

Abstract

101 European XFEL accelerating modules with 808 superconducting cavities and input RF power couplers were assembled and then tested at DESY prior to installation in the European XFEL tunnel. In the Accelerating Module Test Facility (AMTF) warm and cold RF tests were done. The test results went directly to the operational setup for the LINAC. Input couplers did present several problems during the tests, resulting in some minor coupler design changes as well as in a few repair actions. The experience got from the said testing operation is worth to be shared and is presented here together with a discussion.

101 European XFEL-Modules

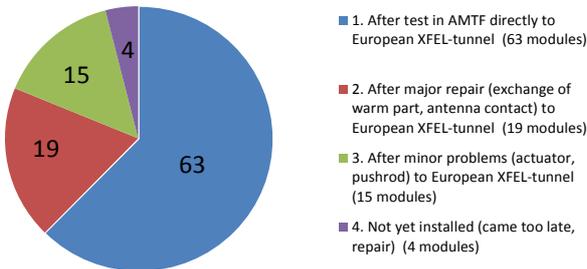


Figure 1: XFEL Modules according to repair actions

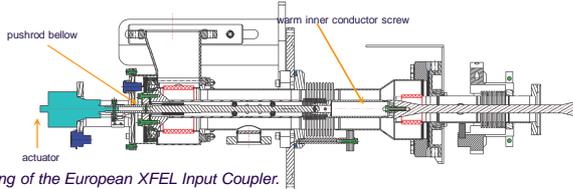
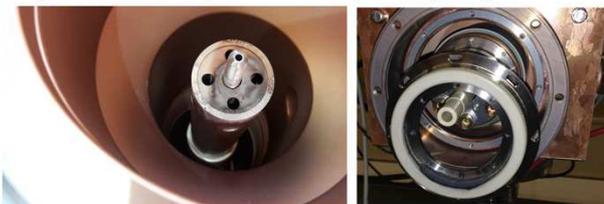


Figure 2: Drawing of the European XFEL Input Coupler.



Cold part after disassembly

Cold part after grinding



Inner cond. after disassembly (exchanged)

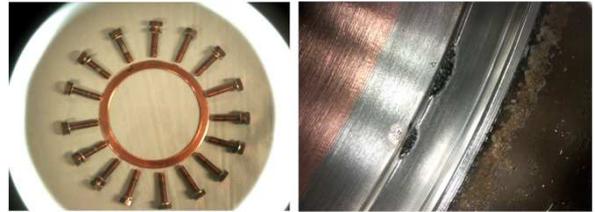
Burnt capacitor

Because of a loose inner conductor screw (connection between the warm part inner conductor and cold part antenna) we observed burnt surfaces on both sides. Normally it's necessary to change both parts (cold and warm part). That means a complete disassembly of the module. That was not possible in a short time. So we changed the warm parts and cleaned the cold part antenna with fine grinding, citric acid and alcohol as dust free and clean as possible.

Figure 3: Burnt main input coupler parts



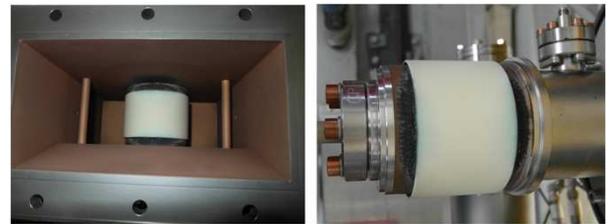
Burnt CF gasket knife edge (not repairable), repair done with a special gasket



Damaged CF100 flange screws (leftover of a rubber seal and stainless steel on the threads)

Leak check with both gaskets before RF test was ok. Because of a forgotten O-ring (on top of serial metal gasket) we faced a vacuum break down, when switching RF power on. After disassembly of warm part we faced the damaged knife of CF-100 flange on cold part. After cleaning all parts we put a special repair gasket and made a new assembly.

Figure 4: Partly destroyed knife of Cold Part



Burnt w. window and transit to waveguide-box, both parts had to be changed.

During the warm conditioning at module XM82 we faced a lot of activities in all couplers, especially in coupler #1. For investigation the spark interlock was disabled, all other were enabled. After test and disassembly of waveguide-box and warm part we discovered the damage caused by the pronged operation with light emission.

Figure 5: Burnt Warm Part

Note 1: Other repairs

During module tests in AMTF we faced the problem with push-rod vacuum leaks (Poster MOPB111, D.Kostin). It was discovered, that the high power RF damages the push-rod bellows from inside because of electrical field penetration through the HV-bias capacitor. The reason for that is a contact discharge inside the bellow and a possibility of a such contact is caused by a change in the pushrod design with a longer version of the bellow. To solve this problem we dismantled all capacitors and replaced them by a copper short-gasket. We also changed two waveguide-boxes: One was burnt in test, another one was damaged mechanically outside on the waveguide flange. Another challenge was due to several problems with coupler warm parts having not conditionable RF discharge and warm part overheating problems. These parts were exchanged after the test.

Summary

- 504 of 808 European XFEL input couplers did operate properly during the test in AMTF and did not need any repair actions.
- 120 couplers did have only some minor problems.
- Nearly all other couplers having problems could be repaired right after the test in AMTF before installing in European XFEL tunnel.
- An important conclusion is that the clean and careful assembly with a control of all design torque values is very important and can save many repair actions.
- To prevent the input coupler parts damage by an RF discharge careful checks of the parts are necessary.