 and 4.8                                                                                                          | $V^0_{Rk,s}$       | [kN] | 0,6 • A <sub>s</sub> • f <sub>uk</sub> (or see Table C1)  |                                       |      |      |      |           |                                  |      |  |
| Characteristic shear resistance<br>Steel, strength class 5.6, 5.8 and 8.8<br>Stainless Steel A2, A4 and HCR, all classes                                                      | $V^0_{Rk,s}$       | [kN] | 0,5 • A <sub>s</sub> • f <sub>uk</sub> (or see Table C1)  |                                       |      |      |      |           |                                  |      |  |
| Characteristic shear resistance (Seismic C1)                                                                                                                                  | $V_{Rk,s,eq,C1}$   | [kN] | 0,70 • V <sup>0</sup> <sub>Rk,s</sub>                     |                                       |      |      |      |           |                                  |      |  |
| Characteristic shear resistance (Seismic C2),<br>Steel, strength class 8.8<br>Stainless Steel A4 and HCR,<br>Strength class ≥70                                               | $V_{Rk,s,eq,C2}$   | [kN] | NPA                                                       | 0,70 • V <sup>0</sup> <sub>Rk,s</sub> |      |      |      |           | NPA                              |      |  |
| Partial factor                                                                                                                                                                | γ <sub>Ms,V</sub>  | [-]  | see Table C1                                              |                                       |      |      |      |           |                                  |      |  |
| Ductility factor                                                                                                                                                              | k <sub>7</sub>     | [-]  | 1,0                                                       |                                       |      |      |      |           |                                  |      |  |
| Steel failure with lever arm                                                                                                                                                  |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |
| Characteristic bending moment                                                                                                                                                 | $M^0_{Rk,s}$       | [Nm] | 1,2 • W <sub>el</sub> • f <sub>uk</sub> (or see Table C1) |                                       |      |      |      |           |                                  |      |  |
|                                                                                                                                                                               | $M^0_{Rk,s,eq,C1}$ | [Nm] | No Performance Assessed (NPA)                             |                                       |      |      |      |           |                                  |      |  |
|                                                                                                                                                                               | $M^0_{Rk,s,eq,C2}$ | [Nm] | No Performance Assessed (NPA)                             |                                       |      |      |      |           |                                  |      |  |
| Partial factor                                                                                                                                                                | γ <sub>Ms,V</sub>  | [-]  | see Table C1                                              |                                       |      |      |      |           |                                  |      |  |
| Concrete pry-out failure                                                                                                                                                      |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |
| Factor                                                                                                                                                                        | k <sub>8</sub>     | [-]  | 2,0                                                       |                                       |      |      |      |           |                                  |      |  |
| Installation factor                                                                                                                                                           | γ <sub>inst</sub>  | [-]  | 1,0                                                       |                                       |      |      |      |           |                                  |      |  |
| Concrete edge failure                                                                                                                                                         |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |
| Effective length of fastener                                                                                                                                                  | l <sub>f</sub>     | [mm] | min(h <sub>ef</sub> ; 12 • d <sub>nom</sub> )             |                                       |      |      |      |           | max(8 • d <sub>nom</sub> ;300mm) |      |  |
| Outside diameter of fastener                                                                                                                                                  | d <sub>nom</sub>   | [mm] | 8                                                         | 10                                    | 12   | 16   | 20   | 24        | 27                               | 30   |  |
| Installation factor                                                                                                                                                           | γ <sub>inst</sub>  | [-]  | 1,0                                                       |                                       |      |      |      |           |                                  |      |  |
| Factor for annular gap                                                                                                                                                        | α <sub>gap</sub>   | [-]  | 0,5 (1,0) <sup>1)</sup>                                   |                                       |      |      |      |           |                                  |      |  |
| <div><sup>1)</sup> 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 required</div> |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |
| Essve Injection system HY for concrete                                                                                                                                        |                    |      |                                                           |                                       |      |      |      | Annex C 3 |                                  |      |  |
| <b>Performances</b><br>Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1+C2)                                 |                    |      |                                                           |                                       |      |      |      |           |                                  |      |  |

**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 |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------|---------|--------------------------------------------------------|--------|---------|-------------------------------|---------|---------|------|
| Steel failure <sup>1)</sup>                                                                                                                                                                                                                                                                                                                                                     |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Characteristic tension resistance, Steel, strength class 5.8                                                                                                                                                                                                                                                                                                                    |                                         | N <sub>Rk,s</sub>   | [kN]    | 10                                                     | 17     | 29      | 42                            | 76      | 123     |      |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                  |                                         | γ <sub>Ms,N</sub>   | [-]     | 1,5                                                    |        |         |                               |         |         |      |
| Characteristic tension resistance, Steel, strength class 8.8                                                                                                                                                                                                                                                                                                                    |                                         | N <sub>Rk,s</sub>   | [kN]    | 16                                                     | 27     | 46      | 67                            | 121     | 196     |      |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                  |                                         | γ <sub>Ms,N</sub>   | [-]     | 1,5                                                    |        |         |                               |         |         |      |
| Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>                                                                                                                                                                                                                                                                                  |                                         | N <sub>Rk,s</sub>   | [kN]    | 14                                                     | 26     | 41      | 59                            | 110     | 124     |      |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                  |                                         | γ <sub>Ms,N</sub>   | [-]     | 1,87                                                   |        |         |                               |         |         | 2,86 |
| Combined pull-out and concrete cone failure                                                                                                                                                                                                                                                                                                                                     |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Characteristic bond resistance in non-cracked concrete C20/25                                                                                                                                                                                                                                                                                                                   |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Temperature range I: 80°C/50°C                                                                                                                                                                                                                                                                                                                                                  | Dry, wet concrete and flooded bore hole | τ <sub>Rk,ucr</sub> | [N/mm²] | 17                                                     | 16     | 15      | 14                            | 13      | 13      |      |
| Temperature range II: 120°C/72°C                                                                                                                                                                                                                                                                                                                                                |                                         | τ <sub>Rk,ucr</sub> | [N/mm²] | 14                                                     | 14     | 13      | 12                            | 12      | 11      |      |
| Temperature range III: 160°C/100°C                                                                                                                                                                                                                                                                                                                                              |                                         | τ <sub>Rk,ucr</sub> | [N/mm²] | 11                                                     | 11     | 10      | 9,5                           | 9,0     | 9,0     |      |
| Characteristic bond resistance in cracked concrete C20/25                                                                                                                                                                                                                                                                                                                       |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Temperature range I: 80°C/50°C                                                                                                                                                                                                                                                                                                                                                  | Dry, wet concrete and flooded bore hole | τ <sub>Rk,cr</sub>  | [N/mm²] | 7,5                                                    | 8,0    | 9,0     | 8,5                           | 7,0     | 7,0     |      |
| Temperature range II: 120°C/72°C                                                                                                                                                                                                                                                                                                                                                |                                         | τ <sub>Rk,cr</sub>  | [N/mm²] | 6,5                                                    | 7,0    | 7,5     | 7,0                           | 6,0     | 6,0     |      |
| Temperature range III: 160°C/100°C                                                                                                                                                                                                                                                                                                                                              |                                         | τ <sub>Rk,cr</sub>  | [N/mm²] | 5,5                                                    | 6,0    | 6,5     | 6,0                           | 5,5     | 5,5     |      |
| Increasing factors for concrete<br>Ψ <sub>c</sub>                                                                                                                                                                                                                                                                                                                               |                                         | C25/30              |         | 1,02                                                   |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 |                                         | C30/37              |         | 1,04                                                   |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 |                                         | C35/45              |         | 1,07                                                   |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 |                                         | C40/50              |         | 1,08                                                   |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 |                                         | C45/55              |         | 1,09                                                   |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 |                                         | C50/60              |         | 1,10                                                   |        |         |                               |         |         |      |
| Concrete cone failure                                                                                                                                                                                                                                                                                                                                                           |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Non-cracked concrete                                                                                                                                                                                                                                                                                                                                                            |                                         | k <sub>ucr,N</sub>  | [-]     | 11,0                                                   |        |         |                               |         |         |      |
| Cracked concrete                                                                                                                                                                                                                                                                                                                                                                |                                         | k <sub>cr,N</sub>   | [-]     | 7,7                                                    |        |         |                               |         |         |      |
| Edge distance                                                                                                                                                                                                                                                                                                                                                                   |                                         | c <sub>cr,N</sub>   | [mm]    | 1,5 h <sub>ef</sub>                                    |        |         |                               |         |         |      |
| Axial distance                                                                                                                                                                                                                                                                                                                                                                  |                                         | s <sub>cr,N</sub>   | [mm]    | 2 c <sub>cr,N</sub>                                    |        |         |                               |         |         |      |
| Splitting failure                                                                                                                                                                                                                                                                                                                                                               |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Edge distance                                                                                                                                                                                                                                                                                                                                                                   | h/h <sub>ef</sub> ≥ 2,0                 | c <sub>cr,sp</sub>  | [mm]    | 1,0 h <sub>ef</sub>                                    |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 | 2,0 > h/h <sub>ef</sub> > 1,3           |                     |         | $2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$ |        |         |                               |         |         |      |
|                                                                                                                                                                                                                                                                                                                                                                                 | h/h <sub>ef</sub> ≤ 1,3                 |                     |         | 2,4 h <sub>ef</sub>                                    |        |         |                               |         |         |      |
| Axial distance                                                                                                                                                                                                                                                                                                                                                                  |                                         | s <sub>cr,sp</sub>  | [mm]    | 2 c <sub>cr,sp</sub>                                   |        |         |                               |         |         |      |
| Installation factor                                                                                                                                                                                                                                                                                                                                                             |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| for dry and wet concrete (MAC)                                                                                                                                                                                                                                                                                                                                                  |                                         | γ <sub>inst</sub>   | [-]     | 1,2                                                    |        |         | No Performance Assessed (NPA) |         |         |      |
| for dry and wet concrete (CAC)                                                                                                                                                                                                                                                                                                                                                  |                                         | γ <sub>inst</sub>   | [-]     | 1,0                                                    |        |         |                               |         |         |      |
| for flooded bore hole (CAC)                                                                                                                                                                                                                                                                                                                                                     |                                         | γ <sub>inst</sub>   | [-]     | 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.<br><sup>2)</sup> For IG-M20 strength class 50 is valid |                                         |                     |         |                                                        |        |         |                               |         |         |      |
| Essve Injection system HY for concrete                                                                                                                                                                                                                                                                                                                                          |                                         |                     |         |                                                        |        |         | Annex C 4                     |         |         |      |
| Performances<br>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                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|-----------------------------------------------|--------|---------|---------|-----------|--------------------------------|
| Steel failure without lever arm <sup>1)</sup>                                                                                                                                                                                                                                                                                                                                                              |                                |      |                                               |        |         |         |           |                                |
| Characteristic shear resistance, Steel, strength class 5.8                                                                                                                                                                                                                                                                                                                                                 | V <sup>0</sup> <sub>Rk,s</sub> | [kN] | 5                                             | 9      | 15      | 21      | 38        | 61                             |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,25                                          |        |         |         |           |                                |
| Characteristic shear resistance, Steel, strength class 8.8                                                                                                                                                                                                                                                                                                                                                 | V <sup>0</sup> <sub>Rk,s</sub> | [kN] | 8                                             | 14     | 23      | 34      | 60        | 98                             |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,25                                          |        |         |         |           |                                |
| Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>                                                                                                                                                                                                                                                                                                               | V <sup>0</sup> <sub>Rk,s</sub> | [kN] | 7                                             | 13     | 20      | 30      | 55        | 40                             |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,56                                          |        |         |         |           | 2,38                           |
| Ductility factor                                                                                                                                                                                                                                                                                                                                                                                           | k <sub>7</sub>                 | [-]  | 1,0                                           |        |         |         |           |                                |
| Steel failure with lever arm <sup>1)</sup>                                                                                                                                                                                                                                                                                                                                                                 |                                |      |                                               |        |         |         |           |                                |
| Characteristic bending moment, Steel, strength class 5.8                                                                                                                                                                                                                                                                                                                                                   | M <sup>0</sup> <sub>Rk,s</sub> | [Nm] | 8                                             | 19     | 37      | 66      | 167       | 325                            |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,25                                          |        |         |         |           |                                |
| Characteristic bending moment, Steel, strength class 8.8                                                                                                                                                                                                                                                                                                                                                   | M <sup>0</sup> <sub>Rk,s</sub> | [Nm] | 12                                            | 30     | 60      | 105     | 267       | 519                            |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,25                                          |        |         |         |           |                                |
| Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>                                                                                                                                                                                                                                                                                                                 | M <sup>0</sup> <sub>Rk,s</sub> | [Nm] | 11                                            | 26     | 52      | 92      | 233       | 456                            |
| Partial factor                                                                                                                                                                                                                                                                                                                                                                                             | γ <sub>Ms,V</sub>              | [-]  | 1,56                                          |        |         |         |           | 2,38                           |
| Concrete pry-out failure                                                                                                                                                                                                                                                                                                                                                                                   |                                |      |                                               |        |         |         |           |                                |
| Factor                                                                                                                                                                                                                                                                                                                                                                                                     | k <sub>8</sub>                 | [-]  | 2,0                                           |        |         |         |           |                                |
| Installation factor                                                                                                                                                                                                                                                                                                                                                                                        | γ <sub>inst</sub>              | [-]  | 1,0                                           |        |         |         |           |                                |
| Concrete edge failure                                                                                                                                                                                                                                                                                                                                                                                      |                                |      |                                               |        |         |         |           |                                |
| Effective length of fastener                                                                                                                                                                                                                                                                                                                                                                               | l <sub>f</sub>                 | [mm] | min(h <sub>ef</sub> ; 12 • d <sub>nom</sub> ) |        |         |         |           | max(8•d <sub>nom</sub> ;300mm) |
| Outside diameter of fastener                                                                                                                                                                                                                                                                                                                                                                               | d <sub>nom</sub>               | [mm] | 10                                            | 12     | 16      | 20      | 24        | 30                             |
| Installation factor                                                                                                                                                                                                                                                                                                                                                                                        | γ <sub>inst</sub>              | [-]  | 1,0                                           |        |         |         |           |                                |
| <div><div>1)</div><div>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.</div><div>2)</div><div>For IG-M20 strength class 50 is valid</div></div> |                                |      |                                               |        |         |         |           |                                |
| Essve Injection system HY for concrete                                                                                                                                                                                                                                                                                                                                                                     |                                |      |                                               |        |         |         | Annex C 5 |                                |
| Performances<br>Characteristic values of shear loads under static and quasi-static action                                                                                                                                                                                                                                                                                                                  |                                |      |                                               |        |         |         |           |                                |



**Table C6: Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)**

| Anchor size reinforcing bar                                                                                                                 |                                               |                                         |                      | Ø 8                                                    | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20                          | Ø 24      | Ø 25 | Ø 28 | Ø 32 |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------|----------------------|--------------------------------------------------------|------|------|------|------|-------------------------------|-----------|------|------|------|
| Steel failure                                                                                                                               |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Characteristic tension resistance                                                                                                           | N <sub>Rk,s</sub>                             |                                         | [kN]                 | A <sub>s</sub> • f <sub>uk</sub> <sup>1)</sup>         |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             | N <sub>Rk,s,eq</sub>                          |                                         | [kN]                 | 1,0 • A <sub>s</sub> • f <sub>uk</sub> <sup>1)</sup>   |      |      |      |      |                               |           |      |      |      |
| Cross section area                                                                                                                          | A <sub>s</sub>                                |                                         | [mm <sup>2</sup> ]   | 50                                                     | 79   | 113  | 154  | 201  | 314                           | 452       | 491  | 616  | 804  |
| Partial factor                                                                                                                              | γ <sub>Ms,N</sub>                             |                                         | [-]                  | 1,4 <sup>2)</sup>                                      |      |      |      |      |                               |           |      |      |      |
| Combined pull-out and concrete failure                                                                                                      |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Characteristic bond resistance in non-cracked concrete C20/25                                                                               |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Temperature range I:<br>80°C/50°C                                                                                                           | Dry, wet concrete<br>and<br>flooded bore hole | τ <sub>Rk,ucr</sub>                     | [N/mm <sup>2</sup> ] | 14                                                     | 14   | 14   | 14   | 13   | 13                            | 13        | 13   | 13   | 13   |
| Temperature range II:<br>120°C/72°C                                                                                                         |                                               | τ <sub>Rk,ucr</sub>                     | [N/mm <sup>2</sup> ] | 13                                                     | 12   | 12   | 12   | 12   | 11                            | 11        | 11   | 11   | 11   |
| Temperature range III:<br>160°C/100°C                                                                                                       |                                               | τ <sub>Rk,ucr</sub>                     | [N/mm <sup>2</sup> ] | 9,5                                                    | 9,5  | 9,5  | 9,0  | 9,0  | 9,0                           | 9,0       | 9,0  | 8,5  | 8,5  |
| Characteristic bond resistance in cracked concrete C20/25                                                                                   |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Temperature range I:<br>80°C/50°C                                                                                                           | Dry, wet concrete<br>and<br>flooded bore hole | τ <sub>Rk,cr</sub> = τ <sub>Rk,eq</sub> | [N/mm <sup>2</sup> ] | 5,5                                                    | 5,5  | 6,0  | 6,5  | 6,5  | 6,5                           | 6,5       | 7,0  | 7,0  | 7,0  |
| Temperature range II:<br>120°C/72°C                                                                                                         |                                               | τ <sub>Rk,cr</sub> = τ <sub>Rk,eq</sub> | [N/mm <sup>2</sup> ] | 4,5                                                    | 5,0  | 5,0  | 5,5  | 5,5  | 5,5                           | 5,5       | 6,0  | 6,0  | 6,0  |
| Temperature range III:<br>160°C/100°C                                                                                                       |                                               | τ <sub>Rk,cr</sub> = τ <sub>Rk,eq</sub> | [N/mm <sup>2</sup> ] | 4,0                                                    | 4,5  | 4,5  | 5,0  | 5,0  | 5,0                           | 5,0       | 5,0  | 5,0  | 5,0  |
| Increasing factors for concrete<br>(only static or quasi-static actions)<br>ψ <sub>c</sub>                                                  |                                               | C25/30                                  |                      | 1,02                                                   |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             |                                               | C30/37                                  |                      | 1,04                                                   |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             |                                               | C35/45                                  |                      | 1,07                                                   |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             |                                               | C40/50                                  |                      | 1,08                                                   |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             |                                               | C45/55                                  |                      | 1,09                                                   |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             |                                               | C50/60                                  |                      | 1,10                                                   |      |      |      |      |                               |           |      |      |      |
| Concrete cone failure                                                                                                                       |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Non-cracked concrete                                                                                                                        |                                               | k <sub>ucr,N</sub>                      | [-]                  | 11,0                                                   |      |      |      |      |                               |           |      |      |      |
| Cracked concrete                                                                                                                            |                                               | k <sub>cr,N</sub>                       | [-]                  | 7,7                                                    |      |      |      |      |                               |           |      |      |      |
| Edge distance                                                                                                                               |                                               | c <sub>cr,N</sub>                       | [mm]                 | 1,5 h <sub>ef</sub>                                    |      |      |      |      |                               |           |      |      |      |
| Axial distance                                                                                                                              |                                               | s <sub>cr,N</sub>                       | [mm]                 | 2 c <sub>cr,N</sub>                                    |      |      |      |      |                               |           |      |      |      |
| Splitting                                                                                                                                   |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Edge distance                                                                                                                               | h/h <sub>ef</sub> ≥ 2,0                       | c <sub>cr,sp</sub>                      | [mm]                 | 1,0 h <sub>ef</sub>                                    |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             | 2,0 > h/h <sub>ef</sub> > 1,3                 |                                         |                      | $2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$ |      |      |      |      |                               |           |      |      |      |
|                                                                                                                                             | h/h <sub>ef</sub> ≤ 1,3                       |                                         |                      | 2,4 h <sub>ef</sub>                                    |      |      |      |      |                               |           |      |      |      |
| Axial distance                                                                                                                              |                                               | s <sub>cr,sp</sub>                      | [mm]                 | 2 c <sub>cr,sp</sub>                                   |      |      |      |      |                               |           |      |      |      |
| Installation factor                                                                                                                         |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| for dry and wet concrete (MAC)                                                                                                              |                                               | γ <sub>inst</sub>                       | [-]                  | 1,2                                                    |      |      |      |      | No Performance Assessed (NPA) |           |      |      |      |
| for dry and wet concrete (CAC)                                                                                                              |                                               | γ <sub>inst</sub>                       | [-]                  | 1,0                                                    |      |      |      |      |                               |           |      |      |      |
| for flooded bore hole (CAC)                                                                                                                 |                                               | γ <sub>inst</sub>                       | [-]                  | 1,4                                                    |      |      |      |      |                               |           |      |      |      |
| <sup>1)</sup> f <sub>uk</sub> shall be taken from the specifications of reinforcing bars<br><sup>2)</sup> in absence of national regulation |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |
| Essve Injection system HY for concrete                                                                                                      |                                               |                                         |                      |                                                        |      |      |      |      |                               | Annex C 6 |      |      |      |
| Performances<br>Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)       |                                               |                                         |                      |                                                        |      |      |      |      |                               |           |      |      |      |



**Table C7: Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1)**

| Anchor size reinforcing bar                                                                                                                                                                                                                                                                                                                      |                 |                    | Ø 8                                  | 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                                                                                                                                                                                                                                                                                                                  | $V_{Rk,s}^0$    | [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  | 314  | 452       | 491  | 616                            | 804  |  |
| Partial factor                                                                                                                                                                                                                                                                                                                                   | $\gamma_{Ms,V}$ | [-]                | $1,5^{2)}$                           |      |      |      |      |      |           |      |                                |      |  |
| Ductility factor                                                                                                                                                                                                                                                                                                                                 | $k_7$           | [-]                | 1,0                                  |      |      |      |      |      |           |      |                                |      |  |
| Steel failure with lever arm                                                                                                                                                                                                                                                                                                                     |                 |                    |                                      |      |      |      |      |      |           |      |                                |      |  |
| 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 Assessed (NPA)        |      |      |      |      |      |           |      |                                |      |  |
| Elastic section modulus                                                                                                                                                                                                                                                                                                                          | $W_{el}$        | [mm <sup>3</sup> ] | 50                                   | 98   | 170  | 269  | 402  | 785  | 896       | 1534 | 2155                           | 3217 |  |
| Partial factor                                                                                                                                                                                                                                                                                                                                   | $\gamma_{Ms,V}$ | [-]                | $1,5^{2)}$                           |      |      |      |      |      |           |      |                                |      |  |
| Concrete pry-out failure                                                                                                                                                                                                                                                                                                                         |                 |                    |                                      |      |      |      |      |      |           |      |                                |      |  |
| Factor                                                                                                                                                                                                                                                                                                                                           | $k_8$           | [-]                | 2,0                                  |      |      |      |      |      |           |      |                                |      |  |
| Installation factor                                                                                                                                                                                                                                                                                                                              | $\gamma_{Inst}$ | [-]                | 1,0                                  |      |      |      |      |      |           |      |                                |      |  |
| Concrete edge failure                                                                                                                                                                                                                                                                                                                            |                 |                    |                                      |      |      |      |      |      |           |      |                                |      |  |
| Effective length of fastener                                                                                                                                                                                                                                                                                                                     | $l_f$           | [mm]               | $\min(h_{ef}; 12 \cdot d_{nom})$     |      |      |      |      |      |           |      | $\max(8 \cdot d_{nom}; 300mm)$ |      |  |
| Outside diameter of fastener                                                                                                                                                                                                                                                                                                                     | $d_{nom}$       | [mm]               | 8                                    | 10   | 12   | 14   | 16   | 20   | 24        | 25   | 28                             | 32   |  |
| Installation factor                                                                                                                                                                                                                                                                                                                              | $\gamma_{Inst}$ | [-]                | 1,0                                  |      |      |      |      |      |           |      |                                |      |  |
| Factor for annular gap                                                                                                                                                                                                                                                                                                                           | $\alpha_{gap}$  | [-]                | $0,5 (1,0)^{3)}$                     |      |      |      |      |      |           |      |                                |      |  |
| <div><sup>1)</sup> <math>f_{uk}</math> shall be taken from the specifications of reinforcing bars</div> <div><sup>2)</sup> in absence of national regulation</div> <div><sup>3)</sup> 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 required</div> |                 |                    |                                      |      |      |      |      |      |           |      |                                |      |  |
| Essve Injection system HY for concrete                                                                                                                                                                                                                                                                                                           |                 |                    |                                      |      |      |      |      |      | Annex C 7 |      |                                |      |  |
| Performances<br>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 under static and quasi-static action</b>         |                              |                           |       |       |       |       |       |       |       |       |
| Temperature range I:<br>80°C/50°C                                               | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,031 | 0,032 | 0,034 | 0,037 | 0,039 | 0,042 | 0,044 | 0,046 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,040 | 0,042 | 0,044 | 0,047 | 0,051 | 0,054 | 0,057 | 0,060 |
| Temperature range II:<br>120°C/72°C                                             | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,032 | 0,034 | 0,035 | 0,038 | 0,041 | 0,044 | 0,046 | 0,048 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,042 | 0,044 | 0,045 | 0,049 | 0,053 | 0,056 | 0,059 | 0,062 |
| Temperature range III:<br>160°C/100°C                                           | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,121 | 0,126 | 0,131 | 0,142 | 0,153 | 0,163 | 0,171 | 0,179 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,124 | 0,129 | 0,135 | 0,146 | 0,157 | 0,168 | 0,176 | 0,184 |
| <b>Cracked concrete C20/25 under static, quasi-static and seismic C1 action</b> |                              |                           |       |       |       |       |       |       |       |       |
| Temperature range I:<br>80°C/50°C                                               | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,081 | 0,083 | 0,085 | 0,090 | 0,095 | 0,099 | 0,103 | 0,106 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,104 | 0,107 | 0,110 | 0,116 | 0,122 | 0,128 | 0,133 | 0,137 |
| Temperature range II:<br>120°C/72°C                                             | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,084 | 0,086 | 0,088 | 0,093 | 0,098 | 0,103 | 0,107 | 0,110 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,108 | 0,111 | 0,114 | 0,121 | 0,127 | 0,133 | 0,138 | 0,143 |
| Temperature range III:<br>160°C/100°C                                           | $\delta_{N0}$ -factor        | [mm/(N/mm <sup>2</sup> )] | 0,312 | 0,321 | 0,330 | 0,349 | 0,367 | 0,385 | 0,399 | 0,412 |
|                                                                                 | $\delta_{N\infty}$ -factor   | [mm/(N/mm <sup>2</sup> )] | 0,321 | 0,330 | 0,340 | 0,358 | 0,377 | 0,396 | 0,410 | 0,424 |
| <b>Cracked concrete C20/25 under seismic C2 action</b>                          |                              |                           |       |       |       |       |       |       |       |       |
| All temperature ranges                                                          | $\delta_{N,eq(DLS)}$ -factor | [mm/(N/mm <sup>2</sup> )] | NPA   | 0,120 | 0,100 | 0,100 | 0,120 | NPA   |       |       |
|                                                                                 | $\delta_{N,eq(ULS)}$ -factor | [mm/(N/mm <sup>2</sup> )] |       |       |       |       |       |       |       |       |

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

$$\begin{aligned} \delta_{N0} &= \delta_{N0}\text{-factor} \cdot \tau; & \delta_{N,eq(DLS)} &= \delta_{N,eq(DLS)}\text{-factor} \cdot \tau; & \tau: &\text{action bond stress for tension} \\ \delta_{N\infty} &= \delta_{N\infty}\text{-factor} \cdot \tau; & \delta_{N,eq(ULS)} &= \delta_{N,eq(ULS)}\text{-factor} \cdot \tau; \end{aligned}$$

**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>Non-cracked and cracked concrete C20/25 under static, quasi-static and seismic C1 action</b> |                              |         |      |      |      |      |      |      |      |      |
| All temperature ranges                                                                          | $\delta_{V0}$ -factor        | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 |
|                                                                                                 | $\delta_{V\infty}$ -factor   | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 |
| <b>Cracked concrete C20/25 under seismic C2 action</b>                                          |                              |         |      |      |      |      |      |      |      |      |
| All temperature ranges                                                                          | $\delta_{V,eq(DLS)}$ -factor | [mm/kN] | NPA  | 0,27 | 0,13 | 0,09 | 0,06 | NPA  |      |      |
|                                                                                                 | $\delta_{V,eq(ULS)}$ -factor | [mm/kN] |      |      |      |      |      |      |      |      |

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

$$\begin{aligned} \delta_{V0} &= \delta_{V0}\text{-factor} \cdot V; & V: &\text{action shear load} \\ \delta_{V\infty} &= \delta_{V\infty}\text{-factor} \cdot V; \\ \delta_{V,eq(DLS)} &= \delta_{V,eq(DLS)}\text{-factor} \cdot V; \\ \delta_{V,eq(ULS)} &= \delta_{V,eq(ULS)}\text{-factor} \cdot V; \end{aligned}$$

**Essve Injection system HY 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 24  | Ø 25  | Ø 28  | Ø 32  |
|---------------------------------------------------------------------------------|-------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Non-cracked concrete C20/25 under static and quasi-static action</b>         |                         |              |       |       |       |       |       |       |       |       |       |       |
| Temperature range I:<br>80°C/50°C                                               | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,031 | 0,032 | 0,034 | 0,035 | 0,037 | 0,039 | 0,042 | 0,043 | 0,045 | 0,048 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,040 | 0,042 | 0,044 | 0,045 | 0,047 | 0,051 | 0,054 | 0,055 | 0,058 | 0,063 |
| Temperature range II:<br>120°C/72°C                                             | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,032 | 0,034 | 0,035 | 0,036 | 0,038 | 0,041 | 0,044 | 0,045 | 0,047 | 0,050 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,042 | 0,044 | 0,045 | 0,047 | 0,049 | 0,053 | 0,056 | 0,057 | 0,060 | 0,065 |
| Temperature range III:<br>160°C/100°C                                           | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,121 | 0,126 | 0,131 | 0,137 | 0,142 | 0,153 | 0,163 | 0,164 | 0,172 | 0,186 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,124 | 0,129 | 0,135 | 0,141 | 0,146 | 0,157 | 0,168 | 0,169 | 0,177 | 0,192 |
| <b>Cracked concrete C20/25 under static, quasi-static and seismic C1 action</b> |                         |              |       |       |       |       |       |       |       |       |       |       |
| Temperature range I:<br>80°C/50°C                                               | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,081 | 0,083 | 0,085 | 0,087 | 0,090 | 0,095 | 0,099 | 0,099 | 0,103 | 0,108 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,104 | 0,107 | 0,110 | 0,113 | 0,116 | 0,122 | 0,128 | 0,128 | 0,133 | 0,141 |
| Temperature range II:<br>120°C/72°C                                             | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,084 | 0,086 | 0,088 | 0,090 | 0,093 | 0,098 | 0,103 | 0,103 | 0,107 | 0,113 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,108 | 0,111 | 0,114 | 0,118 | 0,121 | 0,127 | 0,133 | 0,133 | 0,138 | 0,148 |
| Temperature range III:<br>160°C/100°C                                           | δ <sub>N0</sub> -factor | [mm/(N/mm²)] | 0,312 | 0,321 | 0,330 | 0,340 | 0,349 | 0,367 | 0,385 | 0,385 | 0,399 | 0,425 |
|                                                                                 | δ <sub>N∞</sub> -factor | [mm/(N/mm²)] | 0,321 | 0,330 | 0,340 | 0,349 | 0,358 | 0,377 | 0,396 | 0,396 | 0,410 | 0,449 |

<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 24 | Ø 25 | Ø 28 | Ø 32 |
|-----------------------------------------------------------------------------|-------------------------|---------|------|------|------|------|------|------|------|------|------|------|
| <b>For concrete C20/25 under static, quasi-static and seismic C1 action</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 | 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 | 0,04 | 0,04 |

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

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

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

**Essve Injection system HY for concrete**

**Performances**  
Displacements (rebar)

**Annex C 9**

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

| Anchor size Internal threaded 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:<br>80°C/50°C                                       | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,032  | 0,034  | 0,037   | 0,039   | 0,042   | 0,046   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,042  | 0,044  | 0,047   | 0,051   | 0,054   | 0,060   |
| Temperature range II:<br>120°C/72°C                                     | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,034  | 0,035  | 0,038   | 0,041   | 0,044   | 0,048   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,044  | 0,045  | 0,049   | 0,053   | 0,056   | 0,062   |
| Temperature range III:<br>160°C/100°C                                   | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,126  | 0,131  | 0,142   | 0,153   | 0,163   | 0,179   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,129  | 0,135  | 0,146   | 0,157   | 0,168   | 0,184   |
| <b>Cracked concrete C20/25 under static and quasi-static action</b>     |                            |                           |        |        |         |         |         |         |
| Temperature range I:<br>80°C/50°C                                       | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,083  | 0,085  | 0,090   | 0,095   | 0,099   | 0,106   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,170  | 0,110  | 0,116   | 0,122   | 0,128   | 0,137   |
| Temperature range II:<br>120°C/72°C                                     | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,086  | 0,088  | 0,093   | 0,098   | 0,103   | 0,110   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,111  | 0,114  | 0,121   | 0,127   | 0,133   | 0,143   |
| Temperature range III:<br>160°C/100°C                                   | $\delta_{N0}$ -factor      | [mm/(N/mm <sup>2</sup> )] | 0,321  | 0,330  | 0,349   | 0,367   | 0,385   | 0,412   |
|                                                                         | $\delta_{N\infty}$ -factor | [mm/(N/mm <sup>2</sup> )] | 0,330  | 0,340  | 0,358   | 0,377   | 0,396   | 0,424   |

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

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

$\tau$ : 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 rod)**

| Anchor size Internal threaded 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

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

V: action shear load

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

**Essve Injection system HY for concrete**

**Performances**

Displacements (Internal threaded anchor rod)

**Annex C 10**