

**Welding Procedure Specification (WPS)**

No. CSF-WPS F-BT-MR (EU)

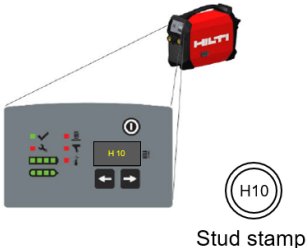
Version: 01/2022-11-14

Stud manufacturer	<b>Hilti AG</b>
Stud types	<b>F-BT-MR SN with sealing washer F-BT-MR without sealing washer</b>
Standard	<b>EN ISO 14555:2017</b>

Examining body	<b>gbd Lab Gmbh</b>		
<b>WPQR No.</b> Tested F-BT stud	L22/0869_01	F-BT-MR M6x25 SN (4)	2022-10-03
	L22/0868_01	F-BT-MR M6x25 SN (6)	2022-10-03
	L22/0867_01	F-BT-MR M8x25 SN (8)	2022-10-03
	L22/1282_01	F-BT-MR M10x50 SN (10)	2022-10-19
	L22/1281_01	F-BT-MR M12x50 SN (10)	2022-10-19
	L22/0873_01	F-BT-MR M6x25 (6)	2022-10-03
	L22/0872_01	F-BT-MR M8x25 (8)	2022-10-03
	L22/1284_01	F-BT-MR M10x50 (10)	2022-10-19
	L22/1283_01	F-BT-MR M12x50 (10)	2022-10-19

Examining body	<b>RINA Services S.p.A</b>		
<b>WPQR No.</b> Tested F-BT stud	N. 22TO00513PW2-A	F-BT-MR M6x25 SN (6)	2022-10-12
		F-BT-MR M10x25 SN (10)	
F-BT-MR M12x25 SN (10)			

Examining body	<b>DNV</b>		
<b>WPQR No.</b> Tested F-BT stud	A1339212	F-BT-MR M6x25 SN (6)	2023-06-07
	A1339212	F-BT-MR M10x50 SN (10)	2023-06-07
	A1339212	F-BT-MR M12x50 SN (10)	2023-06-07

Stud welding process	
	<p>Drawn-arc welding with shielding gas (783)</p> <p>Welding current, welding time, lift and protrusion are automatically adjusted by selecting the weld code H1, H2, H3 and H10. The weld code is stamped on the head of every stud and is given in the instructions for use of the stud.</p> <p>Gas can FX 3-GC, Shielding gas (SG) according to ISO 14175: M21-ArC-18 Gas flow rate: 3 l/min</p> <p>Preheat base material: &gt; 0°C</p>
Welding positions	PA, PC, PE
Earth clamp positioning	Minimum distance to stud welding position $s_{min} = 100$ mm For PC: Clamp must be positioning below stud welding position

Stud welding equipment	
Cordless stud fusion unit	FX 3-A
Cordless stud fusion hand tool	FX 3-HT
Stud holder	X-SH F3 M6-1/4", X-SH F3 M8-5/16", X-SH F3 M10-3/8", X-SH F3 M12-1/2"

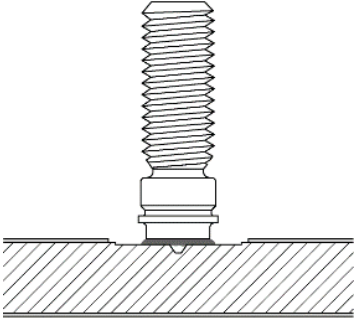
Stud material	
EN steel designation	X6CrNiMoTi17-12-2, Number 1.4571 per EN 10088-3:2014
ASTM designation	S31635, Type 316Ti per ASTM A240/A240-07 or ASTM A276-10

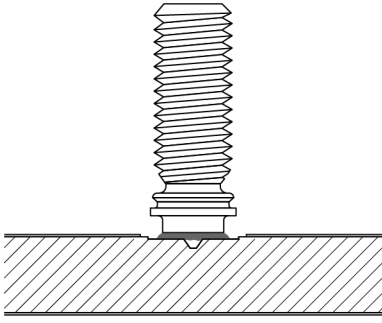
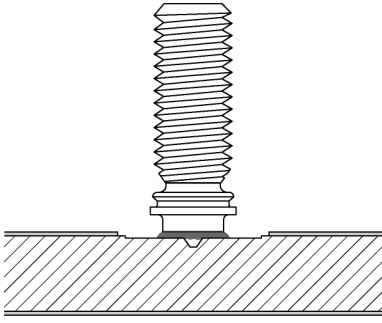
Parent material	
Specification	Subgroups 1.1 and 1.2 according to CEN ISO/TR 15608, CEV ≤ 0.45 %
Minimum thickness	Depends on coating, see allocation table at the end of this WPS
Maximum thickness	30 mm
Shape	Flat steel

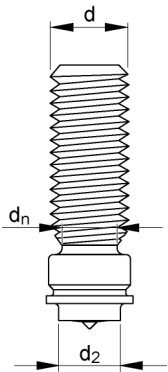
Positioning in base material	
Edge distance	$c_{min} = 38$ mm
Spacing between fasteners	$s_{min} = 35$ mm

Stud welding examination	
Observation of	<b>Hilti F-BT Visual Examination Catalogue, 2022-11-14, OTR/5724148/02</b>

Stud welding parameters					
Weld Code	Welding current [A]	Welding time [ms]	Protrusion [mm]	Lift [mm]	Remarks
H10	250 - 280	390 - 440	4.40 - 4.80	2.30 - 2.80	with magnet field
H3	250 - 280	245 - 285	4.40 - 4.80	2.30 - 2.80	with magnet field
H2	250 - 280	150 - 180	4.20 - 4.60	2.30 - 2.80	with magnet field
H1	250 - 280	80 - 110	4.20 - 4.60	2.30 - 2.80	with magnet field

Parent material surface preparation for F-BT-MR-SN studs with sealing washer		
Surface condition	Uncoated	Coated Non-weldable primer HDG coating Duplex coating Multi-layer coating
Visualization	F-BT-MR-SN studs not applicable on uncoated steel.	
Maximum coating thickness	/	1000 µm
Surface tool	/	FX 3-ST d20
Surface preparation method	Surface preparation with appropriate tool. Prepared surface shall be free of any visible dirt, rust and coating. Surface to be welded shall be maintained dry and free from condensation. Maximum time permitted between preparation and welding: 2 hours Consideration of: <b>F-BT Visual Examination Catalogue, 2022-11-14, OTR/5724148/02</b>	

Parent material surface preparation for F-BT-MR studs without sealing washer		
Surface condition	Uncoated or Weldable primer	Coated Weldable and non-weldable primer HDG coating Duplex coating Multi-layer coating
Visualization		
Maximum coating thickness	25 µm	1000 µm
Surface tool	FX 3-ST d14	FX 3-ST d20
Workmanship	Surface preparation with appropriate tool. Surface shall be free of any visible dirt, rust and coating. Surface to be welded shall be maintained dry and free from condensation. Maximum time permitted between preparation and welding: 2 hours Consideration of: <b>F-BT Visual Examination Catalogue, 2022-11-14, OTR/5724148/02</b>	

F-BT-MR-SN studs with sealing washer for welding on coated parent material						
Allocation of Stud – Stud holder – Weld Code						
Surface tool: FX 3-ST d20						
Stud designation (metric and imperial sizes)	Weld diameter $d_2$ [mm]	Neck diameter $d_n$ [mm]	Stud holder	Weld Code	Minimum parent material thickness	Stud geometry
F-BT-MR M6x25 SN (4)	5	4	X-SH F3 M6-1/4"	H1	4 mm	
F-BT-MR M8x25 SN (4)	5	4	X-SH F3 M8-5/16"	H1	4 mm	
F-BT-MR M6x25 SN (6)	5	4.4	X-SH F3 M6-1/4"	H2	6 mm	
F-BT-MR M8x25 SN (8)	6	6	X-SH F3 M8-5/16"	H3	8 mm	
F-BT-MR M10x25 SN (10)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR M10x50 SN (10)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR M12x25 SN (10)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	
F-BT-MR M12x50 SN (10)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	
F-BT-MR 3/8x1 SN (5/32)	5	4	X-SH F3 M10-3/8"	H1	4 mm	
F-BT-MR 3/8x1 SN (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x1 1/2 SN (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x2 SN (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x4 SN (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	

F-BT-MR studs without sealing washer for welding on uncoated and coated parent material						
Allocation table Stud – Stud holder – Weld Code						
Surface tool: FX 3-ST d14 for uncoated steel or steel with weldable primer FX 3-ST d20 for coated steel						
Stud designation (metric and imperial sizes)	Weld diameter $d_2$ [mm]	Neck diameter $d_n$ [mm]	Stud holder	Weld Code	Minimum parent material thickness of coated steel	Minimum parent material thickness of uncoated steel or steel with weldable primer
F-BT-MR M6x25 (6)	5	4.4	X-SH F3 M6-1/4"	H2	6 mm	3 mm
F-BT-MR M8x25 (8)	6	6	X-SH F3 M8-5/16"	H3	8 mm	
F-BT-MR M10x25 (10)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR M10x50 (10)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR M12x25 (10)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	
F-BT-MR M12x50 (10)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	
F-BT-MR 3/8x1 (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x1 1/2 (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x2 (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 3/8x4 (3/8)	7.2	6.8	X-SH F3 M10-3/8"	H10	10 mm	
F-BT-MR 1/2x1 1/2 (3/8)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	
F-BT-MR 1/2x2 (3/8)	7.2	6.8	X-SH F3 M12-1/2"	H10	10 mm	