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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011



# European Technical Assessment ETA-19/0651 of 2019/10/11

I General Part

| | |
|---|---|
| **Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011:** ETA-Danmark A/S | |
| **Trade name of the construction product:** | Stahlfix EASF Injection System |
| **Product family to which the above construction product belongs:** | Bonded injection type anchor for use in non-cracked concrete: sizes M8 to M24, rebar Ø8 to Ø25 mm |
| **Manufacturer:** | Sogiva Swiss SA<br>Ch. du Lavasson 8<br>CH-1196 Gland<br>Tel. +41 22 364 57 17<br>Internet www. sogivaswiss.com |
| **Manufacturing plant:** | Sogiva Swiss SA<br>Factory Plant 1 |
| **This European Technical Assessment contains:** | 20 pages including 15 annexes which form an integral part of the document |
| **This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:** | EOTA EAD 330499-01-0601, “Bonded fasteners for use in concrete” |
| **This version replaces:** | |

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# II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

## 1 Technical description of product and intended use

**Technical description of the product**
The Stahlfix EASF is a bonded anchor (injection type) for concrete consisting of a cartridge with Stahlfix EASF injection mortar and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M8 to M24 or a reinforcing bar in the range of diameter Ø8 to Ø25 mm.

The product specification is given in annex A.

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 characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation[1] of this European Technical Assessment.

## 2 Specification of the intended use in accordance with the applicable EAD

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 provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, 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.

1 The technical documentation of this European Technical Assessment is deposited at ETA-Danmark and, as far as relevant for the tasks of the Notified bodies involved in the attestation of conformity procedure, is handed over to the notified bodies.

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

## 3.1 Characteristics of product

**Mechanical resistance and stability (BWR 1):**
The essential characteristics are detailed in the Annex C.

**Safety in case of fire (BWR 2):**
The essential characteristics are detailed in the Annex C.

**Hygiene, health and the environment (BWR3):**
No performance assessed

**Safety in use (BWR4):**
For basic requirement Safety in use the same criteria are valid for Basic Requirement Mechanical resistance and stability (BWR1).

**Sustainable use of natural resources (BWR7)**
No performance assessed

Other Basic Requirements are not relevant.

## 3.2 Methods of assessment

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 has been made in accordance with EOTA EAD 330499-01-0601, "Bonded fasteners for use in concrete" option 7.

# 4 Assessment and verification of constancy of performance (AVCP)

## 4.1 AVCP system

According to the decision 96/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

# 5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2019-10-11 by

Thomas Bruun
Managing Director, ETA-Danmark

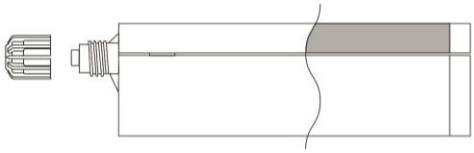
**Cartridge: Stahlfix EASF**

**A) Foil Bag Cartridge 165ml, 300ml.**
**B) Coaxial Cartridge 380ml / 400 ml / 410 ml / 420ml**
**C) Side by Side Cartridge 345ml, 825ml**

Cartridge Print Stahlfix EASF
Including - Installation procedure, Production Batch code, Expiry Date, Storage conditions, Health & Safety warning, Gel & Cure time according to temperatures.

**A)**

**B)**

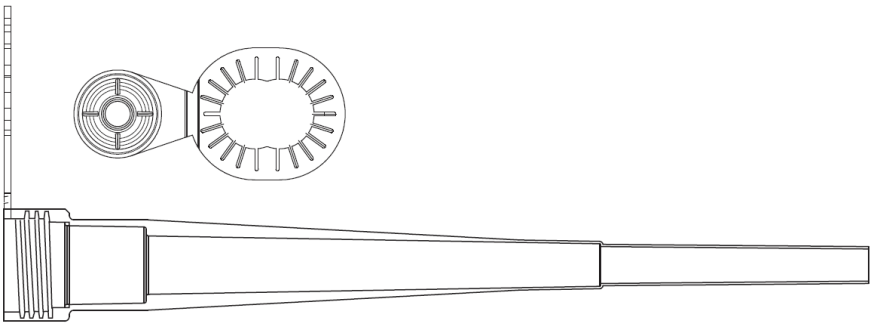


**C)**

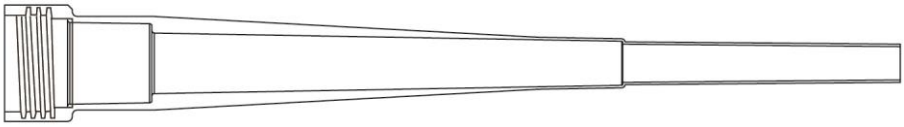
**Marking:**

Stahlfix EASF
Batch code, either expiry date or manufacturing date with shelf life

**Mixer** with hanger



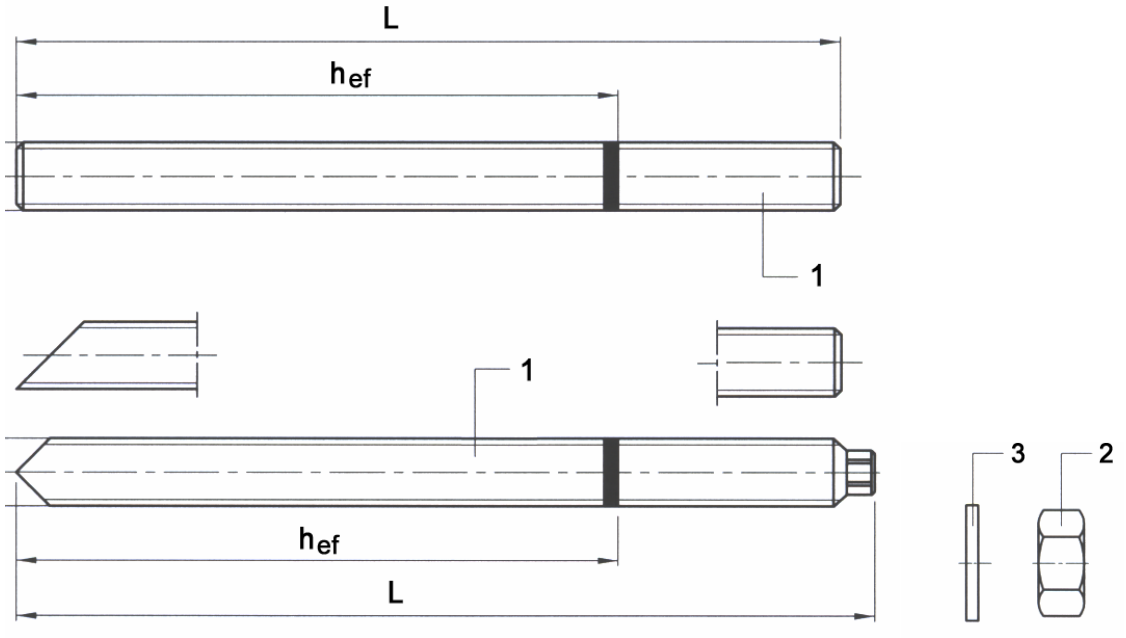
**Mixer**



| Stahlfix EASF | Annex A1<br>of European Technical Assessment ETA-19/0651 |
|---|---|
| Product and intended use | |

**Anchor rod and rebar**

**Threaded Steel Stud, Nut and Washer**
Sizes M8, M10, M12, M16, M20, M24



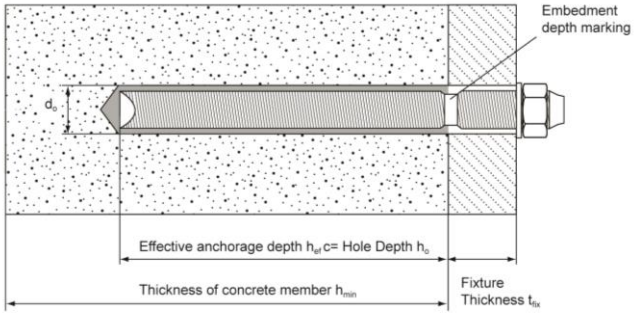

**Rebar**
Diameter Ø 8mm, Ø 10mm, Ø 12mm, Ø 14mm, Ø 16mm, Ø 20mm, Ø 25mm,

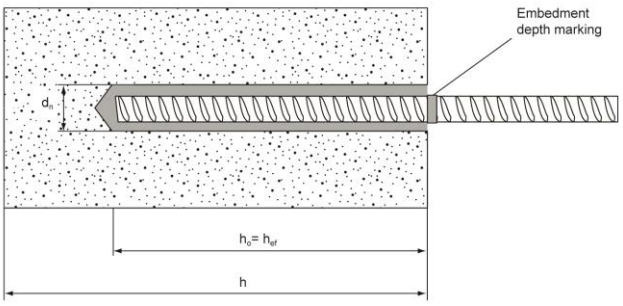
| | |
|---|---|
| **Stahlfix EASF** | **Annex A2** of European Technical Assessment ETA-19/0651 |
| Threaded rod types and rebar's dimensions | |

## Installed Anchor and Intended Use

### Table A1: Installation details for anchor rods

| Anchor size | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| Diameter of element | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Range of effective embedment depth $h_{ef}$ | min | [mm] | 60 | 60 | 70 | 80 | 90 | 100 |
| and bore hole depth $h_o$ | max | [mm] | 96 | 120 | 144 | 192 | 240 | 288 |
| Effective embedment depth | $h_{ef}$ | [mm] | 80 | 90 | 110 | 125 | 170 | 210 |
| Nominal diameter of drill bit | $d_o$ | [mm] | 10 | 12 | 14 | 18 | 24 | 28 |
| Diameter of clearance hole in the fixture | $d_f$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 |
| Maximum torque moment | $T_{max}$ | [Nm] | 10 | 12 | 20 | 40 | 70 | 90 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{ef}$ + 30mm ≥ 100mm | | | $h_{ef}$ + 2$d_o$ | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 |




### Table A2: Installation details for rebar

| Rebar size (mm) | | | ϕ 8 | ϕ 10 | ϕ 12 | ϕ 14 | ϕ 16 | ϕ 20 | ϕ 25 |
|---|---|---|---|---|---|---|---|---|---|
| Diameter of element | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 25 |
| Range of effective embedment depth $h_{ef}$ | min | [mm] | 60 | 60 | 70 | 75 | 80 | 90 | 100 |
| and bore hole depth $h_o$ | max | [mm] | 96 | 120 | 144 | 168 | 192 | 240 | 288 |
| Nominal diameter of drill bit | $d_o$ | [mm] | 12 | 14 | 16 | 18 | 20 | 25 | 30 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{ef}$ + 30mm ≥ 100mm | | | $h_{ef}$ + 2$d_o$ | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 120 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 120 |

| | |
|---|---|
| **Stahlfix EASF** | **Annex A3** |
| Installation details for threaded studs and rebar | of European Technical Assessment ETA-19/0651 |

**Table A3: Threaded rod and rebar materials**

| Designation | Material |
|---|---|
| **Threaded rods made of zinc coated steel** | |
| Threaded rod M8 – M24 | Strength class 4.6 to 12.9 EN ISO 898-1<br>Steel galvanized ≥ 5µm EN ISO 4042<br>Hot dipped galvanized ≥ 45µm EN ISO 10684 |
| Washer<br>ISO 7089 | Steel galvanized EN ISO 4042; hot dipped galvanized EN ISO 10684 |
| Nut<br>EN ISO 4032 | Strength class 8 EN ISO 898-2<br>Steel galvanized ≥ 5µm EN ISO 4042<br>Hot dipped galvanized ≥ 45µm EN ISO 10684 |
| **Threaded rods made of stainless steel** | |
| Threaded rod M8 – M24 | Strength class 50, 70 or 80 EN ISO 3506;<br>Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 – EN 10088 |
| Washer<br>ISO 7089 | Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 – EN 10088 |
| Nut<br>EN ISO 4032 | Strength class 70 and 80 EN ISO 3506-1;<br>Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 – EN 10088 |
| **Threaded rods made of high corrosion resistant steel** | |
| Threaded rod M8 – M24 | Strength class 70 or 80<br>$R_m$ = 800 N/mm²; $R_{p0,2}$=640 N/mm²<br>High corrosion resistant steel 1.4529, 1.4565 EN 10088 |
| Washer<br>ISO 7089 | High corrosion resistant steel 1.4529, 1.4565 EN 10088 |
| Nut<br>EN ISO 4032 | Strength class 70 EN ISO 3506-2;<br>High corrosion resistant steel 1.4529, 1.4565 EN 10088 |
| **Rebars** | |
| Rebars ϕ8 to ϕ25 | class B and C of characteristic yield strength $f_{yk}$ from 400 MPa to 600 MPa |

**Use:**
The anchors are intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 of Regulation 305/2011 (EU) shall be fulfilled and failure of anchorages made with these products would compromise the stability of the works, cause risk to human life and/or lead to considerable economic consequences.

**Anchors subject to:**
- Static and quasi-static loads: M8 to M24, Rebar Ø8 to Ø25

**Base materials:**
- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum to C50/60 at maximum according to EN 206-1.
- Non-cracked concrete: sizes from M8 to M24 and rebar ϕ8mm to ϕ25mm

**Temperature range:**
The anchors may be used in the following temperature range:
a) T: - 40 °C to + 40°C (max short term temperature + 40 °C and max long term temperature + 24 °C).

**Use conditions (Environmental conditions):**
Elements made of galvanized steel and stainless steel may be used in structures subject to the following 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).

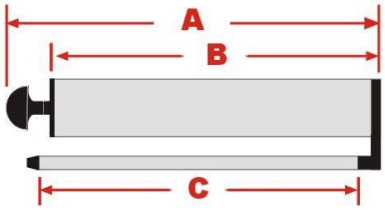
**Installation:**
The anchors may be installed in:
- Dry or wet concrete (use category 1)
- Flooded holes with the exception of seawater (use category 2)
- All the diameters may be used overhead
- The anchor is suitable for hammer drilled holes

**Proposed design methods:**
- Static and quasi-static load: EN 1992-4

**Table B1: Installation data**

| Threaded rod and rebar | Size | Nominal drill bit diameter $d_o$ (mm)  | Steel Brush $d_b$ (mm)  | Cleaning methods | |
|---|---|---|---|---|---|
| | | | | Manual cleaning (MAC) | Compressed air cleaning (CAC) |
| **Studs**  | M8 | 10 | 12 mm | Yes … $h_{ef} \leq 80$ mm | Yes |
| | M10 | 12 | 14 mm | Yes … $h_{ef} \leq 100$ mm | |
| | M12 | 14 | 16 mm | Yes … $h_{ef} \leq 120$ mm | |
| | M16 | 18 | 20 mm | Yes … $h_{ef} \leq 160$ mm | |
| | M 20 | 24 | 26 mm | Yes … $h_{ef} \leq 200$ mm | |
| | M 24 | 28 | 30 mm | Yes … $h_{ef} \leq 240$ mm | |
| **Rebar**  | $\phi$ 8 mm | 12 | 14 mm | Yes … $h_{ef} \leq 80$ mm | Yes |
| | $\phi$ 10 mm | 14 | 16 mm | Yes … $h_{ef} \leq 100$ mm | |
| | $\phi$ 12 mm | 16 | 18 mm | Yes … $h_{ef} \leq 120$ mm | |
| | $\phi$ 14 mm | 18 | 20 mm | Yes … $h_{ef} \leq 140$ mm | |
| | $\phi$ 16 mm | 20 | 22 mm | Yes … $h_{ef} \leq 160$ mm | |
| | $\phi$ 20 mm | 25 | 28 mm | Yes … $h_{ef} \leq 200$ mm | |
| | $\phi$ 25 mm | 30 | 34 mm | Yes … $h_{ef} \leq 240$ mm | |

**Manual Cleaning (MAC):**
Hand pump recommended for
Blowing out bore holes with diameters
$d_o \leq 24$ mm and bore holes depth $h_o \leq 10d$




| 190mm (240x190x300mm) | 280mm (330x280x300mm) | 400mm (420x370x350mm) |
|---|---|---|
| -( A ) : 240mm (overall)<br>-( B ) : 190mm (Body)<br>-( C ) : 300mm (Tube) | -( A ) : 330mm (overall)<br>-( B ) : 280mm (Body)<br>-( C ) : 300mm (Tube) | -( A ) : 420mm (overall)<br>-( B ) : 370mm (Body)<br>-( C ) : 350mm (Tube) |

**Compressed air cleaning (CAC):**
Recommended air nozzle with an
Orifice opening of minimum
3,5mm in diameter.

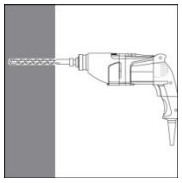
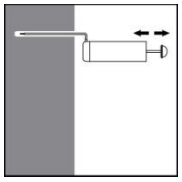
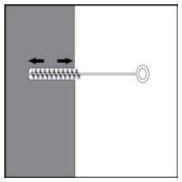
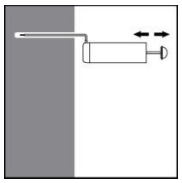
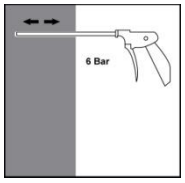
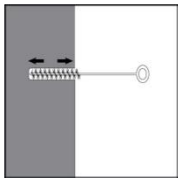
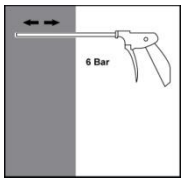
**Table B2: Minimum curing time**

| Minimum base material temperature C° | Gel time (working time) In dry/wet concrete | Curing time in dry concrete | Curing time in wet concrete |
|---|---|---|---|
| 0°C ≤ $T_{base\ material}$ < 10°C | 20 min | 90 min | 180 min |
| 10°C ≤ $T_{base\ material}$ < 20°C | 9 min | 60 min | 120 min |
| 20°C ≤ $T_{base\ material}$ < 30°C | 5 min | 30 min | 60 min |
| 30°C ≤ $T_{base\ material}$ ≤ 40°C | 3 min | 20 min | 40 min |

The temperature of the bond material must be ≥ 20°C

| **Resin injection pump details** | | |
|---|---|---|
| **Image** | **Size Cartridge / Code** | **Type** |
|  | **165 / 300ml**<br>**165 / 300 ml 10:1** | **Manual** |
|  | **345 / 380 / 400 / 410 / 420ml**<br>**420 ml 10:1**<br>**345 ml 10:1** | **Manual** |
|  | **165 / 300 / 345 / 380 / 400 / 410 / 420ml**<br>**165 / 300 ml**<br>**345ml**<br>**380 / 400 / 410 / 420 ml**<br>**7.4v Tool** | **Battery** |
|  | **380 / 400 / 410 / 420 / 825ml**<br>**380 / 400 / 410 / 420 ml**<br>**825ml** | **Pneumatic** |

**Table B3 - parameters: drilling, hole cleaning and installation**

| | | |
|---|---|---|
| **Bore hole drilling** | | |
|  | | Drill hole in the substrate to the required embedment depth using the appropriately sized carbide drill bit. |
| **Bore hole cleaning** Just before setting an anchor, the bore hole must be free of dust and debris. | | |
| **a) Manual air cleaning (MAC)** for all bore hole diameters $d_o \leq$ 24mm and bore hole depth $h_o \leq 10d$ | | |
|  | **X 4** | The manual pump shall be used for blowing out bore holes up to diameters $d_o \leq$ 24mm and embedment depths up to $h_{ef} \leq 10d$.<br><br>Blow out at least 4 times from the back of the bore hole, using an extension if needed. |
|  | **X 4** | Brush 4 times with the specified brush size (see Table B1) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. |
|  | **X 4** | Blow out again with manual pump at least 4 times. |
| **b) Compressed air cleaning (CAC)** for all bore hole diameters $d_o$ and all bore hole depths | | |
|  | **X 2** | Blow 2 times from the back of the hole (if needed with a nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h). |
|  | **X 2** | Brush 2 times with the specified brush size (see Table B1) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. |
|  | **X 2** | Blow out again with compressed air at least 2 times. |

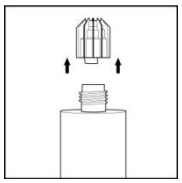
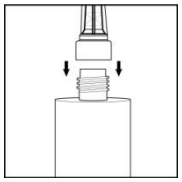
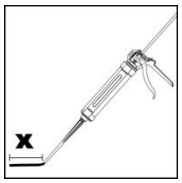
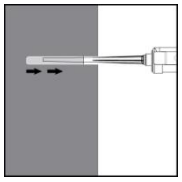
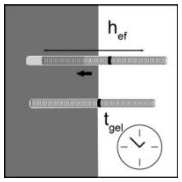
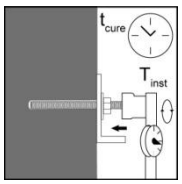
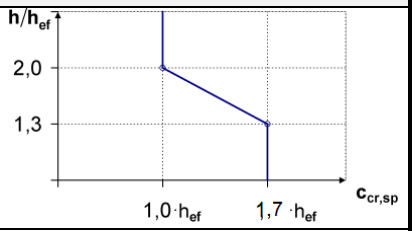
| **Table B4 - parameters: drilling, hole cleaning and installation** | |
|---|---|
|  | Remove the threaded cap from the cartridge. Cut open the foil bag if necessary. |
|  | Tightly attach the mixing nozzle. Do not modify the mixer in any way. Made sure the mixing element is inside the mixer. Use only the supplied mixer. |
|  | Insert the cartridge into the dispenser gun. |
|  | Discard the initial trigger pulls of adhesive. Depending on the size of the cartridge, an initial amount of adhesive mix must be discarded.<br><br>Discard quantities are 10 cm for all cartridges |
|  | Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.<br>Fill holes approximately 2/3 full, to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment depth. |
|  | Before use, verify that the threaded rod is dry and free of contaminants.<br><br>Install the threaded rod to the required embedment depth during the open gel time $t_{gel}$ has elapsed. The working time $t_{gel}$ is given in Table B2. |
|  | The anchor can be loaded after the required curing time $t_{cure}$ (see Table B2).<br>The applied torque shall not exceed the values $T_{max}$ given in Table A1. |

**Table C1: Design method A, characteristic tension load values**

| Stahlfix EASF with threaded rods | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | |
| Characteristic resistance, class 4.6 and 4.8 | $N_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 |
| Characteristic resistance, class 5.6 and 5.8 | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 78 | 122 | 176 |
| Characteristic resistance, class 8.8 | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 125 | 196 | 282 |
| Characteristic resistance, class 10.9 | $N_{Rk,s}$ | [kN] | 38 | 60 | 87 | 163 | 255 | 367 |
| Characteristic resistance, class 12.9 | $N_{Rk,s}$ | [kN] | 44 | 70 | 103 | 190 | 299 | 431 |
| Characteristic resistance, A2, A4 and HCR, Property class 50 | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 78 | 122 | 176 |
| Characteristic resistance, A2, A4 and HCR, Property class 70 | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 | 171 | 247 |
| Characteristic resistance, A4 and HCR, Property class 80 | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 282 |
| Partial safety factor 4.6 and 5.6 | $\gamma_{Ms,N}$ [1] | [-] | 2 | | | | | |
| Partial safety factor 4.8, 5.8, 8.8, 10.9 and 12.9 | $\gamma_{Ms,N}$ [1] | [-] | 1,5 | | | | | |
| Partial safety factor A2, A4 and HCR class 70 | $\gamma_{Ms,N}$ [1] | [-] | 1,87 | | | | | |
| Partial safety factor A2, A4 and HCR class 80 | $\gamma_{Ms,N}$ [1] | [-] | 1,60 | | | | | |
| **Combined Pull-out and Concrete cone failure** [2] | | | | | | | | |
| Diameter of threaded rod | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Characteristic bond resistance in non-cracked concrete C20/25 – dry or wet concrete | | | | | | | | |
| Temperature range a [3] : 40°C/24°C | $\tau_{Rk,ucr}$ | [N/mm²] | 7 | 7 | 6.5 | 6.5 | 6 | 5.5 |
| Partial safety factor – dry or wet concrete | $\gamma_{inst}$ | [-] | 1,2 | | | 1,4 | | |
| Characteristic bond resistance in non-cracked concrete C20/25 – flooded holes | | | | | | | | |
| Temperature range a [3] : 40°C/24°C | $\tau_{Rk,ucr}$ | [N/mm²] | 7 | 7 | 6.5 | 6 | 5 | 4.5 |
| Partial safety factor – flooded holes | $\gamma_{inst}$ | [-] | 1,2 | | 1,4 | | | |
| Increasing factor for $\tau_{Rk,ucr}$ in non-cracked concrete | $\psi_c$ | C30/37 | 1,0 | | | | | |
| | | C40/50 | 1,0 | | | | | |
| | | C50/60 | 1,0 | | | | | |
| Factor for determination of the concrete cone failure | $k_{ucr,N}$ | [-] | 11,0 (based on concrete cylinder strength $f_{ck}$)<br>10,1 (based on concrete strength $f_{ck,cube}$) | | | | | |
| **Splitting failure** [2] | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | $h / h_{ef}$ [4] ≥ 2,0 | | 1,0 $h_{ef}$ | | | | | |
| | 2,0 > $h / h_{ef}$ [4] > 1,3 | | 3 $h_{ef}$ - 1 h | | | | | |
| | $h / h_{ef}$ [4] ≤ 1,3 | | 1.7 $h_{ef}$ | | | | | |
| Spacing | $s_{cr,sp}$ | [mm] | 2 $c_{cr,sp}$ | | | | | |




[1] In absence of national regulations
[2] Calculation of concrete and splitting, see annex B1
[3] Explanations, see annex B1
[4] h = concrete member thickness, $h_{ef}$ = effective embedment depth

**Table C2: Displacements under tension load**

| Stahlfix EASF with threaded rods | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Temperature range a [5] : 40°C / 24°C** | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm$^2$)] | 0,03 | 0,04 | 0,04 | 0,04 | 0,09 | 0,30 |
| Displacement | $\delta_{N\infty}$ | [mm/(N/mm$^2$)] | - | - | 0,15 | - | - | - |

[5] Explanation see annex B1

**Table C3: Design method A, Characteristic shear load values**

| Stahlfix EASF with threaded rods | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | |
| Characteristic resistance, class 4.6 and 4.8 | $V_{Rk,s}$ | [kN] | 7 | 12 | 17 | 31 | 49 | 70 |
| Characteristic resistance, class 5.6 and 5.8 | $V_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 | 61 | 88 |
| Characteristic resistance, class 8.8 | $V_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 |
| Characteristic resistance, class 10.9 | $V_{Rk,s}$ | [kN] | 19 | 30 | 43 | 81 | 127 | 183 |
| Characteristic resistance, class 12.9 | $V_{Rk,s}$ | [kN] | 22 | 35 | 51 | 95 | 149 | 215 |
| Characteristic resistance, A2, A4 and HCR, Property class 50 | $V_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 | 61 | 88 |
| Characteristic resistance, A2, A4 and HCR, Property class 70 | $V_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 86 | 124 |
| Characteristic resistance, A4 and HCR, Property class 80 | $V_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 |
| **Steel failure with lever arm** | | | | | | | | |
| Characteristic resistance, class 4.6 and 4.8 | $M^0_{Rk,s}$ | [Nm] | 15 | 30 | 52 | 133 | 260 | 449 |
| Characteristic resistance, class 5.6 and 5.8 | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 65 | 166 | 324 | 560 |
| Characteristic resistance, class 8.8 | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 266 | 519 | 896 |
| Characteristic resistance, class 10.9 | $M^0_{Rk,s}$ | [Nm] | 37 | 75 | 131 | 333 | 649 | 1123 |
| Characteristic resistance, class 12.9 | $M^0_{Rk,s}$ | [Nm] | 45 | 90 | 157 | 400 | 779 | 1347 |
| Characteristic resistance, A2, A4, HCR -50 | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 65 | 166 | 324 | 560 |
| Characteristic resistance, A2, A4, HCR -70 | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 95 | 232 | 454 | 784 |
| Characteristic resistance, A4, HCR - 80 | $M^0_{Rk,s}$ | [Nm] | 30 | 59 | 105 | 266 | 519 | 896 |
| **Partial safety factor steel failure** | | | | | | | | |
| Steel, Property class 4.6 or 5.6 | $\gamma_{Ms,V}$ [1)] | [-] | 1,67 | | | | | |
| Steel, Property class 4.8, 5.8 or 8.8 | $\gamma_{Ms,V}$ [1)] | [-] | 1,25 | | | | | |
| Steel, Property class 10.9 or 12.9 | $\gamma_{Ms,V}$ [1)] | [-] | 1,50 | | | | | |
| Stainless steel A2, A4 or HCR Property class 50 | $\gamma_{Ms,V}$ [1)] | [-] | 2,38 | | | | | |
| Stainless steel A2, A4 or HCR Property class 70 | $\gamma_{Ms,V}$ [1)] | [-] | 1,56 | | | | | |
| Stainless steel A4 or HCR Property class 80 | $\gamma_{Ms,V}$ [1)] | [-] | 1,33 | | | | | |
| **Concrete pryout failure** | | | | | | | | |
| Factor in equation (27) of EN 1992-4-5, 6.3.3 | $k_3$ | [-] | 1,0 for $h_{ef}$ < 60mm<br>2,0 for $h_{ef}$ ≥ 60mm | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [-] | 1,5 | | | | | |
| **Concrete edge failure** | | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [-] | 1,5 | | | | | |

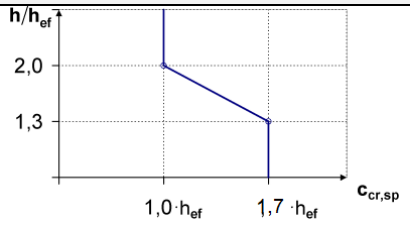
1) In absence of national regulations

**Table C4: Displacements under shear load**

| Stahlfix EASF with threaded rods | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 | 0,03 |
| Displacement | $\delta_{V\infty}$ | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 |

**Table C5: Design method A, characteristic tension load values**

| **Stahlfix EASF with rebar** | | | **ϕ 8** | **ϕ 10** | **ϕ 12** | **ϕ 16** | **ϕ 20** | **ϕ 25** |
|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ [1] | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 201 | 314 | 491 |
| Partial safety factor | $\gamma_{Ms,N}$ [2] | [-] | 1,4 | | | | | |
| **Combined Pull-out and Concrete cone failure** [3] | | | | | | | | |
| Diameter of rebar | d | [mm] | 8 | 10 | 12 | 16 | 20 | 25 |
| Characteristic bond resistance in non-cracked concrete C20/25 – dry or wet concrete | | | | | | | | |
| Temperature range a [4] : **40°C/24°C** | $\tau_{Rk,ucr}$ | [N/mm²] | **5.5** | **5.5** | **5.5** | **5** | **5** | **5** |
| Partial safety factor – dry or wet concrete | $\gamma_{inst}$ [2] | [-] | 1,2 | | | 1,4 | | |
| Characteristic bond resistance in non-cracked concrete C20/25 – flooded holes | | | | | | | | |
| Temperature range a [4] : **40°C/24°C** | $\tau_{Rk,ucr}$ | [N/mm²] | **5.5** | **5.5** | **5.5** | **5** | **4.5** | **4** |
| Partial safety factor – flooded holes | $\gamma_{inst}$ | [-] | 1,2 | | 1,4 | | | |
| Increasing factor for $\tau_{Rk,ucr}$ in non-cracked concrete | $\psi_c$ | C30/37 | 1,0 | | 1,1 | | | |
| | | C40/50 | 1,0 | 1,1 | | | | 1,2 |
| | | C50/60 | 1,0 | 1,1 | 1,2 | | | 1,3 |
| **Splitting failure** [3] | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | | $h / h_{ef}$ [5] ≥ 2,0 | 1,0 $h_{ef}$ | | | | | |
| | | 2,0 > $h / h_{ef}$ [5] > 1,3 | 3 $h_{ef}$ - 1 h | | | | | |
| | | $h / h_{ef}$ [5] ≤ 1,3 | 1.7 $h_{ef}$ | | | | | |
| Spacing | $s_{cr,sp}$ | [mm] | 2 $c_{cr,sp}$ | | | | | |




[1] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation
[3] Calculation of concrete and splitting, see annex B1
[4] Explanations, see annex B1
[5] h = concrete member thickness, $h_{ef}$ = effective embedment depth

**Table C6: Displacements under tension load**

| **Stahlfix EASF with rebar** | | | **ϕ 8** | **ϕ 10** | **ϕ 12** | **ϕ 16** | **ϕ 20** | **ϕ 25** |
|---|---|---|---|---|---|---|---|---|
| **Temperature range a [4] : 40°C / 24°C** | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,03 | 0,04 | 0,07 | 0,07 | 0,10 |
| Displacement | $\delta_{N\infty}$ | [mm/(N/mm²)] | - | - | 0,15 | - | - | - |

**Table C7: Design method A, Characteristic shear load values**

| **Stahlfix EASF with rebar** | | | **ϕ 8** | **ϕ 10** | **ϕ 12** | **ϕ 16** | **ϕ 20** | **ϕ 25** |
|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | $0{,}50 \cdot A_s \cdot f_{uk}$ [1)] | | | | | |
| Cross section area | $A_s$ | [$mm^2$] | **50** | **79** | **113** | **201** | **314** | **491** |
| Partial safety factor | $\gamma_{Ms,N}$ [2)] | [-] | 1,5 | | | | | |
| **Steel failure with lever arm** | | | | | | | | |
| Characteristic bending moment | $M^0_{Rk,s}$ | [Nm] | $1.2 \cdot W_{el} \cdot f_{uk}$ [1)] | | | | | |
| Elastic section modulus | $W_{el}$ | [Nm] | **50** | **98** | **170** | **402** | **785** | **1534** |
| Partial safety factor | $\gamma_{Ms,N}$ [2)] | [-] | 1,5 | | | | | |
| **Concrete pryout failure** | | | | | | | | |
| Factor | $k_8$ | [-] | 1,0 for $h_{ef} < 60mm$<br>2,0 for $h_{ef} \geq 60mm$ | | | | | |
| Partial safety factor | $\gamma_{Mc}$ | [-] | 1,5 | | | | | |
| **Concrete edge failure** | | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [-] | 1,5 | | | | | |

[1)] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2)] In absence of national regulations

**Table C8: Displacements under shear load**

| **Stahlfix EASF with rebar** | | | **ϕ 8** | **ϕ 10** | **ϕ 12** | **ϕ 16** | **ϕ 20** | **ϕ 25** |
|---|---|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,05 | 0,05 | 0,05 | 0,04 | 0,04 | 0,03 |
| Displacement | $\delta_{V\infty}$ | [mm/kN] | 0,08 | 0,08 | 0,07 | 0,06 | 0,05 | 0,05 |

### Table C9: Resistance to fire

| ESSENTIAL CHARACTERISTICS | PERFORMANCE |
|---|---|
| **Resistance to fire** | NPA |

### Table C10: Reaction to fire

| ESSENTIAL CHARACTERISTICS | PERFORMANCE |
|---|---|
| **Reaction to fire** | In the final application, the thickness of the mortar layer is about 1 to 2 mm and most of the mortar is material classified class A1 according to EC Decision 96/603/EC. Therefore, it may be assumed that the bonding material (synthetic mortar or a mixture of synthetic mortar and cementitious mortar) in connection with the metal anchor in the end use application do not contribute to fire growth or to the fully developed fire and they have no influence to the smoke hazard. |