X-BT-MF Additional Technical Information

1. Fastening / anchoring mechanism

The X-BT-MF fastener with a shank diameter of 4.5 mm / 0.177" is driven in a pre-drilled 4.0 mm / 0.157" diameter hole made with the TX-BT step drill bit. This leads to displacement of the base material. Part of the base steel is punched down into the pre-drilled hole, generating high temperatures and causing friction welding.
Due to elasticity of the base steel, additional clamping effects are also superimposed. Displaced base material can be clearly seen in the photograph. Base material adhering to the fastener shank indicates a welding effect.

Clamping and welding effect of base material on the X-BT-MF shank

2. Corrosion environment

For fastenings exposed to outdoor environments in mildly corrosive conditions where HDG coated parts are commonly specified or used (C3 environment in accordance with EN-ISO 12944-2).
Not for use in atmospheres with chlorides (marine atmospheres) or in heavily polluted environments (e.g. sulfur dioxide).

3. Durability

Key findings from the lifetime tests

Lifetime assessment tests (FRP material) under extreme conditions (-15°C / 5°F to +90°C / 194°F and 80% humidity) for a simulated period of 20 years have yielded good results. The tests have been conducted and assessed by independent experts.

An additional lifetime assessment of the X-BT-MF product under real environmental conditions (test duration of 20 years) will begin in 2015.

4. FRP material

The X-BT-MF sleeve and nut are made from a 50% glass-fiber reinforced polyamide (FRP) material based on a semi-crystalline, partially aromatic copolyamide.

- ISO 1874: PA6T/6I, MH, 12-190, GF50 (glass-fiber content: 50%)

X-BT-MF

This FRP material has been developed for the manufacture of injection-molded parts with the following key characteristics:

- High stiffness and impact resistance at low, medium and high temperatures
- Good weld line strength
- High toughness and energy absorption
- Low water absorption
- Good chemical resistance

It is suitable for applications requiring:

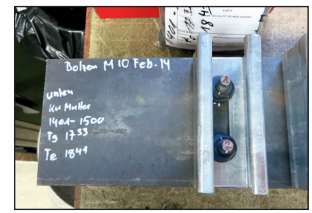
- High transverse strength (parts with high inner pressure)
- Fast energy absorption

5. Vibration resistance

Internal vibration tests and test results

The tests were conducted in order to gain an insight into the effects of the following types of vibration on the system:

- Vibration and shock during transportation and handling
- Base material vibrations

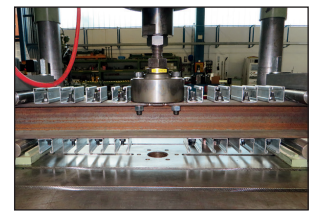


Test setup

Vibration tests have been conducted on the X-BT-MF tightened to 4 Nm (3.0 lbft) and the max. recommended torque of 8 Nm (5.9 lbft) with the X-BT-MF flange nut.

The fastener was tested to:

- A total of 8.5 million load cycles
- Varying frequencies from 6 to 60 Hz at different amplitudes

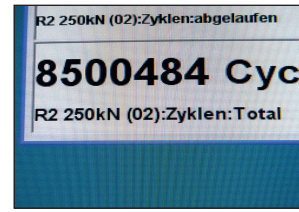


Vibration test machine

Results

There was no loosening of the FRP nuts during and after the tests.

After undergoing the vibration test, the X-BT-MF were subjected to tensile loads and achieved ultimate loads of 8.3 kN / 1866 lb to 10 kN / 2248 lb.



Cycle count

Conclusions

Vibration tests and other internal tests have shown that the X-BT-MF system is robust enough to withstand vibration and shock during transportation and handling as well as base material vibration as tested.

The use of an additional lock washer is not required. A lock washer will affect the integrity and functionality of the Hilti glass-fiber reinforced polyamide nuts. Additional lock or spring washers must therefore not be used in combination with the X-BT-MF system.

6. Ductility

In internal hammer tests the X-BT-MF exhibited a ductile behavior which is an indication of the X-BT-MF's robustness against accidental impact.

Bent X-BT-MF in internal test

7. Temperatures

Installation temperatures

The installation temperature range for the X-BT-MF system is -10°C / 14°F to +60°C / 140°F.

The ambient and base material temperature can be lower than -10°C / 14°F if the X-BT-MF fastening system is kept at a temperature above -10°C / 14°F prior to installation.

The X-BT fastening system, consisting of:
- DX 351 BT powder-actuated fastening tool
- High-precision cartridges (power level: brown)
- XBT 4000A cordless drill and battery
- TX-BT 4/7 stepped-shank drill bit
- X-BT-MF fastener

has been tested and proven suitable for installation at -10°C / 14°F to +60°C / 140°F.

In-service temperature

The in-service temperature range of the X-BT-MF is -40°C / -40°F to +100°C / 212°F.

8. In case of fire

Internal fire test results

A series of fire tests have been conducted to determine the performance of the X-BT-MF in fire and/or heat situations.
- Flammability: the FRP material has the flammability rating UL94 HB (slow burning on a horizontal specimen; burning rate < 76 mm/min for thickness < 3 mm and burning stops before 100 mm).
- In these tests, the X-BT-MF exhibited the temporary capacity to hold loads of 1 kN / 225 lb at temperatures up to +275°C / 527°F.
- The X-BT-MF is NOT recommended for applications at temperatures above +100°C / 212°F and should not be relied upon under fire exposure conditions.

Temperature testing