# DÉCLARATION DES PERFORMANCES

## DoP 0321

pour fischer Strong Undercut Anchor FSU (fixation mécanique pour utilisation dans le béton) FR

1. Code d'identification unique du type de produit: **DoP 0321**

2. Usage(s) prévu(s): **Fixation dans du béton fissuré ou non fissuré, voir annexes, en particulier les annexes B1 - B5.**

3. Fabricant: **fischerwerke GmbH & Co. KG, Klaus-Fischer-Str. 1, 72178 Waldachtal, Allemagne**

4. Mandataire: **–**

5. Système(s) d'évaluation et de vérification de la constance des performances: **1**

6. Document d'évaluation européen: **EAD 330232-01-0601-v02, Edition 06/2023**
   Evaluation Technique Européenne: **ETA-22/0674; 2023-07-26**
   Organisme d'évaluation technique: **DIBt- Deutsches Institut für Bautechnik**
   Organisme(s) notifié(s): **2873 TU Darmstadt**

7. Performance(s) déclarée(s):

**Résistance mécanique et stabilité (BWR 1)**

**Résistance caractéristique à la charge de traction (charge statique et quasi-statique) Méthode A:**
Résistance à la rupture de l'acier: voir annexes, en particulier annexe C1 $E_S$= 210 000 MPa
Résistance à l'extraction glissement: voir annexes, en particulier annexe C1
Résistance à la rupture du cône béton: voir annexes, en particulier annexe C1
Robustesse: voir annexes, en particulier annexe C1
Distance au bord et entraxe mini.: voir annexes, en particulier annexe C3
Distance au bord pour éviter la rupture par fendage sous charge: voir annexes, en particulier annexe C1

**Résistance caractéristique à la charge de cisaillement (charge statique et quasi-statique), Méthode A:**
Résistance à la rupture de l'acier (charge de cisaillement) : voir annexes, en particulier annexe C2
Résistance à la rupture par effet de levier : voir annexes, en particulier annexe C2

**Résistance caractéristique pour un dimensionnement simplifié:**
Méthode B: NPD
Méthode C: NPD

**Déplacements:**
Déplacements sous charge statique et quasi-statique: voir annexes, en particulier annexe C6

**Résistance caractéristique et déplacements pour les catégories de performance sismique C1 et C2:**
Résistance à la charge de traction, déplacements, catégorie C1: voir annexes, en particulier annexe C5
Résistance à la charge de traction, déplacements, catégorie C2: voir annexes, en particulier les annexes C5, C6
Résistance à la charge de cisaillement, déplacements, catégorie C1: voir annexes, en particulier annexe C5
Résistance à la charge de cisaillement, déplacements, catégorie C2: voir annexes, en particulier les annexes C5, C6
Facteur espace annulaire : voir annexes, en particulier annexe C5

**Sécurité en cas d'incendie (BWR 2)**
Réaction au feu: Classe (A1)

**Résistance au feu:**
Résistance en cas d'incendie, rupture de l'acier (charge de traction) : voir annexes, en particulier annexe C4
Résistance en cas d'incendie, extraction glissement (charge de traction) : voir annexes, en particulier annexe C4
Résistance en cas d'incendie, rupture de l'acier (charge de cisaillement) : voir annexes, en particulier annexe C4

**Durabilité:**
Durabilité: voir annexes, en particulier les annexes A2, B1

8. Documentation technique appropriée et/ou documentation technique spécifique: –

Les performances du produit identifié ci-dessus sont conformes aux performances déclarées. Conformément au règlement (UE) no 305/2011, la présente déclaration des performances est établie sous la seule responsabilité du fabricant mentionné ci-dessus.

Signé pour le fabricant et en son nom par:

Dr.-Ing. Oliver Geibig, Directeur Général Business Units & Ingénierie

Jürgen Grün, Directeur Général Chimie & Qualité

Tumlingen, 2023-09-01

Cette DoP a été préparée en plusieurs langues. En cas de différend relatif à l'interprétation, la version anglaise prévaudra.

L'annexe comprend des informations volontaires et complémentaires en langue anglaise dépassant les exigences légales (spécifiées de manière neutre).

Translation guidance Essential Characteristics and Performance Parameters for Annexes

**Guide de traduction des caractéristiques essentielles et des paramètres de performance pour les annexes**

| | | |
|---|---|---|
| Mechanical resistance and stability (BWR 1)<br>**Résistance mécanique et stabilité (BWR 1)** | | |
| Characteristic resistance under static and quasi-static loading, Method A<br>**Résistance caractéristique à la charge de traction (charge statique et quasi-statique) Méthode A:** | | |
| 1 | Resistance to steel failure:<br>**Résistance à la rupture de l'acier:** | $N_{Rk,s}$ [kN], $E_s$ [N/mm$^2$] |
| 2 | Resistance to pull- out failure:<br>**Résistance à l'extraction glissement:** | $N_{Rk,p}$ [kN], $\psi_c$ |
| 3 | Resistance to concrete cone failure:<br>**Résistance à la rupture du cône béton:** | $k_{cr,N}$, $k_{ucr,N}$ [-], $h_{ef}$, $c_{cr,N}$ [mm] |
| 4 | Robustness:<br>**Robustesse:** | $\gamma_{inst}$ [-] |
| 5 | Minimum edge distance and spacing:<br>**Distance au bord et entraxe mini.:** | $c_{min}$, $s_{min}$, $h_{min}$ [mm] |
| 6 | Edge distance to prevent splitting under load:<br>**Distance au bord pour éviter la rupture par fendage sous charge:** | $N^0_{Rk,sp}$ [kN], $c_{cr,sp}$ [mm] |
| Characteristic resistance to shear load (static and quasi-static loading), Method A<br>**Résistance caractéristique à la charge de cisaillement (charge statique et quasi-statique), Méthode A:** | | |
| 7 | Resistance to steel failure under shear load:<br>**Résistance à la rupture de l'acier (charge de cisaillement) :** | $V^0_{Rk,s}$ [kN], $M^0_{Rk,s}$ [Nm], $k_7$ [-] |
| 8 | Resistance to pry-out failure:<br>**Résistance à la rupture par effet de levier :** | $k_8$ [-] |
| Characteristic Resistance for simplified design<br>**Résistance caractéristique pour un dimensionnement simplifié:** | | |
| 9 | Method B:<br>**Méthode B:** | $F^0_{Rk}$ [kN], $c_{cr}$, $s_{cr}$ [mm] |
| 10 | Method C:<br>**Méthode C:** | $F_{Rk}$ [kN] |
| Displacements<br>**Déplacements:** | | |
| 11 | Displacements under static and quasi-static loading:<br>**Déplacements sous charge statique et quasi-statique:** | $\delta_{N0}$, $\delta_{N\infty}$, $\delta_{V0}$, $\delta_{V\infty}$ [mm] |
| Characteristic resistance and displacements for seismic performance categories C1 and C2<br>**Résistance caractéristique et déplacements pour les catégories de performance sismique C1 et C2:** | | |
| 12 | Resistance to tension load, displacements, category C1:<br>**Résistance à la charge de traction, déplacements, catégorie C1:** | $N_{Rk,s,C1}$ [kN], $N_{Rk,p,C1}$ [kN] |
| | Resistance to tension load, displacements, category C2:<br>**Résistance à la charge de traction, déplacements, catégorie C2:** | $N_{Rk,s,C2}$ [kN], $N_{Rk,p,C2}$ [kN], $\delta_{N,C2}$ [mm] |
| 13 | Resistance to shear load, displacements, category C1:<br>**Résistance à la charge de cisaillement, déplacements, catégorie C1:** | $V_{Rk,s,C1}$ [kN] |
| | Resistance to shear load, displacements, category C2:<br>**Résistance à la charge de cisaillement, déplacements, catégorie C2:** | $V_{Rk,s,C2}$ [kN], $\delta_{V,C2}$ [mm] |
| 14 | Factor for annular gap<br>**Facteur espace annulaire :** | $\alpha_{gap}$ [-] |
| Safety in case of fire (BWR 2)<br>**Sécurité en cas d'incendie (BWR 2)** | | |
| 15 | Reaction to fire:<br>**Réaction au feu:** | Class |
| Resistance to fire:<br>**Résistance au feu:** | | |
| 16 | Fire resistance to steel failure (tension load):<br>**Résistance en cas d'incendie, rupture de l'acier (charge de traction) :** | $N_{Rk,s,fi}$ [kN] |
| 17 | Fire resistance to pull-out failure (tension load):<br>**Résistance en cas d'incendie, extraction glissement (charge de traction) :** | $N_{Rk,p,fi}$ [kN] |
| 18 | Fire resistance to steel failure (shear load):<br>**Résistance en cas d'incendie, rupture de l'acier (charge de cisaillement) :** | $V_{Rk,s,fi}$ [kN], $M^0_{Rk,s,fi}$ [Nm] |
| Aspects of durability<br>**Durabilité:** | | |
| 19 | Durability:<br>**Durabilité:** | Class |

**Specific Part**

## 1 Technical description of the product

The fischer Strong Undercut Anchor is an anchor made of galvanized steel which is placed in a cylindrical hole and anchored by displacement-controlled, self-undercutted mechanical interlock.

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), Method A | See Annex C 1 and C 3 |
| Characteristic resistance to shear load (static and quasi-static loading) | See Annex C 2 |
| Displacements | See Annex C 6 |
| Characteristic resistance and displacements for seismic performance categories C1 and C2 | See Annex C 5 and C 6 |

### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Class A1 |
| Resistance to fire | See Annex C 4 |

### 3.3 Aspects of Durability

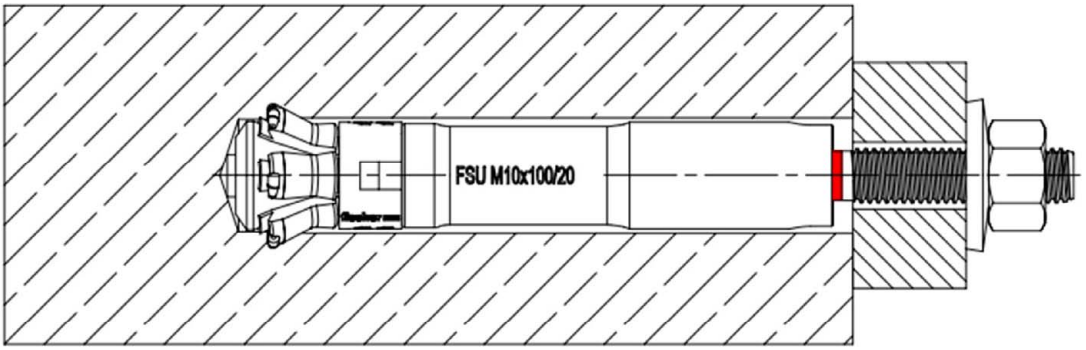
| Essential characteristic | Performance |
|---|---|
| Durability | See Annex B 1 |

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

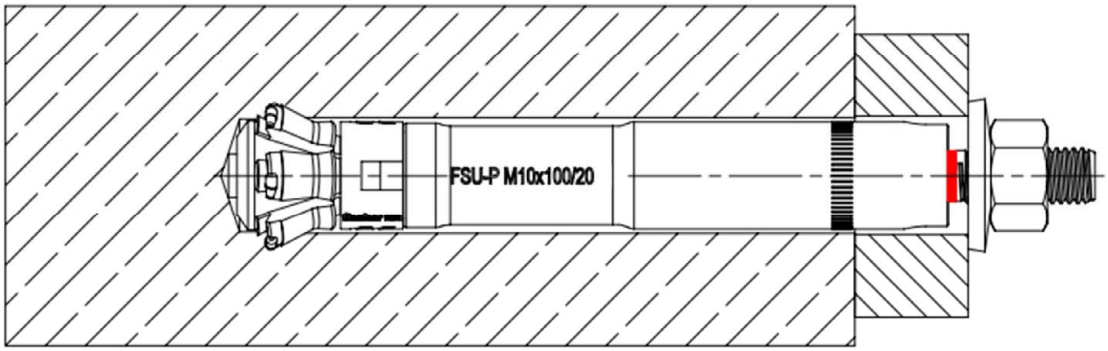
In accordance with the European Assessment Document EAD 330232-01-0601-v02 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

## Pre-setting anchor FSU




## Push-through anchor FSU-P




*(Fig. not to scale)*

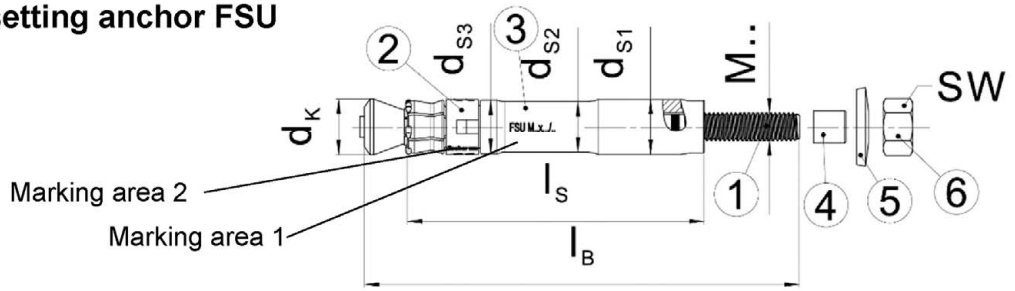
fischer Strong Undercut Anchor FSU

**Product description**
Installed condition

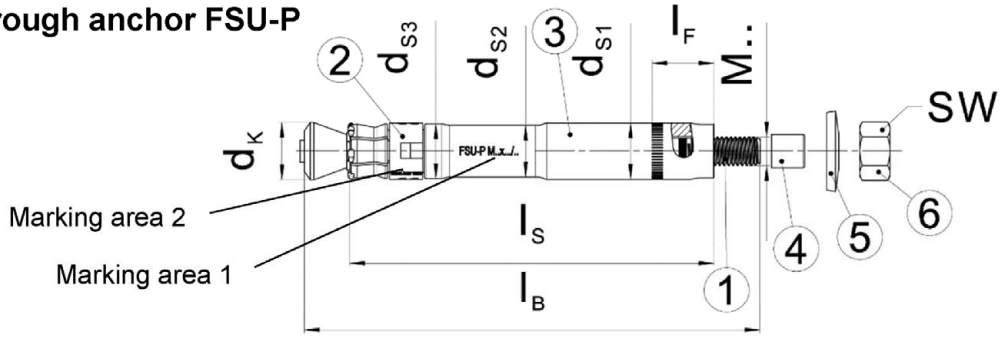
**Annex A 1**

Appendix 3 / 16

**Pre-setting anchor FSU**




**Push-through anchor FSU-P**




Product marking, example: FSU-P M10x100/20 optional: Brand

Type of fastener

Thread size x effective embedment depth ($h_{ef}$) / Max. thickness of the fixture ($t_{fix}$)

**Table A2.1:** Dimensions [mm]

| Type of anchor | $t_{fix}$ | $d_K$ | $d_{S1}$ | $d_{S2}$ | $d_{S3}$ | M | $l_S$ | $l_B$ | $l_F$ | SW |
|---|---|---|---|---|---|---|---|---|---|---|
| FSU M10x100/20 | ≤ 20 | 19,3 | 19 | 17,5 | 18,5 | 10 | 100 | 148 | - | 17 |
| FSU M12x125/30 | ≤ 30 | 21,5 | 21 | 19,3 | 20,5 | 12 | 125 | 188 | - | 19 |
| FSU M12x125/50 | ≤ 50 | 21,5 | 21 | 19,3 | 20,5 | 12 | 125 | 208 | - | 19 |
| FSU-P M10x100/20 | ≥ 10 ≤ 20 | 19,3 | 19 | 17,5 | 18,5 | 10 | 120 | 148 | 20 | 17 |
| FSU-P M12x125/30 | ≥ 12 ≤ 30 | 21,5 | 21 | 19,3 | 20,5 | 12 | 155 | 188 | 30 | 19 |
| FSU-P M12x125/50 | ≥ 12 ≤ 50 | 21,5 | 21 | 19,3 | 20,5 | 12 | 175 | 208 | 50 | 19 |

**Table A2.2:** Materials FSU

| Part | Designation | Material |
|---|---|---|
| | | **FSU, FSU-P** |
| 1 | Cone bolt | Steel, zinc plated ≥ 5 µm according to EN ISO 4042:2018 |
| 2 | Plastic sleeve | Plastic |
| 3 | Sleeve | Steel, zinc plated ≥ 5 µm according to EN ISO 4042:2018 |
| 4 | Protective cap | Plastic |
| 5 | Washer | Steel, zinc plated ≥ 5 µm according to EN ISO 4042:2018 |
| 6 | Hexagon nut | Steel, zinc plated ≥ 5 µm according to EN ISO 4042:2018 |

*(Fig. not to scale)*

fischer Strong Undercut Anchor FSU

**Product description**
Product marking, dimensions and materials

**Annex A 2**

## Stop drill bit FSU-SD

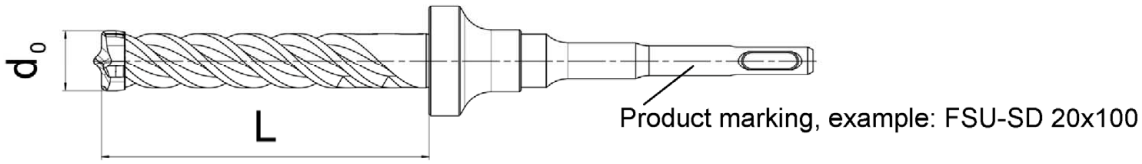



**Table A3.1:** Required stop drill bits for FSU

| Type of anchor | Type of stop drill bit | $d_0$ [mm] | L [mm] |
|---|---|---|---|
| FSU M10x100/20 | FSU-SD 20x100 | 20 | 107 |
| FSU M12x125/30 | FSU-SD 22x125 | 22 | 132 |
| FSU M12x125/50 | | | |
| FSU-P M10x100/20 | FSU-SD 20x120 | 20 | 127 |
| FSU-P M12x125/30 | FSU-SD 22x155 | 22 | 162 |
| FSU-P M12x125/50 | FSU-SD 22x175 | 22 | 182 |

## Machine setting tool FSU-ST

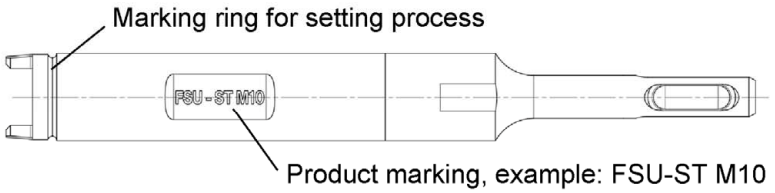



**Table A3.2:** Required setting tools for FSU

| Type of anchor | Type of setting tool |
|---|---|
| FSU M10x100/20 | FSU-ST M10 |
| FSU M12x125/30 | FSU-ST M12 |
| FSU M12x125/50 | |
| FSU-P M10x100/20 | FSU-ST M10 |
| FSU-P M12x125/30 | FSU-ST M12 |
| FSU-P M12x125/50 | |

**Table A3.3:** Recommendations for hammer drills used with FSU-ST

| Technical feature | | Recommendation |
|---|---|---|
| Drill chuck | [-] | SDS plus |
| Hammer drilling RPM | [rpm] | 600 - 1800 |
| Hammer impact energy | [J] | 2 - 5 |

*(Fig. not to scale)*

## Specifications of intended use

**Fastenings subject to:**

| Size | | FSU | | | FSU-P | | |
|---|---|---|---|---|---|---|---|
| | | **M10x100 /20** | **M12x125 /30** | **M12x125 /50** | **M10x100 /20** | **M12x125 /30** | **M12x125 /50** |
| Static and quasi-static loads | | ✓ | | | | | |
| Cracked and uncracked concrete | | | | | | | |
| Seismic performance category | C1 | | | | | | |
| | C2 | | | | | | |
| Fire exposure | | | | | | | |

**Base materials:**

- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked and uncracked) according to EN 206:2013+A2:2021
- Strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions

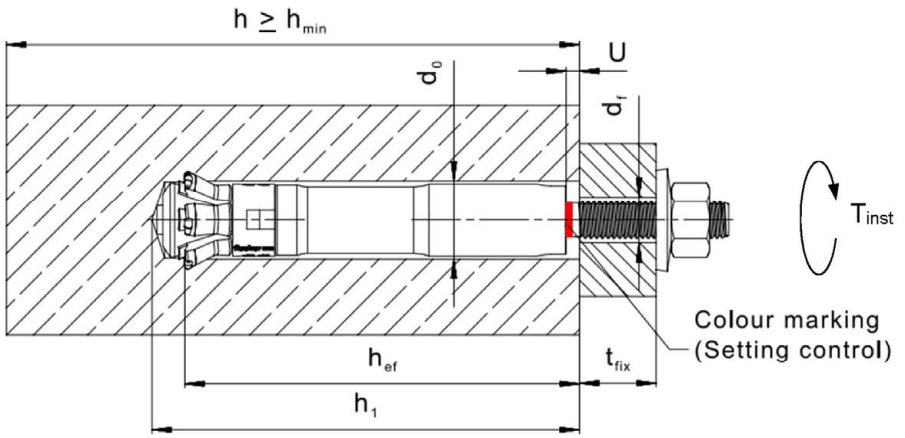
**Design:**

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- 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 in accordance with EN 1992-4:2018 and EOTA Technical Report TR 055:2018.
- For requirements to resistance to fire local spalling of the concrete cover must be avoided

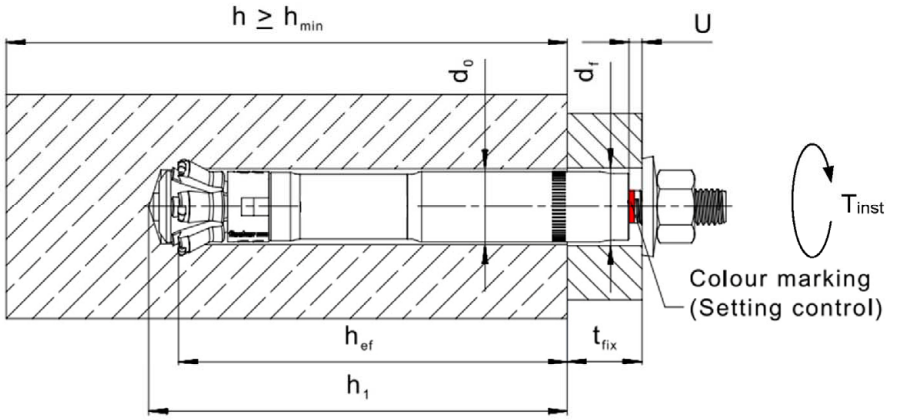
## Installation parameters

**Table B2.1:** Installation parameters

| Size | | | FSU | | | FSU-P | | |
|---|---|---|---|---|---|---|---|---|
| | | | **M10x100 /20** | **M12x125 /30** | **M12x125 /50** | **M10x100 /20** | **M12x125 /30** | **M12x125 /50** |
| Nominal drill hole diameter | $d_0$ | [mm] | 20 | 22 | 22 | 20 | 22 | 22 |
| Cutting diameter of drill bits | $d_{cut} \leq$ | | 20,5 | 22,5 | 22,5 | 20,5 | 22,5 | 22,5 |
| Depth of drill hole to deepest point | $h_1 \geq$ | | 107 | 132 | 132 | 127-$t_{fix}$ | 162-$t_{fix}$ | 182-$t_{fix}$ |
| Effective embedment depth | $h_{ef} \geq$ | | 100 | 125 | 125 | 100 | 125 | 125 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | | 12 | 14 | 14 | 21 | 23 | 23 |
| Thickness of the fixture | $t_{fix}$ | | ≤ 20 | ≤ 30 | ≤ 50 | ≥ 10 ≤ 20 | ≥ 12 ≤ 30 | ≥ 12 ≤ 50 |
| Gap after setting | U | | 2 - 5 | 3 - 6 | 3 - 6 | 2 - 5 | 3 - 6 | 3 - 6 |
| Required setting torque | $T_{inst}$ | [Nm] | 40 | 80 | 80 | 40 | 80 | 80 |




FSU



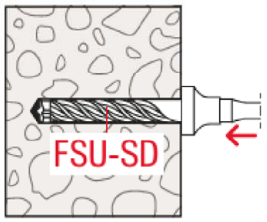

FSU-P

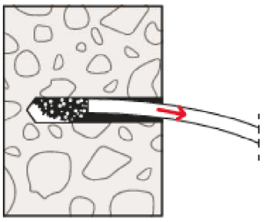
*(Fig. not to scale)*

## Installation instructions

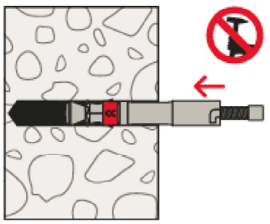
- Fastener installation carried out by appropriately qualified personnel according to the design drawings and under the supervision of the person responsible for technical matters on the site.
- Use of the fastener only as supplied by the manufacturer without exchanging the components of the fastener.
- Fastener installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools (machine setting tool FSU-ST, stop drill bit FSU-SD).
- Drill hole created perpendicular (tolerance +/- 5°) to concrete surface.
- Cleaning the hole of drilling dust.
- Fastener installation ensuring complete expansion of the sleeve with checking that the coloured ring marking on the bolt is visible above the top edge of the anchor sleeve, therefore it is required using the setting tool FSU-ST, that is the appropriate depth ring marking of the setting tool at least flush with the concrete surface (pre-setting) respecting with the fixture surface (Push-through-setting).
- Fastener installation ensuring complete shear load capacity, after setting the gap between the top edge of the sleeve and the concrete surface (pre-setting) or with surface of the fixture (Push-through-setting) has to be in the specified range according to Annex B 2, Table B2.1.
- Positioning of the drill holes and the undercut without damaging the reinforcement.
- In case of aborted hole: new drilling at a minimum distance twice the depth of the aborted drill hole or smaller distance, if the aborted drill hole is filled with high strength mortar and, if under shear or oblique tension load, it is not in the direction of load application.
- Application of the torque moment given in Annex B 2, Table B2.1 using a calibrated torque wrench.

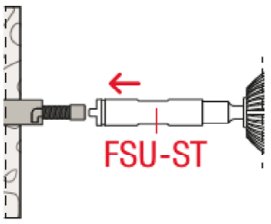
## Installation instructions for pre-setting anchor FSU

1) 

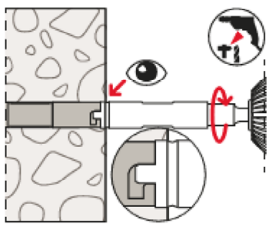

2) 

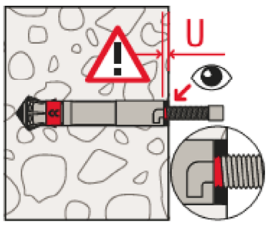
1) Drill the hole with the designated stop drill bit FSU-SD (see Table A3.1).
2) Clean the hole.

3) 

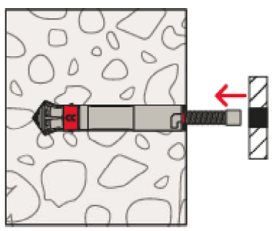
4) 

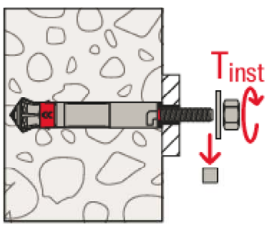

3) Place the anchor in the hole by hand. Do not use any hammering tools.
4) Use the designated setting tool FSU-ST (see Table A3.2) and follow the recommendations for the hammer drill (see Table A3.3).

5) 

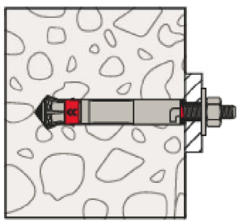
6) 


5) Place the setting tool in the grooves provided on the anchor. Carry out the setting process with the rotary-impact mode of the hammer drill. The setting process is completed when the marking ring of the setting tool is flush with the concrete surface.
6) After removing the setting tool, the red coloured ring marking on the bolt must be visible above the top edge of the anchor sleeve. The gap U between the top edge of the sleeve and the concrete surface must be in the specified range according to Table B2.1.

7) 

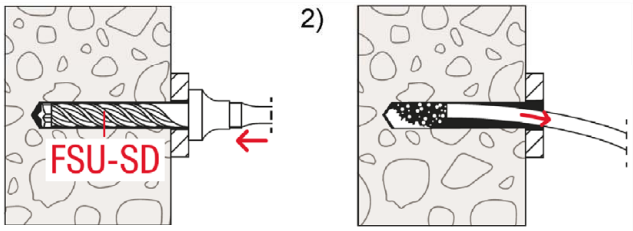
8) 


7) Place the fixture.
8) Remove the protective cap. Place the spring washer and the hexagon nut on the bolt. Take care of the right orientation of the spring washer, in the way, that the outer diameter of the washer in uncompressed condition is in touch with the fixture, only. Apply the installation torque.

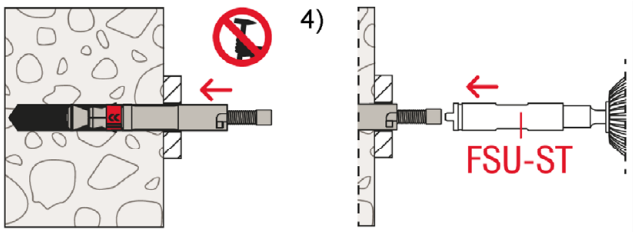
9) 

9) Correctly installed fastener.

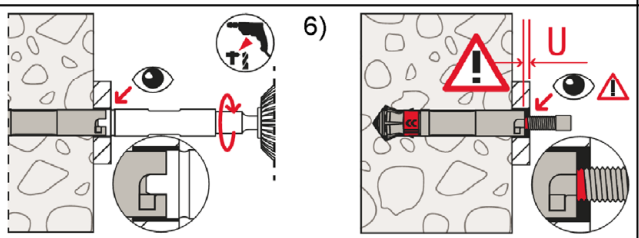
## Installation instructions for push-though anchor FSU-P



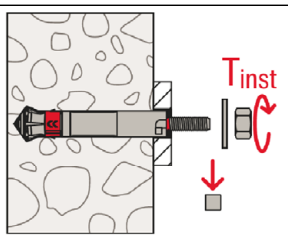

1) Drill the hole with the designated stop drill bit FSU-SD (see table A3.1) in compliance with the specified range of fixture thicknesses (see Table B2.1).
2) Clean the hole.



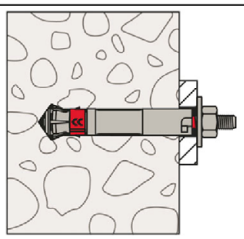

3) Place the anchor in the hole by hand. Do not use any hammering tools.
4) Use the designated setting tool FSU-ST (see Table A3.2) and follow the recommendations for the hammer drill (see Table A3.3).




5) Place the setting tool in the grooves provided on the anchor. Carry out the setting process with the rotary-impact mode of the hammer drill. The setting process is completed when the marking ring of the setting tool is flush with the fixture surface.
6) After removing the setting tool, the red coloured ring marking on the bolt must be visible above the top edge of the anchor sleeve. The gap U between the top edge of the sleeve and the fixture surface must be in the specified range according to Table B2.1.




7) Remove the protective cap. Place the spring washer and the hexagon nut on the bolt. Take care of the right orientation of the spring washer, in the way, that the outer diameter of the washer in uncompressed condition is in touch with the fixture, only. Apply the installation torque.




8) Correctly installed fastener.

**Table C1.1:** Characteristic **tension resistance** under static and quasi-static action

| Size | | | | FSU, FSU-P | |
|---|---|---|---|---|---|
| | | | | M10x100 | M12x125 |
| **Steel failure** | | | | | |
| Characteristic resistance | | $N_{Rk,s}$ | [kN] | 44,2 | 65,9 |
| Partial factor for steel failure | | $\gamma_{Ms}$ | [-] | 1,5 | |
| **Pullout failure** | | | | | |
| Characteristic resistance in C20/25 | cracked concrete | $N_{Rk,p}$ | [kN] | 30,0 | 40,0 |
| | uncracked concrete | | | 44,2 | 65,9 |
| Increasing factor for $N_{Rk,p}$ $N_{Rk,p} = \psi_c * N_{Rk,p}$ (C20/25) | | $\psi_c$ [-] | C25/30 | 1,12 | |
| | | | C30/37 | 1,22 | |
| | | | C35/45 | 1,32 | |
| | | | C40/50 | 1,41 | |
| | | | C45/55 | 1,50 | |
| | | | C50/60 | 1,58 | |
| Installation sensitivity factor | | $\gamma_{inst}$ | [-] | 1,0 | |
| **Concrete cone and splitting failure** | | | | | |
| Effective embedment depth | | $h_{ef}$ | [mm] | 100 | 125 |
| Factor for cracked concrete | | $k_{cr,N}$ | [-] | 8,9 | |
| Factor for uncracked concrete | | $k_{ucr,N}$ | | 12,7 | |
| Characteristic spacing | | $s_{cr,N}$ | [mm] | 3 x $h_{ef}$ | |
| Characteristic edge distance | | $c_{cr,N}$ | | 1,5 x $h_{ef}$ | |
| Characteristic spacing | | $s_{cr,sp}$ | | 3 x $h_{ef}$ | |
| Characteristic edge distance | | $c_{cr,sp}$ | | 1,5 x $h_{ef}$ | |
| Characteristic resistance to splitting | | $N^0_{Rk,sp}$ | [kN] | min $\{N^0_{Rk,c}; N_{Rk,p}\}$[1)] | |

[1)] $N^0_{Rk,c}$ according to EN 1992-4:2018

**Table C2.1:** Characteristic **shear resistance** under static and quasi-static action **FSU**

| Size | | | FSU | |
|---|---|---|---|---|
| | | | M10x100 | M12x125 |
| **Steel failure without lever arm** | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 26,8 | 38,2 |
| Partial factor for steel failure | $\gamma_{Ms}$ | [-] | 1,25 | |
| Factor for ductility | $k_7$ | | 1,0 | |
| **Steel failure with lever arm** | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 59,8 | 104,8 |
| Partial factor for steel failure | $\gamma_{Ms}$ | [-] | 1,25 | |
| **Concrete pryout failure** | | | | |
| Factor for pryout failure | $k_8$ | [-] | 2,0 | |
| **Concrete edge failure** | | | | |
| Effective length in concrete | $l_f$ | [mm] | 100 | 125 |
| Effective diameter of fastener | $d_{nom}$ | | 19 | 21 |

**Table C2.2:** Characteristic **shear resistance** under static and quasi-static action **FSU-P**

| Size | | | FSU-P | | | |
|---|---|---|---|---|---|---|
| | | | M10x100 | | M12x125 | |
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance | for $t_{fix}$ | [mm] | $10 \le t_{fix} < 15$ | $15 \le t_{fix} \le 20$ | $12 \le t_{fix} < 20$ | $20 \le t_{fix} \le 50$ |
| | $V^0_{Rk,s}$ | [kN] | 66,1 | 69,6 | 86,4 | 96,7 |
| Partial factor for steel failure | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Factor for ductility | $k_7$ | | 1,0 | | | |
| **Steel failure with lever arm** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 59,8 | | 104,8 | |
| Partial factor for steel failure | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| **Concrete pryout failure** | | | | | | |
| Factor for pryout failure | $k_8$ | | 2,0 | | | |
| **Concrete edge failure** | | | | | | |
| Effective length in concrete | $l_f$ | [mm] | 100 | | 125 | |
| Effective diameter of fastener | $d_{nom}$ | | 19 | | 21 | |

**Table C3.1:** Minimum thickness of concrete members **FSU**

| Size | | | FSU | | |
|---|---|---|---|---|---|
| | | | **M10x100/20** | **M12x125/30** | **M12x125/50** |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | 170 | 215 | |

**Table C3.2:** Minimum thickness of concrete members **FSU-P**

| Size | | | FSU-P | | |
|---|---|---|---|---|---|
| | | | **M10x100/20** | **M12x125/30** | **M12x125/50** |
| Maximum thickness of the fixture | $t_{fix,max}$ | [mm] | 20 | 30 | 50 |
| Minimum thickness of concrete member | $h_{min}$ | | 190-$t_{fix}$ [1)] | 245-$t_{fix}$ [1)] | 265-$t_{fix}$ [1)] |

[1)] $t_{fix}$ = actual thickness of the fixture

**Table C3.3:** Minimum spacings and edge distances

| Size | | | FSU, FSU-P | | |
|---|---|---|---|---|---|
| | | | **M10x100/20** | **M12x125/30** | **M12x125/50** |
| Minimum spacing | $s_{min}$ | [mm] | 80 | 90 | |
| Minimum edge distance | $c_{min}$ | | 80 | 90 | |

**Table C4.1:** Characteristic **tension resistance** under **fire exposure**

| Size | | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|---|
| Characteristic resistance **steel failure** | $N_{Rk,s,fi}$ | R30 | [kN] | 3,7 | 4,5 |
| | | R60 | | 2,2 | 3,2 |
| | | R90 | | 1,7 | 2,8 |
| | | R120 | | 1,5 | 2,6 |
| Characteristic resistance **Concrete cone failure** | $N_{Rk,c,fi}$ | R30-R90 | | 19,9 | 34,8 |
| | | R120 | | 15,9 | 27,7 |
| Characteristic resistance **pullout failure** | $N_{Rk,p,fi}$ | R30-R90 | | 7,5 | 10,0 |
| | | R120 | | 6,0 | 8,0 |

**Table C4.2:** Characteristic **shear resistance** under **fire exposure**

| Size | | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|---|
| Characteristic resistance **steel failure without lever arm** | $V_{Rk,s,fi}$ | R30 | [kN] | 3,7 | 4,4 |
| | | R60 | | 2,2 | 3,0 |
| | | R90 | | 1,7 | 2,6 |
| | | R120 | | 1,5 | 2,3 |
| Characteristic bending resistance **steel failure with lever arm** | $M^0_{Rk,s,fi}$ | R30 | [Nm] | 4,8 | 6,9 |
| | | R60 | | 2,9 | 5,0 |
| | | R90 | | 2,2 | 4,4 |
| | | R120 | | 1,9 | 4,0 |

Concrete pryout failure according to EN 1992-4:2018

**Table C4.3:** **Minimum spacings** and **minimum edge distances** under **fire exposure** for **tension** and **shear** load

| Size | | | FSU, FSU-P All sizes |
|---|---|---|---|
| Spacing | $s_{min,fi}$ | [mm] | $4 \cdot h_{ef}$ |
| Edge distance | $c_{min,fi}$ | | $c_{min,fi} = 2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min,fi} \geq 300$ mm |

**Table C5.1:** Characteristic values of **tension** and **shear resistance** under **seismic performance category C1**

| **Size** | | | | **FSU, FSU-P** | | | |
|---|---|---|---|---|---|---|---|
| | | | | **M10x100** | | **M12x125** | |
| Factor for annular gap | Without filling of annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | |
| **Steel failure** | | | | | | | |
| Characteristic resistance tension load C1 | | $N_{Rk,s,C1}$ | [kN] | 44,2 | | 65,9 | |
| **Pullout failure** | | | | | | | |
| Characteristic resistance tension load in cracked concrete C1 | | $N_{Rk,p,C1}$ | [kN] | 30,0 | | 40,0 | |
| **Steel failure without lever arm** | | | | | | | |
| Characteristic resistance shear load C1 | for $t_{fix}$ | | [mm] | $10 \le t_{fix} < 15$ | $15 \le t_{fix} \le 20$ | $12 \le t_{fix} < 20$ | $20 \le t_{fix} \le 50$ |
| | $V_{Rk,s,C1}$ FSU | | [kN] | 18,8 | | 26,8 | |
| | $V_{Rk,s,C1}$ FSU-P | | | 46,3 | 48,7 | 60,5 | 67,7 |

**Table C5.2:** Characteristic values of **tension** and **shear resistance** under **seismic performance category C2**

| **Size** | | | | **FSU, FSU-P** | | | |
|---|---|---|---|---|---|---|---|
| | | | | **M10x100** | | **M12x125** | |
| Factor for annular gap | Without filling of annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | |
| **Steel failure** | | | | | | | |
| Characteristic resistance tension load C2 | | $N_{Rk,s,C2}$ | [kN] | 44,2 | | 65,9 | |
| **Pullout failure** | | | | | | | |
| Characteristic resistance tension load in cracked concrete C2 | | $N_{Rk,p,C2}$ | [kN] | 30,0 | | 40,0 | |
| **Steel failure without lever arm** | | | | | | | |
| Characteristic resistance shear load C2 | for $t_{fix}$ | | [mm] | $10 \le t_{fix} < 15$ | $15 \le t_{fix} \le 20$ | $12 \le t_{fix} < 20$ | $20 \le t_{fix} \le 50$ |
| | $V_{Rk,s,C2}$ FSU | | [kN] | 20,1 | | 24,5 | |
| | $V_{Rk,s,C2}$ FSU-P | | | 39,6 | 41,8 | 51,8 | 62,9 |

**Table C6.1: Displacements** under static and quasi-static **tension** loads

| Size | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|
| Tension load in cracked concrete C20/25 | N | [kN] | 22,1 | 32,1 |
| Displacements | $\delta_{N0}$ | [mm] | 1,1 | 1,3 |
| | $\delta_{N\infty}$ | | 2,8 | 3,0 |
| Tension load in uncracked concrete C20/25 | N | [kN] | 22,1 | 32,1 |
| Displacements | $\delta_{N0}$ | [mm] | 1,1 | 1,3 |
| | $\delta_{N\infty}$ | | 2,3 | 2,3 |

**Table C6.2: Displacements** under static and quasi-static **shear** loads

| Size | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|
| Shear load in cracked and uncracked concrete C20/25 | V | [kN] | 13,8 | 21,3 |
| Displacements FSU | $\delta_{V0}$ | [mm] | 5,4 | 6,7 |
| | $\delta_{V\infty}$ | | 8,0 | 10,0 |
| Shear load in cracked and uncracked concrete C20/25 | V | [kN] | 36,3 | 52,2 |
| Displacements FSU-P | $\delta_{V0}$ | [mm] | 5,9 | 7,2 |
| | $\delta_{V\infty}$ | | 8,8 | 10,7 |

**Table C6.3: Displacements** under **tension** loads for **seismic performance category C2**

| Size | | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|---|
| Displacement | DLS | $\delta_{N,C2}$ | [mm] | 4,6 | 4,6 |
| | ULS | | | 11,4 | 10,4 |

**Table C6.4: Displacements** under **shear** loads for **seismic performance category C2**

| Size | | | | FSU, FSU-P M10x100 | FSU, FSU-P M12x125 |
|---|---|---|---|---|---|
| Displacement FSU | DLS | $\delta_{V,C2}$ | [mm] | 5,2 | 5,0 |
| | ULS | | | 7,3 | 6,7 |
| Displacement FSU-P | DLS | $\delta_{V,C2}$ | [mm] | 4,8 | 5,0 |
| | ULS | | | 10,7 | 18,5 |