DNV·GL

TYPE APPROVAL CERTIFICATE

Certificate No:
TAS00001SV
Revision No:
2

This is to certify:

That the Structural Connecting Elements

with type designation(s)
HILTI X-BT-GR, X-BT-MR and X-BT-ER Threaded Fasteners

Issued to
Hilti AG
Schaan, Liechtenstein

is found to comply with
EN 1993-1-9:2005 Eurocode 3: Design of steel structures – Part 1-9: Fatigue
IEC 62561-1:2017 Lightning protection system components (LPSC) – Part 1: Requirements for connection components
IEC 60947-7-1:2009 Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors
IEC 60947-7-2:2009 Low-voltage switchgear and controlgear – Part 7-2: Ancillary equipment – Protective conductor terminal blocks for copper conductors

Application :

Refer to section Application in the certificate.

Issued at **Hamburg** on **2019-12-19**

This Certificate is valid until **2023-12-09**.
DNV GL local station: **Augsburg**

Approval Engineer: **Thilo Pabst**

for **DNV GL**
Digitally Signed By: Drews, Olaf
Location: DNV GL SE Hamburg, Germany
Signing Date: 2019-12-20

Olaf Drews
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

PRODUCT DESCRIPTION

The X-BT threaded stud product family are manufactured, assembled and used acc. specification: "New Generation X-BT-GR, X-BT-MR and X-BT-ER Threaded Fastener Specification" (July 2019).
The X-BT threaded stud fasteners are from austenitic-ferritic (Duplex) stainless steel, with a conical shank for attachment on one end and a threaded tip on the other end. All studs are supplied with a SN washer - stainless steel sealing washer.
The sealing ring made from rubber offers weather resistant fastenings against moisture or condensation.
The sealing washer protects the fastener, the fastener hole and the area around the hole from moisture and corrosion.
The X-BT fastener will be pressed in into a pre-drilled hole.
For drilling the hole into the base material, a special stepped drill bit is needed to guarantee an accurately defined hole in terms of the borehole (depth and diameter) and the surface of the base material in the area of sealing washer.
For the installation process (pressing of stud into the hole) special piston-type tools are needed.
Detailed information to be found in the Installation Instruction of manufacturer.

Designation	Item Description	Application
X-BT-MR M6/10 SN 8 X-BT-MR M6/14 SN 8[x)]	Stainless steel threaded stud M6 with sealing washer	Multipurpose
X-BT-MR W6/10 SN 8 X-BT-MR W6/14 SN 8[x)]	Stainless steel threaded stud W6 with sealing washer	Multipurpose
X-BT-MR M8/14 SN 8	Stainless steel threaded stud M8 with sealing washer	Multipurpose
X-BT-MR M10/15 SN 8	Stainless steel threaded stud M10 with sealing washer	Multipurpose
X-BT-MR W10/15 SN 8	Stainless steel threaded stud W10 with sealing washer	Multipurpose
X-BT-GR M8/7 SN 8	Stainless steel threaded stud M8 with sealing washer	Gratings
X-BT-ER M6/3 SN 8 X-BT-ER M6/7 SN 8[x)]	Stainless steel threaded stud M6 with sealing washer	Electrical connections
X-BT-ER W6/3 SN 8 X-BT-ER W6/7 SN 8[x)]	Stainless steel threaded stud W6 with sealing washer	Electrical connections
X-BT-ER M8/7 SN 8	Stainless steel threaded stud M8 with sealing washer	Electrical connections
X-BT-ER M10/7 SN 8	Stainless steel threaded stud M10 with sealing washer	Electrical connections
X-BT-ER W10/7 SN 8	Stainless steel threaded stud W10 with sealing washer	Electrical connections

[x)] only to be used with tool DX 351 BT

Material specification X-BT fasteners:

Shank and Thread:
Upper part (thread): metric (M) or inch (W) thread from 6 to 10
Lower part (shank): conical shaft with a diameter of 4.9 mm (0.19") to 5.4 mm (0.21")
Material: 1.4462 / S31803 (minimum equivalent to grade AISI 316 or A4) acc. DIN-EN 10088-1

SN Washer:
Dimensions: outer Ø 12.0 mm (0.47"), thickness 1.0 mm (0.04")
Material: austenitic-ferritic (Duplex) stainless steel 1.4404 / 316L / S31603, 1.4571 / 316Ti / S31635

Sealing ring:
Dimensions: outer Ø 10.5 mm (0.41”), inner Ø 3.9 mm (0.15”)
properties: black; resistant to UV, salt water, water, ozone, oils etc.
Material: chloroprene rubber CR 3.1107

TOOLS AND COMPONENTS OF X-BT FASTENING SYSTEM

Fastening tools and components

Designation	Item Description Tool	Item Description Component
DX 351 BTG (powder-actuated)	Fastening tool for X-BT-GR	Fastener guide: X-351-BT FG G Piston: X-351-BT P G
DX 351 BT (powder-actuated)	Fastening tool for X-BT-MR and X-BT-ER (Metric treads: M6 to M10)	Fastener guide: X-351-BT FG M1024 Piston: X-351-BT P 1024
	Fastening tool for X-BT-MR and X-BT-ER (Withworth treads W6, W10)	Fastener guide: X-351-BT FG W1024 Piston: X-351-BT P 1024
BX 3-BT (accumulator-actuated)	Fastening tool for X-BT-MR and X-BT-ER (Metric treads: M6 to M10)	Fastener guide: X-FG B3-BT M accumulator: B22 (with diverse charges)
	Fastening tool for X-BT-MR and X-BT-ER (Withworth treads W6, W10)	Fastener guide: X-FG B3-BT W accumulator: B22 (with diverse charges)
BX 3-BTG (accumulator-actuated)	Fastening tool for X-BT-GR	Fastener guide: X-FG B3-BTG accumulator: B22 (with diverse charges)
6.8/11 M brown High Precision	Hilti high precision cartridge	The recommended tool energy setting = 1 (if required, increase of energy setting based on job site tests).

Remark:
The accumulator-actuated tool BX 3-BT(G) is also suitable to drive the following previous generation X-BT threaded fasteners as covered by DNVGL Certificate 12272-10 HH (valid until 2020-12-10):

- Type: X-BT M8-15-6 SN12-R
  Fastener guide: X-FG B3-BTG
- Types: X-BT M10-24-6 SN12-R, X-BT-ER M10/3 SN 4, X-BT-ER M8/7 SN 4
  Fastener guide: X-FG B3-BT M
- Types: X-BT W10-24-6 SN12-R, X-BT-ER W10/3 SN 4
  Fastener guide: X-FG B3-BT W

Drilling tools and bits

Designation	Item Description	Application
SF BT 22-A SF BT 18-A	HILTI drilling tools	Accumulator-actuated power drill in different sizes of series B22 (or B18).
TX-BT 4.7/7-80	Stepped shank drill bits	Drilling in steel. The three step shank drills only differ in their length. Their use depends on the accessibility condition on the jobsite.
TX-BT 4.7/7-110		
TX-BT 4.7/7-150		

APPLICATION/LIMITATION

Conditions of applications, installation instructions and load data are to be observed according to the „New Generation Hilti X-BT-GR, X-BT-MR and X-BT-ER Threaded Fastener Specification" (July 2019).

In general, the installation of the fasteners may be carried out in areas where drilling for bolting is permissible.

The fasteners may also be used for applications other than those listed below, subject to special consideration either by the local DNV GL Surveyor.

CARBON STEEL BASE MATERIAL

The HILTI X-BT Fastening System is type examined for fastening various materials to base metals of carbon steel on board ships and other structures classed by DNV GL as follows:

- Metal and fiberglass gratings to steel
- Cable, conduit and tubing connectors to steel
- Trays, channels and struts to steel for cable, conduit and tubing runs
- Instrumentation, junction boxes, lighting
- Pipe hangers
- Signage
- Door frames
- Mounting cabinets, securing furniture, utensils, etc.
- Grounding and bonding equipment (e.g. for equipment, pipe flanges, storage tanks, junction boxes etc.)

Base Material:

Thickness t_{II}:	$t_{II} \geq 8$ mm (5/16") - without through penetration/damage of backside coating. For thinner base material thickness (4 mm $\leq t_{II} <$ 8 mm) the load reduction factor α (for tensile and shear forces of X-BT fastener) applies
Tensile Strength:	No limits with regard to steel strength.
Coating:	coating thickness ≤ 500 µm

Fasteners should be installed with a distance of ≥ 10 mm (3/8") from the edge of a flange or cutout. In case of edge distance 6 mm (1/4") ≤ c < 10 mm (3/8"), tension, shear and moment need to be reduced with the reduction factor: α = 0.65.

CAST IRON BASE MATERIAL

The HILTI X-BT Fastening System (except X-BT-ER fasteners) may also be used for fastening various materials to spheroid graphite cast iron on board ships and other structures classed by DNV GL as follows:

- Cable, conduit and tubing connections
- Trays, channels and struts for cable, conduit and tubing runs
- Instrumentation, junction boxes, lighting
- T-bars for cable and conduit connections
- Pipe hangers
- Signage

Base Material:

Material thickness t_{II}:	≥ 20 mm
Minimum edge distance:	10 mm
Minimum fastener spacing:	15 mm

Cast iron specification: EN-GJS-400 to EN-GJS-600 according to EN 1563

The recommended working loads as given in the "New Generation Hilti X-BT-GR, X-BT-MR and X-BT-ER Threaded Fastener Specification" (July 2019) cover the effect of dynamic loading on the fasteners.

The X-BT fasteners are not to be used for the following locations:

- For attachment of structural fire protection insulation
- On bulkheads and decks with a thickness less than 8 mm (5/16"), if through penetration of the base material is not accepted.
  If through penetration is accepted, the base material thickness can be reduced to minimum of 4 mm.
  The load reduction factor α for tensile and shear forces of X-BT fastener applies.
- On the shell plating, sea chests and collision bulkheads.

Using on watertight bulkheads and tank boundaries should be avoided.
If necessary or requested, this has to be decided case by case by the DNV GL Surveyor.

The selection of the HILTI X-BT Fastening System for the corresponding application and the proper assembly are to be in accordance with the instructions of the manufacturer.

FATIGUE DESIGN OF CARBON STEEL BASE MATERIAL

The X-BT fasteners are type examined to be used on structural members made from carbon steel that require fatigue verification.

Description of constructional detail:
Structural steel base material with Hilti X-BT-GR, X-BT-MR and X-BT-ER power-actuated fastener driven in pre-drilled hole.

The fatigue detail categories apply for both Ship- and Offshore steel structures as well as constructions according to Eurocode 3 (e.g. crane structures or steel towers for wind turbines).

The fatigue detail categories shall be used in combination with a fatigue assessment procedure based on summation of cumulative damage taking care of the different slopes (m_1 and m_2).

Standard fatigue detail category for steel grades S235 to S960

Fatigue verification of structural members in ship and offshore steel structures in compliance with: DNVGL-RP-C203 (2016).
For fatigue verification the characteristic fatigue S-N curve (detail category) "X-BT" as described in the "Hilti Report XE-18-12", dated 2018-05-22
in format of DNV GL Off-shore fatigue Standard: DNVGL-RP-C203 (2016) shall be used:

Parameter of S-N curve for detail category X-BT					
Detail category	**$N \leq 10^7$ cycles**		**$N > 10^7$ cycles log a_2**	**Fatigue limit at 10^7 cycles [MPa]**	**Thickness exponent**
	m_1	**log a_1**	**$m_2 = 5.0$**		**k**
X-BT*	5.0	16.300	16.300	72.4	0

*Alternatively to the proposed detail class 100 with m = 5, detail category D with m = 3 may be used for $\Delta\sigma \leq 200$ N/mm² (DNV GL recommended practices, RP-C203, Table 2-1, S-N curves in air).

Other constructions (e.g. crane structures or steel towers for wind turbines)" which require fatigue verification are to be made in compliance with:
Eurocode 3 (EN 1993-1-9: Eurocode 3: Design of Steel structures – Part 1.9: Fatigue)
For Fatigue verification of normal stresses, the detail category 100 (m=5) acc. to EN 1993-1-9 applies.

Requirement / Limitation

The nominal stress range [N/mm²] is to be calculated by the gross cross-section fulfilling the requirements of the nominal stress approach and limited to:

Material thicknesses t_{II}: ≥ 8 mm
Minimum edge distance: 15 mm
Minimum spacing of fasteners: 15 mm

Structural steel grades: S235 up to S960Q grades acc. to EN 10025-2, EN 10025-3, EN 10025-4, EN 10025-6 and EN 10225.

Imperfect fastener installations up to an angle of 5°, pulled-out fasteners or pre-drilled holes without fasteners are covered.

The X-BT fastening system is to be observed in view of the project specific static and dynamic load in conjunction with the latest product data sheets.

Optimized fatigue detail category for steel grades S355 to S460

Fatigue verification in compliance with:
Eurocode 3 (EN 1993-1-9: Eurocode 3: Design of Steel structures – Part 1.9: Fatigue) and DNVGL-RP-C203 (2016):
For fatigue verification the optimized fatigue S-N curve and detail category as described in the Report "Optimized fatigue classification of the constructional detail "Structural steel base material with the HILTI power-actuated threaded fastener X-BT-GR, X-BT-MR and X-BT-ER" ", dated 2019-09-17 may be used:

According EN 1993-1-9:2005:

Parameter of S-N curve for		
Detail category	**$N \leq 5*10^6$ cycles**	**$N > 5*10^6$ cycles [1]**
	m_1	**m_2**
125	7	5

[1] Note: No cut-off limit at $N = 1*10^8$

In format of DNV GL Off-shore fatigue Standard: DNVGL-RP-C203 (2016):

Parameter of S-N curve for detail category X-BT					
Detail category	**$N \leq 10^7$ cycles**		**$N > 10^7$ cycles log a_2 $m_2 = 5.0$**	**Fatigue limit at 10^7 cycles [MPa]**	**Thickness exponent k**
	m_1	**log a_1**			
X-BT	7.0	22.979	16.985	99.32	0

Requirement / Limitation

The nominal stress range [N/mm^2] is to be calculated by the gross cross-section fulfilling the requirements of the nominal stress approach and limited to:

Material thicknesses t_{II}: ≥ 14 mm
Minimum edge distance: 15 mm
Minimum spacing of fasteners: 15 mm
Maximum Stress ratio R: +0.5

Structural steel grades: S355 up to S460 grades acc. to EN 10025-2, EN 10025-3, EN 10025-4 and EN 10225.

Inclined fastener installations up to an angle of 5° are covered.

The X-BT fastening system is to be observed in view of the project specific static and dynamic load in conjunction with the latest product data sheets.

Not covered are structural steel base material with imperfect Hilti X-BT-GR, X-BT-MR and X-BT-ER fastener installations as pulled-out fasteners or pre-drilled holes without fasteners.

TYPE APPROVAL DOCUMENTATION

- Evaluation report on new generation Hilti X-Bt-Gr, X-BT-MR and X-BT-ER threaded fasteners, Hilti Report XE-18-12;
  HILTI AG, dated 2018-05-22

- Evaluation report on new generation Hilti X-BT-GR, X-BT-MR and X-BT-ER threaded fasteners: Validation of fastening tool BX 3-BT(G), Hilti Report XE-19-22;
  HILTI AG, dated 2019-07-30

- Test report: Tension and shear tests;
  HTL Rankweil, dated 2017-12-04

- Test report: Equivalency of BX3-BT and DX351-BT_Pull out resistance test
  HTL Rankweil, dated 2019-07-24

- Expert assessment: Investigation of the corrosion resistance of Hilti X-BT fasteners in marine atmospheres and in sea;
  MPA Stuttgart, dated 2014-02-03

- Investigation report no. 903 4407 000 - new-generation-X-BT;
  MPA Stuttgart, dated 2018-01-08

- Report "Optimized fatigue classification of the constructional detail "Structural steel base material with the HILTI power-actuated threaded fastener X-BT-GR, X-BT-MR and X-BT-ER"
  Universität Stuttgart - Institut für Konstruktion und Entwurf, U. Kuhlmann + H.-P. Günther, dated 2019-09-17

- Test Report
  Empa Dübendorf (Switzerland), dated
- Expert's report suitability of hilti x-bt-er threaded studs as connection point in protective grounding and bonding circuits and for lightning protection;
  Eurofins Electrosuisse, dated 2017-11-22

- Test report: FRM-1659, Entwicklung T4 (X-BT-Lightning);
  DEHN + SÖHNE GmbH & Co.KG, dated 2017-03-17

- Test reports No.:
  5214017148/e – Tensile tests determination of mechanical properties, dated 2018-01-16
  5214017145/e – Constant amplitude fatigue tests S235, dated 2018-01-15
  5214015649/e – Constant amplitude fatigue tests S960, dated 2017-06-28
  5214021401/e - Constant Amplitude Fatigue Tests: Flat-sheet fatigue specimens made of steel S355J2+N with fastener of the new generation type X-BT-MR M10/15 SN8, dated 2019-06-07
  Empa, Swiss Federal Laboratories for Materials Science and Technology

- Fatigue classification of the constructional detail "Structural steel base material with the Hilti power-actuated threaded fasteners X-BT-GR and X-BT-MR";
  Universität Stuttgart - Institut für Konstruktion und Entwurf, U. Kuhlmann + H.-P. Günther, dated 2018-05-19

- ACDS Test report: ID 04112018 - Tension and shear tests with the grating fastener X-FCS-R combined with X-BT-GR;
  Hilti(Shanghai)Ltd, ACDS test lab P88, dated 2018-05-10

- "New Generation Hilti X-BT-GR, X-BT-MR, X-BT-ER Threaded Fastener Specification";
  HILTI AG, dated July 2019

- Part Lists and Drawings:
  X-BT-GR M8/7
  X-BT-MR M6/W6/14
  X-BT-MR M8/14

- ISO 9001 and 14001 Certificates,
  Swiss Association for Quality and Management Systems SQS, dated 2019-07-01.

- Type Approval Assessment Report
  DNV GL, dated 2018-12-05

TESTS CARRIED OUT

Documentation of tests performed and references provided and mentioned under TYPE APPROVAL DOCUMENTATION, are the basis for this type approval.

MARKING OF PRODUCT

For traceability to this type approval the products are to be marked with:
• Manufacturers name or trade mark
• Type designation

PERIODICAL ASSESSMENT

A condition for retention of the type approval certificate in its validity period is that periodical assessments are successfully carried out.
The objective of the periodical assessment is to verify that the conditions for the type approval have not been altered.
The Society shall be informed of any modifications to the product which are liable to affect its characteristics and functions, as originally specified and tested.
The Society shall be informed of any shifting of the production site and any additional production site.
If such notifications are not made, the validity of the type approval certificate terminates.

Regulations for the periodical assessment of the type approval certificate are to be find in the DNVGL Class Programme CP-0338.

END OF CERTIFICATE