Deutsches Institut für Bautechnik
DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-15/0476 of 19 September 2022

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	TUF-S
Product family to which the construction product belongs	Fastener for the rear fixing of facade panels made of high-pressure decorative laminates (HPL) according to EN 438-7:2005
Manufacturer	SFS Group Schweiz AG Rosenbergsaustrasse 10 CH - 9435 Heerbrugg SCHWEIZ
Manufacturing plant	Plants of SFS Group Schweiz AG
This European Technical Assessment contains	17 pages including 4 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 330030-00-0601, Edition 10/2018
This version replaces	ETA-15/0476 issued on 1 June 2022

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Specific Part

1 Technical description of the product

The TUF-S-6xL is special anchor made of stainless steel for fixing HPL-facade panels according to EN 438-7:2005 to metal substructures. The anchor consists of a mandrel made of carbon steel zinced and a stainless steel sleeve. The anchor is put in a drill hole and placed by pulling out the mandrel. The pull out of the mandrel widens the body of the sleeve and punches the thread of the sleeve into the façade panel.

The product description is given in Annex A. The material values, dimensions and tolerances of the components of the fastener not indicated in the annexes shall correspond to the values laid down in the technical documentation.

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 fastener 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 fasteners 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 breakout or pull-out failure under tension load	See Annex C 1 and C 2
Characteristic resistance to breakout or pull-out failure under shear load	See Annex C 1 and C 2
Characteristic resistance to breakout or pull-out failure under combined tension and shear load	See Annex C 1 and C 2
Edge distance and spacing	See Annex C 1 and C 2
Durability	Corrosion Resistance Class (CRC) III in accordance with EN 1993-1-4:2015
Characteristic resistance to steel failure under tension and shear loads	See Annex C 2

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

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

In accordance with EAD No. 330030-00-0601 the applicable European legal act is: [97/161/EG].

The system to be applied is: 2+

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 with Deutsches Institut für Bautechnik.

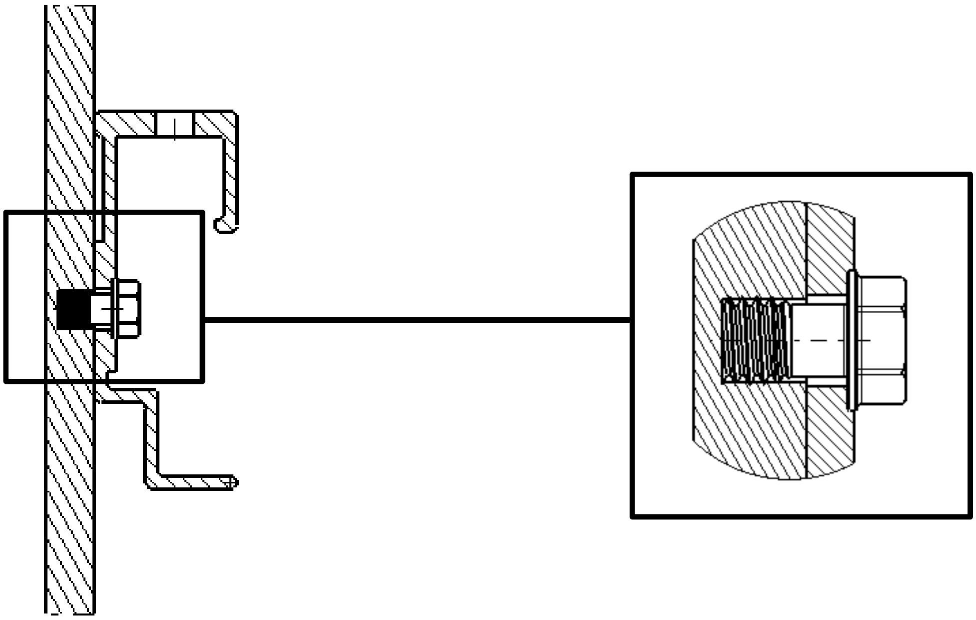
Issued in Berlin on 19 September 2022 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

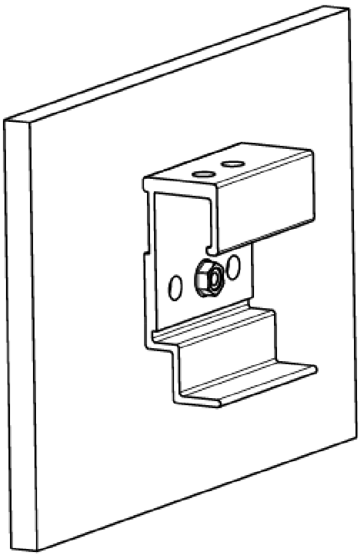
beglaubigt:
Aksünger

Deutsches Institut für Bautechnik DIBt

Installed Anchor



Fixing example



TUF-S	Annex A 1
Product description Installed anchor and fixing example	

Fastener

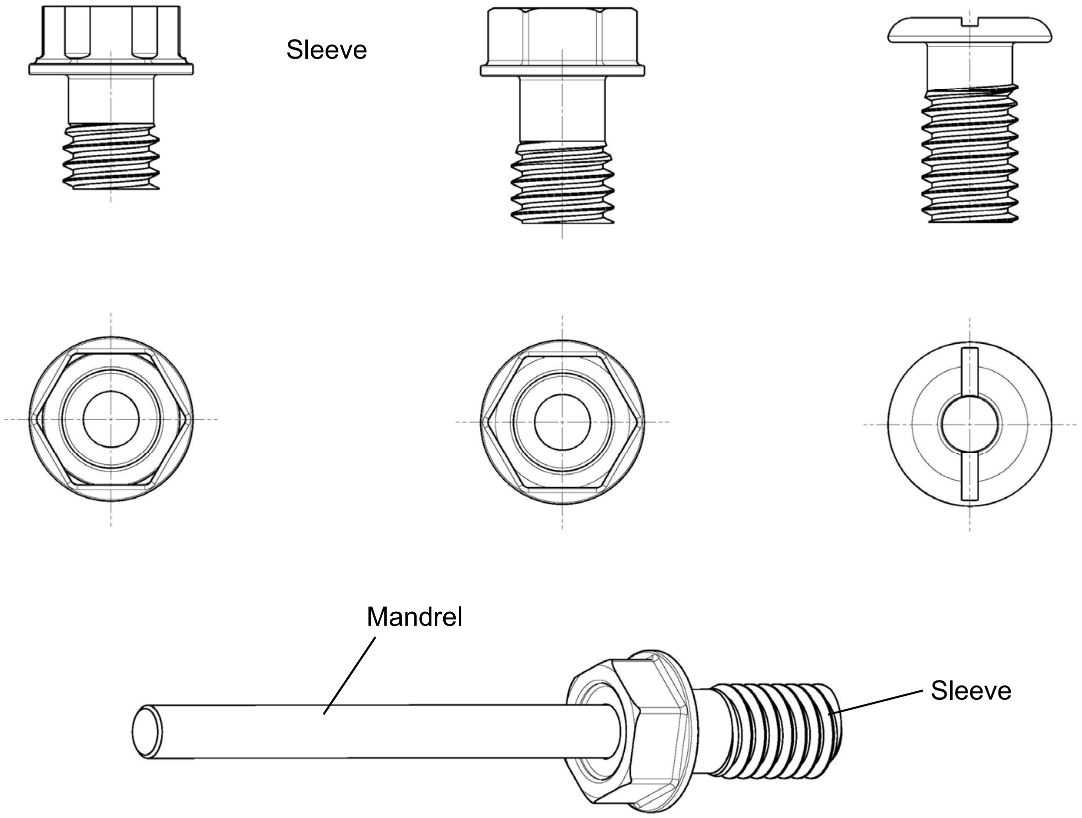


Table 1

Anchor parts	**Material**
Sleeve	Stainless steel A4
Mandrel	Carbon steel zinced

TUF-S	Annex A 2
Product description System components	

Specifications of intended use

Anchorages subject to

- Static and quasi-static loads

Base material

- The HPL façade panels shall be classified “EDS” or “EDF” in accordance with EN 438-6:2014
- The minimum requirements for the façade panels are documented in the following table

Table 2: Minimum requirements for the façade panel

Characteristic values for the facade panel	Thickness of the panel	h ≥	[mm]	8
	Bending stress [1]	$\sigma_{fm,T}$ [2]	N/mm²	≥ 100
		$\sigma_{fm,L}$ [2]		≥ 130
	Bending modulus	E_T [3]	N/mm²	10000
		E_L [3]		14000
	Maximum mass increase in accordance with EN 438-2:2016-06, section 15 (Resistance to wet conditions)	δ_w	[%]	2,00

1) σ_{fm} in accordance with EN ISO 178:2013-09
2) $\sigma_{fm,T}$: Bending strength transverse
$\sigma_{fm,L}$: Bending strength longitudinal
3) E_T : Bending modulus transverse
E_L : Bending modulus longitudinal

Use conditions (Environmental conditions):

- In accordance with EN 1993-1-4:2015 according to the Corrosion Resistance Class (CRC) of the fastener III

Design:

- The design of the façade panels and their fixing is carried out according to the conditions given in Annex D 1 and D 2.

TUF-S	Annex B 1
Intended use Specifications	

Installation

- Each façade panel shall be fixed technically strain-free with at least four anchors in a rectangular arrangement.
- The substructure is constructed such that the façade panels are fixed technically strain free via skids (loose bearings) and one fixed point (fixed bearing).
- The thickness of the fixing member (clamp or panel load-bearing profile) shall be at least 2,0 mm and shall be at least made of aluminum with $R_m \geq 215$ N/mm^2.
- The drillings are done at the factory or on site. The drillings are executed with special drill bits made available by SFS intec AG. The drillings are executed by skilled personnel.
- The façade panel is pre-drilled with diameter Ø 5,9 mm to 6,0 mm.
- The drilling is always in a 90°- angle to the panel's surface.
- The minimum edge distance of the drilling is 40,0 mm.
- The clamps are predrilled with diameter Ø 6,5 mm to 7,0 mm.
- The geometry of the drill hole shall be checked minimum on 1 % of all drillings.
- The façade panels, their fixings as well as the substructure including its connection to wall brackets and their connection to the construction works are designed for the respective case of application under the responsibility of an engineer skilled in the field of façade construction.
- The panels are installed by skilled specialists and the laying instructions of the manufacturer shall be paid attention to.
- Overhead mounting is for façade panels of Trespa International B.V and Fundermax GmbH allowed.

TUF-S	Annex B 2
Intended use Requirements to the HPL-facade panels	

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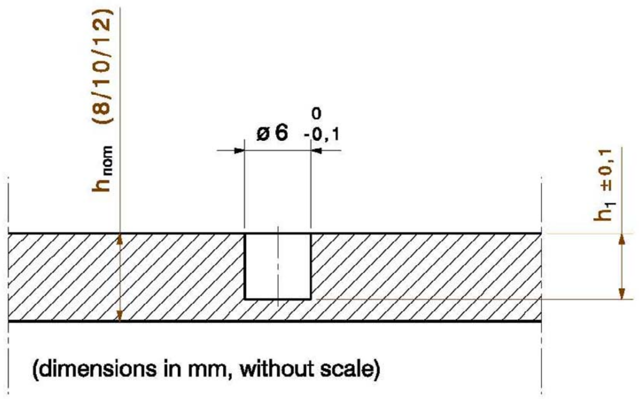
Drill hole geometry and drill bit

Drill hole geometry

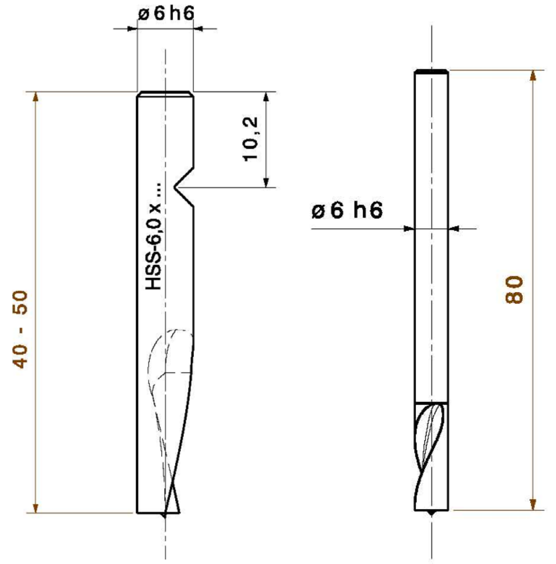


h_{nom}	8 / 10 / 12			10 / 12			
h_1	5	5.5	6	6.5	7	7.5	8
h_s	5	5.5	6	6.5	7	7.5	8

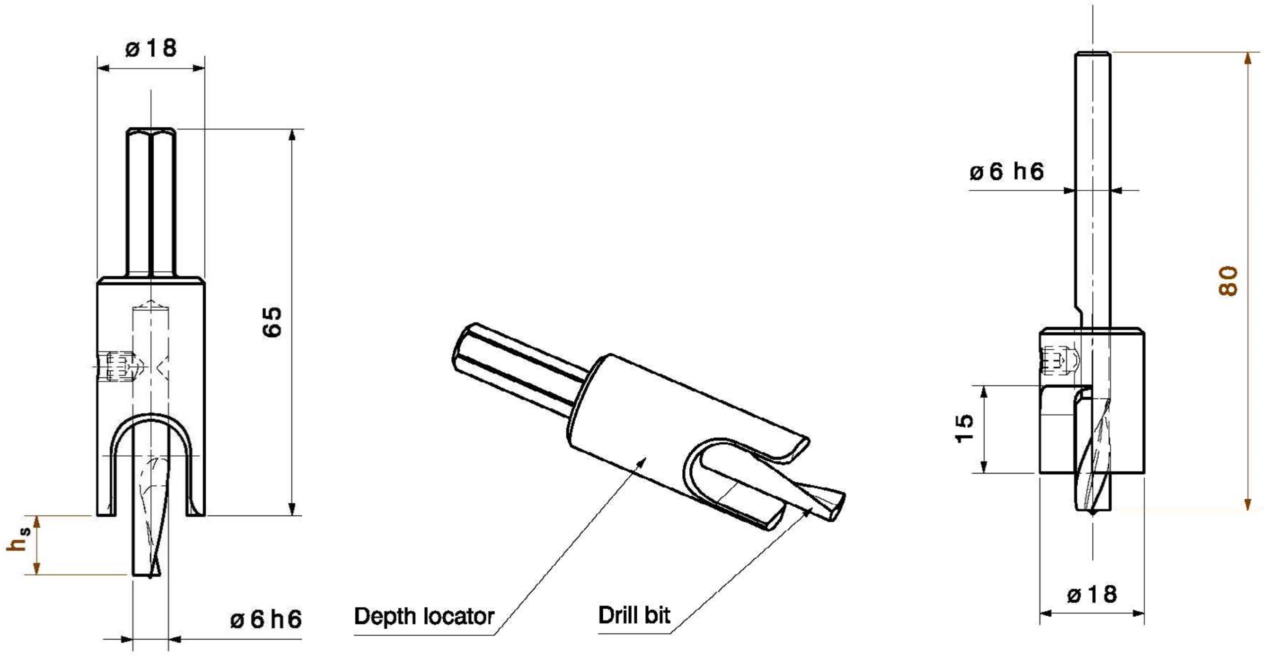
h_{nom} = Panel nominal thickness
h_s = anchorage depth
h_1 = depth of drill hole

special drill bit

HSS-6xL

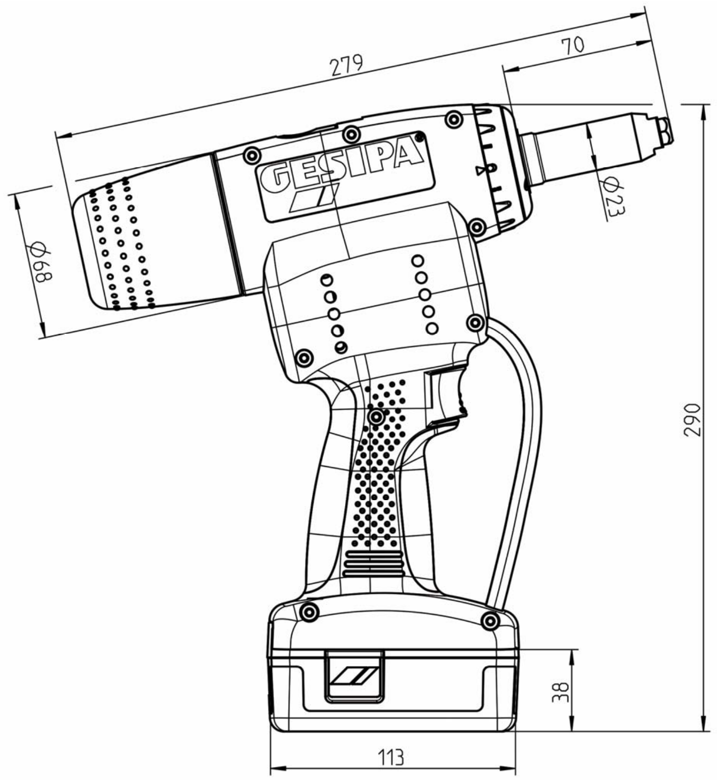


Depth locator and Drill bit

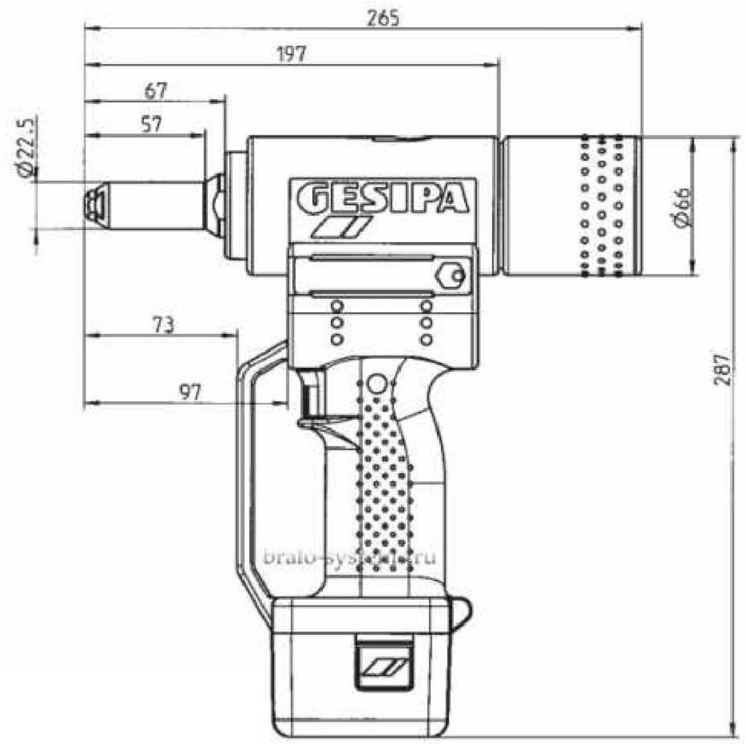


TUF-S	Annex B 3
Intended use Drill hole dimensions and drill bit	

Setting tools



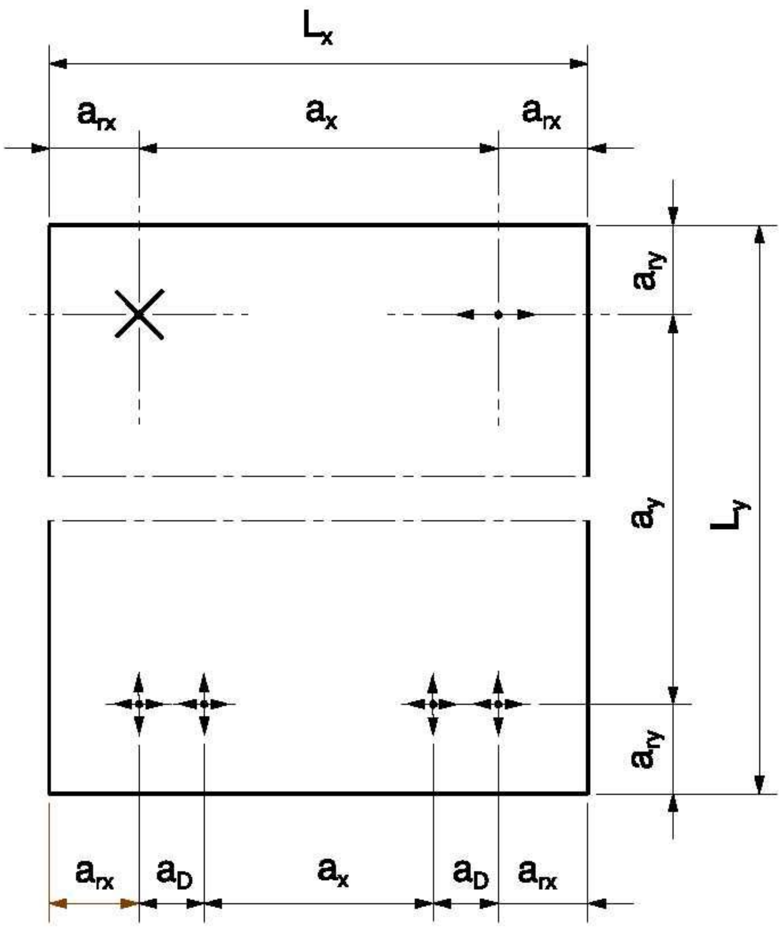
Riveting tool
GESIPA PowerBird Pro



Riveting tool
GESIPA PowerBird

TUF-S	Annex B 4
Intended use Setting tool	

Definition of edge distance and spacing



Legend:

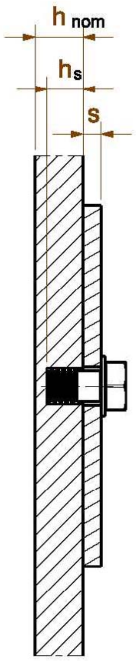
$a_{rx,y}$ = edge distance – distance of an anchor to the panel edge
$a_{x,y}$ = spacing between outer anchors in adjoining groups or between single anchors distance between anchors
a_D = spacing of anchors in an anchor group
L_x = greater length of the façade panel
L_y = smaller length of the façade panel
✕ = fixed point (fixed bearing)
↔ = horizontal skid (loose bearing)
✥ = horizontal and vertical skid (loose bearing)

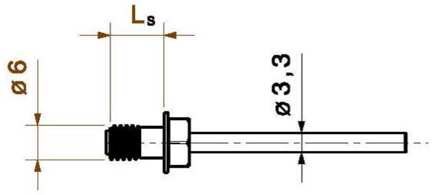
TUF-S

Intended use
Definition of edge distance and spacing

Annex B 5

Installation parameters





h_{nom} = Panel nominal thickness
h_s = anchorage depth
s = bracket thickness
L_s = length TUF-S
[h_s + s = Ls]

TUF-S-6X7-A4

TUF…name product
S…….stainless steel
6…….∅ (diameter)
7…….L_s (length)
A4…..stainless steel A4 material

Table 4

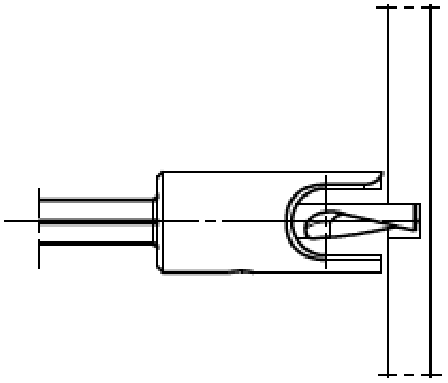
Panel nominal thickness	Bracket thickness	anchorage depth	TUF-S
8,0 mm	2,0 mm	5,0 mm	TUF-S-6x7-A4
		5,5 mm	TUF-S-6x7.5-A4
		6,0 mm	TUF-S-6x8-A4
	2,5 mm	5,0 mm	TUF-S-6x7.5-A4
		5,5 mm	TUF-S-6x8-A4
		6,0 mm	TUF-S-6x8.5-A4
	3,0 mm	5,0 mm	TUF-S-6x8-A4
		5,5 mm	TUF-S-6x8.5-A4
	3,5 mm	5,0 mm	TUF-S-6x8.5-A4
		5,5 mm	TUF-S-6x9-A4
	5,0 mm	5,0 mm	TUF-S-6x10-A4
		6,0 mm	TUF-S-6x11-A4
10,0 mm	3,0 mm	6,0 mm	TUF-S-6x9-A4
		7,0 mm	TUF-S-6x10-A4
		8,0 mm	TUF-S-6x11-A4
	3,5 mm	6,5 mm	TUF-S-6x10-A4
		7,5 mm	TUF-S-6x11-A4
	5,0 mm	7,0 mm	TUF-S-6x12-A4
		8,0 mm	TUF-S-6x13-A4
12.0 mm - 13.0 mm	3,0 mm	8,0 mm	TUF-S-6x11-A4
	3,5 mm	8,5 mm	TUF-S-6x12-A4
	5,0 mm	8,0 mm	TUF-S-6x13-A4

TUF-S

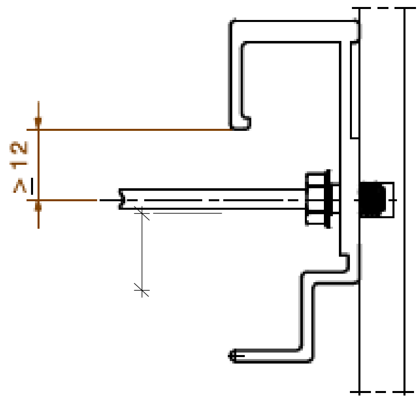
Intended use
Installation parameters

Annex B 6

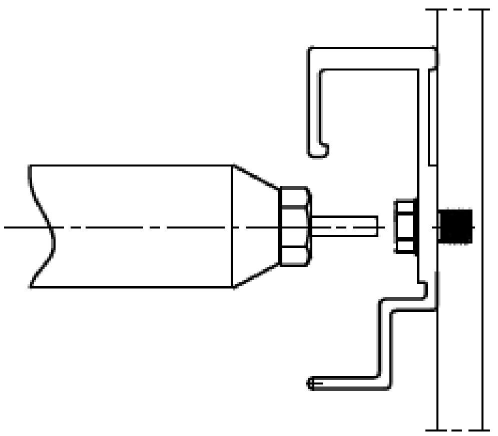
Installation instructions



Pilot drilling in the panel with the
6 mm dia. HSS drill bit with depth locator
or CNC machine



Position the pre-drilled bracket over the
hole in the panel and push through the TUF-S
blind fastener



Apply pressure with the rivet setting tool during the
setting process.
Remove the mandrel completely with the riveting
tool (GESIPA PowerBird, PowerBird Pro,
use nosepiece 17/36 or 17/40)

TUF-S	Annex B 7
Intended use Installation instructions	

Characteristic value of the anchor

Table 5: Characteristic values of the anchor with single clamp

Single clamp												
Characteristic values for the anchor	Setting depth 2)			[mm]	5,0	5,5	6,0	6,5	7,0	7,5	8,0
	Characteristic resistance	Tension 1)	N_{Rk}	[kN]	1,12	1,26	1,40	1,65	1,90	1,97	2,04
		Shear	V_{Rk}	[kN]	2,78	2,89	2,99	3,28	3,57	3,79	4,00
	Partial safety factor		γ_M 3)	[-]	1,8						
	Edge distance		a_r	[mm]	≥ 40						
	Spacing		a	[mm]	≥ 100						
	Value for tri-linear function with combined tension and shear load		X	[-]	1,0						

Table 6: Characteristic values of the anchor with double clamp (20,0 mm ≤ a_D < 40,0 mm)

Double clamp with 20,0 mm ≤ a_D < 40,0 mm											
Characteristic values for two anchors	Setting depth 2)			[mm]	5,0	5,5	6,0	6,5	7,0	7,5	8,0
	Characteristic resistance	Tension 1)	N_{Rk}	[kN]	1,93	2,03	2,11	2,41	2,71	2,71	2,71
		Shear	V_{Rk}	[kN]	4,85	4,85	4,85	5,83	6,80	6,80	6,80
	Partial safety factor		γ_M 3)	[-]	1,8						
	Edge distance		a_r	[mm]	≥ 40						
	Spacing		a	[mm]	≥ 100						
	Value for tri-linear function with combined tension and shear load		X	[-]	1,0						

1) Values valid for bending angle of the façade panels ß ≤ 1,0° (Definition of ß see Annex D 1)
2) A minimum remaining panel thickness (panel thickness - setting depth) of 2,0 mm is required. For intermediate values of the setting depth, linear interpolation is possible.
3) In absence of national regulations.

Table 7: Characteristic values of the anchor with double clamp (40,0 mm ≤ a_D < 100,0 mm)

Double clamp with 40,0 mm ≤ a_D < 100,0 mm												
Characteristic values for two anchors	Setting depth [2]			[mm]	5,0	5,5	6,0	6,5	7,0	7,5	8,0
	Characteristic resistance	Tension [1]	N_{Rk}	[kN]	2,07	2,26	2,44	3,17	3,89	3,89	3,89
		Shear	V_{Rk}	[kN]	4,85	4,85	4,85	5,83	6,80	6,80	6,80
	Partial safety factor		γ_M [3]	[-]	1,8						
	Edge distance		a_r	[mm]	≥ 40						
	Spacing		a	[mm]	≥ 100						
	Value for tri-linear function with combined tension and shear load		X	[-]	1,0						

[1] Values valid for bending angle of the façade panels ß ≤ 1,0° (Definition of ß see Annex D 1)
[2] A minimum remaining panel thickness (panel thickness - setting depth) of 2,0 mm is required. For intermediate values of the setting depth, linear interpolation is possible.
[3] In absence of national regulations.

Table 8: Characteristic resistance for steel failure

Size			**TUF-S-6xL**
Characteristic resistance under tension load	$N_{Rk,s}$	[kN]	7,19
Partial safety factor	γ_{Ms} [3]	[-]	2,5
Characteristic resistance under shear load	$V_{Rk,s}$	[kN]	5,23
Partial safety factor	γ_{Ms} [3]	[-]	2,5

[3] In absence of national regulations.

Design method

Loads

The design loads shall be calculated on basis of EN 1990:2010. The combination of loads shall be equal to EN 1990:2010. The loads shall be specified in accordance with EN 1991-1-1:2010 to EN 1991-1-7:2010.
Corresponding national regulations shall be taken into consideration. The unfavorable combination is decisive. Where necessary for the design of the anchor and the façade panel several combinations shall be analyzed separately.
The typical fundamental combination for façade panels considers loads from dead load $F_{Ek,G}$ (permanent loads) and wind $F_{Ek,w}$ (leading variable load)

In accordance with EN 1990:2010 the following fundamental combination depending on the load direction results for a vertical façade panel:

Fundamental combination for loads parallel to the panel: $F_{Ed\parallel} = F_{Ek,G} \cdot \gamma_G$

Fundamental combination for loads perpendicular to the panel: $F_{Ed\perp} = F_{Ek,w} \cdot \gamma_Q$

mit $\gamma_G = 1{,}35$; $\gamma_Q = 1{,}50$

Resistance:

$$N_{Rd} = \frac{N_{Rk}}{\gamma_M} \bullet \alpha_{F0} \bullet \alpha_{bend} \bullet \alpha_{wet} \bullet \alpha_{oh}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_M} \bullet \alpha_{F0} \bullet \alpha_{wet}$$

$$\sigma_{Rd} = \frac{\sigma Rk}{\gamma M}$$

with:

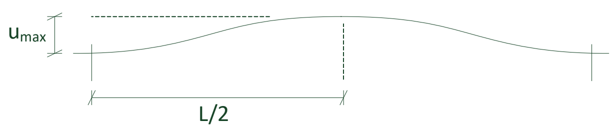
N_{Rk} = characteristic tension resistance in accordance with Annex C 1, Table 5 to 7
V_{Rk} = characteristic shear resistance in accordance with Annex C 1, Table 5 to 7
σ_{Rk} = characteristing bending stress in accordance with EN 438:2005
α_{F0} = If the façade panels do not meet the minimum requirements in accordance with Annex B 1, Table 2, the characteristic values of load bearing capacity have to be multiplied additionally by α_{F0}:

$$\alpha_{F0} = \min\left\{\frac{\sigma_{f,L,min}}{130\ N/mm^2}; \frac{E_{L,min}}{14000\ N/mm^2}; \frac{\sigma_{f,T,min}}{100\ N/mm^2}; \frac{E_{T,min}}{10000\ N/mm^2}; 1\right\}$$

α_{bend} = reduction factor of bearing of facade panel

The bending angle of the façade panel

$$ß = \arctan\left(\frac{u_{max}}{L/2}\right)$$



ß ≤ 1,0° => $\alpha_{bend} = 1{,}0$
1,0° < ß ≤ 1,5° => $\alpha_{bend} = 0{,}89$
1,5° < ß ≤ 2,0° => $\alpha_{bend} = 0{,}80$

α_{wet} = If the façade panels do not meet the minimum requirements regarding the maximum mass increase of $\delta_w = 2.0$ % according to Table 2, the characteristic values of load bearing capacity have to be multiplied additionally by $\alpha_{wet} = 0{,}78$.
α_{oh} = Overhead mounting, the characteristic tension resistance shall be reduced with 0,9

γ_M = 1,8

TUF-S	Annex D 1
Informativ Design method	

Verification

The calculation shall be carried out in a linear elastic manner. The stiffness of the substructure shall be considered for the respective case of application.

For the determined anchor loads it shall be verified, that the following equations are met.

Equation 1: $\frac{N_{Ed}}{N_{Rd}} \leq 1$

Equation 2: $\frac{V_{Ed}}{V_{Rd}} \leq 1$

Equation 3: $\frac{V_{Ed}}{V_{Rd}} + \frac{N_{Ed}}{N_{Rd}} \leq X$

with:

N_{Ed} = design value of the tensile force acting on the anchor

V_{Ed} = design value of the shear force acting on the anchor

N_{Rd} = design value of the tensile load bearing capacity of the anchor

V_{Rd} = design value of the shear load bearing capacity of the anchor

X = see Annex C 1

For the determined panel loads it shall be verified, that the following equation according is met:

Equation 4: $\frac{\sigma_{Ed}}{\sigma_{Rd}} \leq 1$

with:

σ_{Ed} = design value of the bending stress of the façade panel

σ_{Rd} = design value of the bending stress resistance of the façade panel

Verification to steel failure

$$\frac{N_{Ed}}{N_{Rd,s}} \leq 1{,}0$$

$$\frac{V_{Ed}}{V_{Rd,s}} \leq 1{,}0$$

$$\left(\frac{N_{Ed}}{N_{Rd,s}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd,s}}\right)^2 \leq 1{,}0$$

N_{Ed}: Design value of the tensile force

$N_{Rd,s}$: design value of steel failure under tension load

$N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$

$N_{Rk,s}$: Characteristic resistance to steel failure under tension

V_{Ed}: design value of the shear force

$V_{Rd,s}$: design value of steel failure under shear load

$V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$

$V_{Rk,s}$: Characteristic resistance to steel failure shear load