Deutsches Institut für Bautechnik

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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-20/0530 of 18 September 2020

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	Hilti threaded stud S-BT
Product family to which the construction product belongs	Threaded studs for connection of materials to structural steel and aluminium members
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti AG - Plant 1
This European Technical Assessment contains	17 pages including 13 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 333037-00-0602

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Specific part

1 Technical description of the product

The Hilti S-BT screw-in threaded studs are mechanical fasteners made of corrosion resistant stainless steel or galvanized and coated carbon steel with metric threads M8 or M10 for attachment of supported materials on one end, and a threaded tip on the other end which taps its own internal mating threads for embedment into the supporting steel or aluminium.

The Hilti S-BT screw-in threaded studs require a pre-drilled hole in the supporting steel or aluminium. The screw-in threaded studs are completed with a sealing washer, which consists of a metal washer with a sealing ring made of chloroprene rubber. The purpose of the sealing washer is to protect the pre-drilled location in the base material against corrosion.

For pre-drilling the hole in the base material, the corresponding stepped drill bit shall be used to achieve a defined hole geometry (hole depth and diameter). In order to ensure the exact screw-in depth and a proper compressed sealing washer, the S-BT studs have to be installed with the appropriate depth gauge and screw-driver.

The product description and installation condition are given in Annex A3.

2 Specification of the intended use in accordance with the applicable European Assessment Document 333037-00-0602

The intended use of Hilti threaded studs S-BT is specified in Annex B1.

The performances given in section 3 are only valid if the threaded studs are used in compliance with the specifications and conditions given in Annexes B1 to B5.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the threaded studs of at least 25 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
Tension resistance	see Annex C1
Shear resistance of individual threaded studs	see Annexes C2 and C3
Shear Resistance of groups of threaded stud connections	see Annexes C2 and C3
Bending moment resistance	see Annex C4
Resistance in case of combined loading (interaction)	see Annex B2
Application limits	see Annexes B1, B3 and C1 to C4
Fatigue classification of base material	Detail category 100, m = 5 acc. to EN 1993-1-9 see Annexe C4

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1 - EN 13501-1
Resistance to fire	no performances assessed

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

In accordance with EAD No. 333037-00-0602 the applicable European legal act is: 1998/214/EC amended by 2001/596/EC

The system(s) to be applied is (are): 2+

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

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 18 September 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Hahn

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Terms and symbols used in this ETA

General

Fixed material (component I)	=	component to be fixed to the base material
Base material (component II)	=	member made from steel or aluminium, into which the threaded studs are screwed-in

Threaded stud and threaded stud connections

L	=	total length of the threaded stud
L_1	=	length of the fastening thread incl. the hexagon head
d_1	=	nominal diameter of threaded tip screwed-in to the base material
d_2	=	thread diameter of the threaded stud or flange nut
d_a	=	outer diameter of the flange nut
d_w	=	outer diameter of the sealing washer
SW	=	width across flats
h_{NVS}	=	fastener standoff (distance from top of the threaded stud to the surface of either coated or uncoated base material)
c	=	edge distance
s	=	spacing
T	=	installation torque of the flange nut, grating fastener or checker plate fastener

Fixed material (component I) and base material (component II)

t_I	=	thickness of fixed material (component I)
t_{II}	=	thickness of base material (component II)
t_c	=	coating thickness of base material (component II)
d_c	=	diameter of the clearance hole in the fixed material (component I)

Design

N_{Rk}	=	characteristic tension resistance
$N_{Rk,I}$	=	characteristic pull-over resistance of fixed material (component I)
$N_{Rk,II}$	=	characteristic tension resistance, addressing pull-out from base material (component II) and fastener failure
V_{Rk}	=	characteristic shear resistance
$V_{Rk,I}$	=	characteristic bearing resistance of fixed material (component I)
$V_{Rk,II}$	=	characteristic shear resistance, addressing failure of base material (component II) and fastener failure
$V_{Rk,II,g}$	=	characteristic shear resistance of a group of fasteners, addressing failure of base material (component II) and fastener failure
M_{Rk}	=	characteristic bending resistance

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Terms and symbols	Annex A1

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Design (continued)

N_{Rd}	=	design tension resistance
$N_{Rd,I}$	=	design pull-over resistance of fixed material (component I)
$N_{Rd,II}$	=	design tension resistance, addressing pull-out from base material (component II) and fastener failure
V_{Rd}	=	design shear resistance
$V_{Rd,I}$	=	design bearing resistance of fixed material (component I)
$V_{Rd,II}$	=	design shear resistance, addressing failure of base material (component II) and fastener failure
$V_{Rd,II,g}$	=	design shear resistance of a group of fasteners, addressing failure of base material (component II) and fastener failure
M_{Rd}	=	design bending resistance
N_{Ed}	=	design value of the acting tensile force
V_{Ed}	=	design value of the acting shear force
M_{Ed}	=	design value of the acting bending moment
α	=	reduction factor to consider the group effect
n	=	total number of threaded studs in a group of fasteners
γ_M	=	partial factor
γ_{MII}	=	partial factor for considering base material variations
$\Delta\sigma_C$	=	reference value of the fatigue strength at $N_C = 2 \cdot 10^6$ cycles
m	=	slope of fatigue strength curve

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Terms and symbols (continued)	Annex A2

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Product description: Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF

Figure A1: S-BT-MR, S-BT-MF

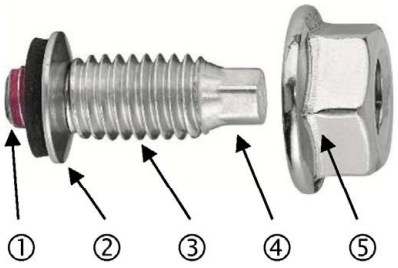


Figure A2: S-BT-GR, S-BT-GF

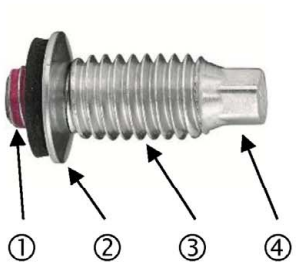


Table A1: Product description

Position	Description
①	Screw-in thread with thread lock
②	Sealing washer consisting of metal washer with vulcanized sealing ring made of chloroprene rubber
③	Fastening thread
④	Hexagon head with embossing (head mark) Stainless steel S-BT-MR and S-BT-GR: **HI** Coated carbon steel S-BT-MF and S-BT-GF: **H**
⑤	Flange nut

Installed condition

Figure A3: S-BT-MR, S-BT-MF

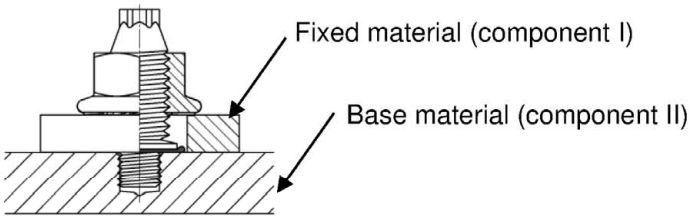
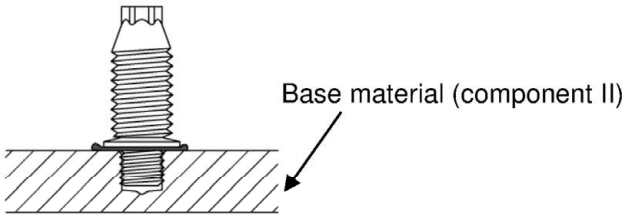


Figure A4: S-BT-GR, S-BT-GF



The threaded studs S-BT-MR and S-BT-MF are always supplied with the corresponding flange nut, which shall be used for fastening the fixed material.

The threaded studs S-BT-GR and S-BT-GF are intended for fixing gratings or floor plates and are combined with a suitable grating plate or checker plate fastener after installation. The threaded studs S-BT-GR and S-BT-GF are not supplied with a flange nut. The grating plate and checker plate fastener are not part of this ETA.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Product description and installed condition	Annex A3

Dimensions:

Figure A5: Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF and flange nuts M8, M10

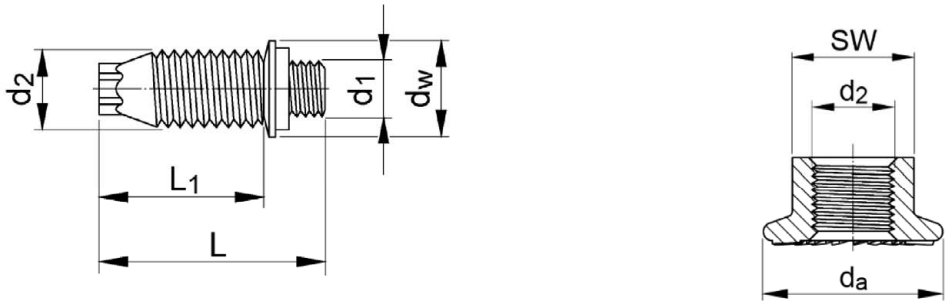


Table A2: Dimensions threaded studs

Threaded studs	L [mm]	L_1 [mm]	d_1 [mm]	d_2	d_w [mm]
S-BT-MR M8/7	23,2	17,05	5,8	acc. to M8	12
S-BT-MR M8/15	33,9	27,75	5,8	acc. to M8	12
S-BT-MR M10/15	33,9	27,75	5,8	acc. to M10	12
S-BT-MF M8/7	23,2	17,05	5,8	acc. to M8	10
S-BT-MF M8/15	33,9	27,75	5,8	acc. to M8	10
S-BT-MF M10/15	33,9	27,75	5,8	acc. to M10	10
S-BT-GR M8/7	23,2	17,05	5,8	acc. to M8	12
S-BT-GF M8/7	23,2	17,05	5,8	acc. to M8	10

Table A3: Dimensions flange nut

Flange nut	d_a [mm]	d_2	SW [mm]
M8	17,9	acc. to M8	13
M8	21,8	acc. to M8	13
M10	21,8	acc. to M10	15

Table A4: Materials

Designation	Material	
	S-BT-MR, S-BT-GR	S-BT-MF, S-BT-GF
Threaded stud	Stainless steel 1.4462 - EN 10088-2, zinc-coated	Carbon steel grade acc. to EN ISO 1620-4, galvanized and coated
Sealing washer	Stainless steel 1.4404 - EN 10088-2 with vulcanized sealing ring made of chloroprene rubber CR 3.1107	Aluminium EN AW-5754 - EN 573-3 with vulcanized sealing ring made of chloroprene rubber CR 3.1107
Flange nut	Stainless steel A4-70 - EN ISO 3506-2	Carbon steel, HDG, grade 8 - EN ISO 898-2

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Dimensions and Materials	Annex A4

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Specifications of intended use

The S-BT threaded studs are intended to be used for redundant multiple fastening and group fastening of non-structural components.

Examples:

- Fastening of non-structural components in mechanical and electrical installations (e.g. pipes, electric conduits, installation channels etc.)
- Group fastenings (base plates of consoles or footings or other members e.g. electrical switch box)
- Fastening floor gratings and floor plates in conjunction with grating fasteners or checker plate fasteners
- Fastening of the substructure of suspended ceilings

Use of the fastening:

- Static and quasi static loading

Material of the fixed material (component I):

- non-alloy structural steel, e.g. covered by EN 1993-1-1 and the material codes given there and EN 10346, or
- corrosion resistant steel according to EN 10088-2, or
- Aluminium, e.g. according to EN 755-2 or EN 485-2

Material of the base material (component II):

- non-alloy structural steel, according to EN 1993-1-1 and the material codes given there, EN 10025, EN 10346 with tensile strength $360 \leq R_m \leq 630$ N/mm²
- Aluminium according to EN 1999-1-1 and the material codes given there with tensile strength $R_m \geq 270$ N/mm²

Use conditions (environmental conditions):

- S-BT-MF and S-BT-GF threaded studs made from galvanized and coated carbon steel:
  Use in corrosivity category C1 according to EN ISO 9223 (dry internal conditions).
- S-BT-MR and S-BT-GR threaded studs made of stainless steel:
  Use in dry internal conditions and also in corrosive environments. The threaded studs are allocated to the corrosion resistance class (CRC) IV according to EN 1993-1-4.
- All S-BT threaded studs can be used in the temperature range from −40 °C to +100 °C.

Design:

- The fasteners are designed under the responsibility of an engineer experienced in fasteners work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the threaded studs, their designation and the ETA number is indicated on the design drawings.
- The verification concept in EN 1990:2002 + A1:2005 + A1:2005/AC:2010 is used for the design of connections with S-BT threaded studs.
- The partial factors γ_M and γ_{MII} specified in the Annexes of this ETA are used to determine the design values of the load carrying capacity.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Specifications of intended use	Annex B1

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Design (continued)

- The design tension resistance value shall be determined as follows:

$$N_{Rd} = \min \begin{cases} N_{Rd,I} \\ N_{Rd,II} \end{cases} \qquad N_{Rd,I} = \frac{N_{Rk,I}}{\gamma_M} \qquad N_{Rd,II} = \frac{N_{Rk,II}}{\gamma_M \cdot \gamma_{MII}}$$

$N_{Rk,I}$ shall be calculated according to EN 1993-1-3, Table 8.3 (for fixed material made of steel with thickness $t_I \leq 3$ mm) or EN 1993-1-8, Table 3.4 (for fixed material made of steel with thickness $t_I > 3$ mm) or EN 1999-1-1, section 8.5.5 for fixed material made of aluminium. When combining the S-BT-GR or S-BT-GF threaded studs with grating plates or checker plate fasteners, the load capacity of grating plates or checker plate fasteners can be found in the manufacturer's specifications.

$N_{Rk,II}$, γ_M and γ_{MII} are listed in Annex C1.

- The design shear resistance value shall be determined as follows:

$$V_{Rd} = \min \begin{cases} V_{Rd,I} \\ V_{Rd,II} \text{ or } V_{Rd,II,g} \end{cases}$$

$$V_{Rd,I} = \frac{V_{Rk,I}}{\gamma_M} \qquad V_{Rd,II} = \frac{V_{Rk,II}}{\gamma_M \cdot \gamma_{MII}} \qquad V_{Rd,II,g} = \frac{V_{Rk,II,g}}{\gamma_M \cdot \gamma_{MII}} \qquad V_{Rk,II,g} = \alpha \cdot n \cdot V_{Rk,II}$$

$V_{Rk,I}$ shall be calculated according to EN 1993-1-3, Table 8.4 (for fixed material made of steel with thickness $t_I \leq 3$ mm) or EN 1993-1-8, Table 3.4 (for fixed material made of steel with thickness $t_I > 3$ mm) or EN 1999-1-1, section 8.5.5 for fixed material made of aluminium.

$V_{Rk,II}$, α, γ_M and γ_{MII} are listed in Annexes C2 and C3.

- In case of combined tension and shear loading and/or bending moment, the resistance can be calculated by the interaction formulas in table B1.

Table B1: Interaction

Load combination	Interaction provision
Shear - Tension	$\frac{V_{Ed}}{V_{Rd}} + \frac{N_{Ed}}{N_{Rd}} \leq 1{,}0$
Shear – Bending moment	$\frac{V_{Ed}}{V_{Rd}} + \frac{M_{Ed}}{M_{Rd}} \leq 1{,}0$
Tension – Bending moment	$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{Ed}}{M_{Rd}} \leq 1{,}0$
Shear − Tension – Bending moment	$\frac{V_{Ed}}{V_{Rd}} + \frac{N_{Ed}}{N_{Rd}} + \frac{M_{Ed}}{M_{Rd}} \leq 1{,}0$

- When using S-BT threaded studs installed into structural steel elements that are subjected to cyclic loading, the effect of the threaded studs on the fatigue strength of the steel base material has to be considered. The design is carried out according to EN 1993-1-9:2005.
  The construction detail „Steel base material with S-BT threaded studs" and the corresponding detail category $\Delta\sigma_C$ is listed in Annex C4, Table C5.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Specifications of intended use (continued)	Annex B2

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Installation:

- The installation is carried out according to the manufacturer's specifications with the tools and devices defined therein.
- The installation is carried out by appropriately qualified personnel and under the supervision of the site manager.
- The S-BT threaded stud and the bore hole in the base material may only be used once.
- When installing the S-BT threaded studs in steel base material with a thickness of 3,0 mm ≤ t_{II} < 6,0 mm, any corrosion protection coating on the reverse side of the base material will be damaged. A repair of the existing corrosion protection coating may have to be considered.
- Only S-BT-MR and S-BT-GR threaded studs made of stainless steel are to be used for fixings on aluminium base materials.
- The application limits (maximum and minimum tensile strength as well as minimum thickness of component II) must be observed.
- The tightening torque T for the flange nut and grating fastener depends on the type of base material and the thickness of the base material. These details can be found in the installation instructions for the S-BT threaded studs or in Table B2 of this ETA. The tightening torque T must not be exceeded. Exceeding the tightening torque T leads to damage of the S-BT stud's anchorage with negative impact on the load values and the sealing function.

Table B2: Installation parameters

Threaded studs	$t_{I,min}$ [mm]	$t_{I,max}$ [mm]	$d_{c,max}$ [mm]	$t_{II,min}$ [mm]	$t_{c,max}$ [mm]	T_{max} [Nm]	SW [mm]
S-BT-MR M8/7	2,5	7	14	3,0 5,0 [1]	0,8	8 5 [2]	13
S-BT-MR M8/15		15					
S-BT-MR M10/15							15
S-BT-MF M8/7		7	12	3,0			13
S-BT-MF M8/15		15					
S-BT-MF M10/15							15
S-BT-GR M8/7	-	-	-	3,0 5,0 [1]			-
S-BT-GF M8/7	-	-	-	3,0			-

[1] For base material made of aluminium

[2] For base material made of steel with thickness 3,0 mm ≤ t_{II} < 5,0 mm and base material made of aluminium

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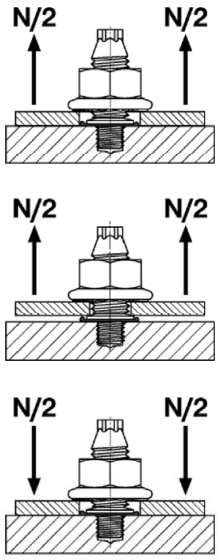
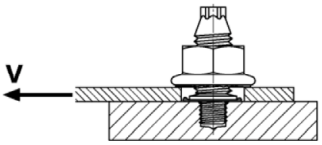
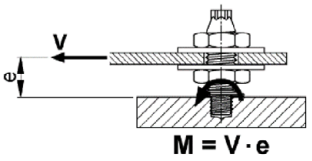
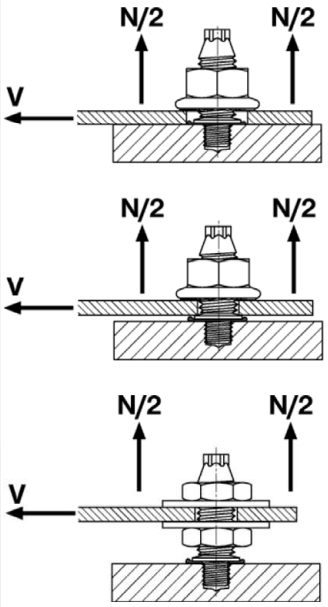
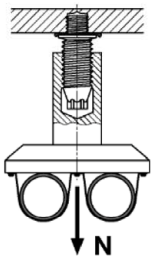
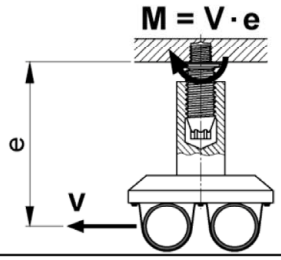
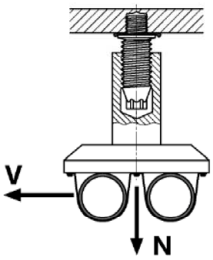
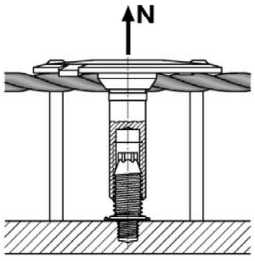
Table B3: Type of connections and loading conditions

Fastening of components to base material with nut			
Tensile / pressure loading	Lateral shear loading (Introduction of the shear load via the sealing washer)	Bending loading (Introduction of the shear load via the thread)	Interaction
			
Fastening of components in mechanical and electrical installations [1)]			
Tensile loading		Bending loading	Interaction
	-		
Fastening of gratings and floor plates [1)]			
Tensile loading			
	-	-	-

[1)] The components for fastening mechanical and electrical installations, grating plate fastener and checker plate fastener are not part of this ETA.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Type of connections and loading conditions	Annex B4

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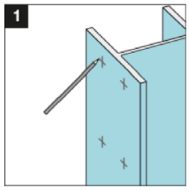
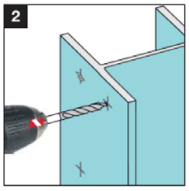
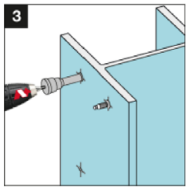
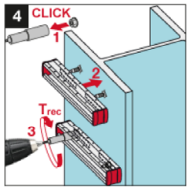
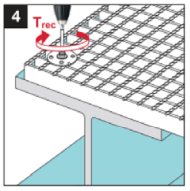
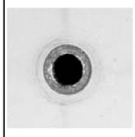
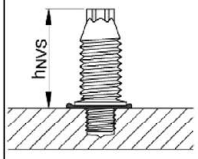
Table B4: General installation instruction: Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF

Mark location for each fastening	Pre-drill with TS-BT stepped drill bit	Screw-in S-BT stud into drilled hole	Fasten component or grating on base material
			 
	Usage of screw-driver SBT 4-A22 or SF BT 22-A. Pre-drill until the shoulder of the stepped drill bit grinds a shiny ring on the surface.  **Before fastener installation:** The drilled bore hole and the area around the drilled hole must be clear of liquids and debris.	Usage of screw-driver SBT 4-A22 or SFC 22-A in combination with the calibrated depth gauge S-DG BT. Verify stud stand-off h_{NVS} with check gauge S-CG BT.  Sealing washer must be properly compressed.	Position component or grating on S-BT studs and hold in place. Tighten the nuts or grating fastener with the suited tightening torque T. Tighten the nuts using: • Torque wrench and wrench socket, or • Torque tool X-BT ¼" (8 Nm) or S-BT ¼" (5 Nm), or • Screw-driver SBT 4-A22 or SFC 22-A and suitable wrench socket S-NS

Hilti screw-driver:	T	
	5 Nm	8 Nm
	Torque-setting:	
SBT 4-A22	4	5
SFC 22-A	4	5

Note: Table B4 shows only the general installation steps, which may vary depending on the S-BT threaded stud type and application. Always follow the installation instructions accompanying the respective S-BT threaded stud.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
General installation instruction	Annex B5

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Table C1: Characteristic tension resistance for Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF

			S-BT-MR, S-BT-GR	S-BT-MF, S-BT-GF
Steel failure threaded studs and pull-out				
Steel S235 to S355 - EN 10025, S280GD to S420GD - EN 10346 Thickness 3,0 mm ≤ t_{II} < 5,0 mm				
Characteristic tension resistance	$N_{Rk,II}$ [1]	[kN]	5,00	5,30
Steel S235 to S355 - EN 10025, S280GD to S420GD - EN 10346 Thickness t_{II} ≥ 5,0 mm				
Characteristic tension resistance	$N_{Rk,II}$ [1]	[kN]	5,30	5,50
Aluminium [2] - EN 1999-1-1 Thickness t_{II} ≥ 5,0 mm				
Characteristic tension resistance	$N_{Rk,II}$	[kN]	5,30	- [3]
Spacing	s	[mm]	≥ 18,0 for M8 ≥ 22,0 for M10	
Edge distance	c	[mm]	≥ 6,0	
Coating thickness of steel base material	t_c	[mm]	≤ 0,8	
Partial factor	γ_M	[-]	1,25	
Partial factor	γ_{MII}	[-]	1,60	

[1] The characteristic tension resistance $N_{Rk,II}$ may be increased by 20% when using steel base material S355 - EN 10025, S390GD and S420GD - EN 10346.

[2] Tensile strength R_m ≥ 270 N/mm²

[3] Only S-BT-MR and S-BT-GR threaded studs made of stainless steel are to be used for fixings on aluminium base materials.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Characteristic values of resistance under tension loading	Annex C1

Deutsches Institut für Bautechnik DIBt

Table C2: Characteristic shear resistance for Hilti threaded studs S-BT-MR, S-BT-MF at an edge distance 6,0 mm ≤ c < 15,0 mm

			S-BT-MR	S-BT-MF
Steel failure threaded studs and pull-out				
Steel S235, S275 - EN 10025, S280GD to S350GD - EN 10346 Thickness 3,0 mm ≤ t_{II} < 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	6,70	6,70
Reduction factor considering group effect	α [3]	[-]	0,78	0,76
Steel S235, S275 - EN 10025, S280GD to S350GD - EN 10346 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	7,00	7,00
Reduction factor considering group effect	α [3]	[-]	0,67	0,71
Steel S355 - EN 10025, S390GD, S420GD - EN 10346 Thickness 3,0 mm ≤ t_{II} < 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	6,90	6,90
Reduction factor considering group effect	α [3]	[-]	0,67	0,92
Steel S355 - EN 10025, S390GD, S420GD - EN 10346 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	7,70	7,70
Reduction factor considering group effect	α [3]	[-]	0,67	0,51
Aluminium [2] - EN 1999-1-1 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	8,00	- [4]
Reduction factor considering group effect	α [3]	[-]	0,90	- [4]
Spacing	s	[mm]	≥ 18,0 for M8 ≥ 22,0 for M10	
Edge distance	c	[mm]	≥ 6,0	
Coating thickness of steel base material	t_c	[mm]	≤ 0,8	
Partial factor	γ_M	[-]	1,25	
Partial factor	γ_{MII}	[-]	1,60	

[1] The characteristic shear resistance $V_{Rk,II}$ is related to a shear load introduction via the sealing washer according to Table B3. In case of a shear load introduction via the fastening thread, the additional bending moment due to the resulting eccentricity has to be considered in design.

[2] Tensile strength R_m ≥ 270 N/mm²

[3] The performance reduction factor α covers group effects with a row-setup of maximum 4 studs or a rectangular plate setup of 2 rows with maximum 4 studs per row and symmetrical load introduction with uniform load distribution on all rows.

[4] Only S-BT-MR and S-BT-GR threaded studs made of stainless steel are to be used for fixings on aluminium base materials.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Characteristic values of resistance under shear loading at an edge distance 6,0 mm ≤ c < 15,0 mm	Annex C2

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Table C3: Characteristic shear resistance for Hilti threaded studs S-BT-MR, S-BT-MF at an edge distance c ≥ 15,0 mm

			S-BT-MR	S-BT-MF
Steel failure threaded studs and pull-out				
Steel S235, S275 - EN 10025, S280GD to S350GD - EN 10346 Thickness 3,0 mm ≤ t_{II} < 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	10,50	7,50
Reduction factor considering group effect	α [3]	[-]	0,78	0,76
Steel S235, S275 - EN 10025, S280GD to S350GD - EN 10346 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	11,20	7,50
Reduction factor considering group effect	α [3]	[-]	0,67	0,71
Steel S355 - EN 10025, S390GD, S420GD - EN 10346 Thickness 3,0 mm ≤ t_{II} < 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	10,50	8,00
Reduction factor considering group effect	α [3]	[-]	0,67	0,92
Steel S355 - EN 10025, S390GD, S420GD - EN 10346 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	11,20	8,00
Reduction factor considering group effect	α [3]	[-]	0,67	0,51
Aluminium [2] - EN 1999-1-1 Thickness t_{II} ≥ 5,0 mm				
Characteristic shear resistance	$V_{Rk,II}$ [1]	[kN]	9,90	- [4]
Reduction factor considering group effect	α [3]	[-]	0,90	- [4]
Spacing	s	[mm]	≥ 18,0 for M8 ≥ 22,0 for M10	
Edge distance	c	[mm]	≥ 15,0	
Coating thickness of steel base material	t_c	[mm]	≤ 0,8	
Partial factor	γ_M	[-]	1,25	
Partial factor	γ_{MII}	[-]	1,60	

[1] The characteristic shear resistance $V_{Rk,II}$ is related to a shear load introduction via the sealing washer according to Table B3. In case of a shear load introduction via the fastening thread, the additional bending moment due to the resulting eccentricity has to be considered in design.

[2] Tensile strength R_m ≥ 270 N/mm²

[3] The performance reduction factor α covers group effects with a row-setup of maximum 4 studs or a rectangular plate setup of 2 rows with maximum 4 studs per row and symmetrical load introduction with uniform load distribution on all rows.

[4] Only S-BT-MR and S-BT-GR threaded studs made of stainless steel are to be used for fixings on aluminium base materials.

Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR, S-BT-GF	
Characteristic values of resistance under shear loading at an edge distance c ≥ 15,0 mm	Annex C3

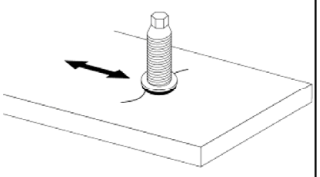
Table C4: Characteristic bending resistance for Hilti threaded studs S-BT-MR, S-BT-MF

			S-BT-MR	S-BT-MF
Steel failure with lever arm				
Steel S235 to S355 - EN 10025, S280GD to S420GD - EN 10346 Thickness ≥ 3,0 mm				
Characteristic bending resistance	M_{Rk}	[Nm]	19,50	11,80
Aluminium [1] - EN 1999-1-1 Thickness t_{II} ≥ 5,0 mm				
Characteristic bending resistance	M_{Rk}	[Nm]	19,50	- [2]
Spacing	s	[mm]	≥ 18,0 for M8 ≥ 22,0 for M10	
Edge distance	c	[mm]	≥ 6,0	
Coating thickness of steel base material	t_c	[mm]	≤ 0,8	
Partial factor	γ_M	[-]	1,25	
Partial factor	γ_{MII}	[-]	1,00	

[1] Tensile strength R_m ≥ 270 N/mm²

[2] Only S-BT-MR threaded studs made of stainless steel are to be used for fixings on aluminium base materials.

Table C5: Construction detail „Steel base material with Hilti S-BT threaded studs“ in compliance with EN 1993-1-9:2005

Detail category	Construction detail	Description	Requirements
100 m = 5		Hilti threaded studs S-BT-MR, S-BT-MF, S-BT-GR and S-BT-GF with pre-drilled hole in structural steel base material. Imperfect fastener installations as e.g. overwound or pulled-out fasteners are covered.	$\Delta\sigma$ to be calculated on the gross cross section. Base material thickness t_{II} ≥ 3 mm. Steel base material S235 to S355 according to EN 10025.