

# Test sequence for superconducting XFEL Cavities in the Accelerator Module Test Facility (AMTF) at DESY

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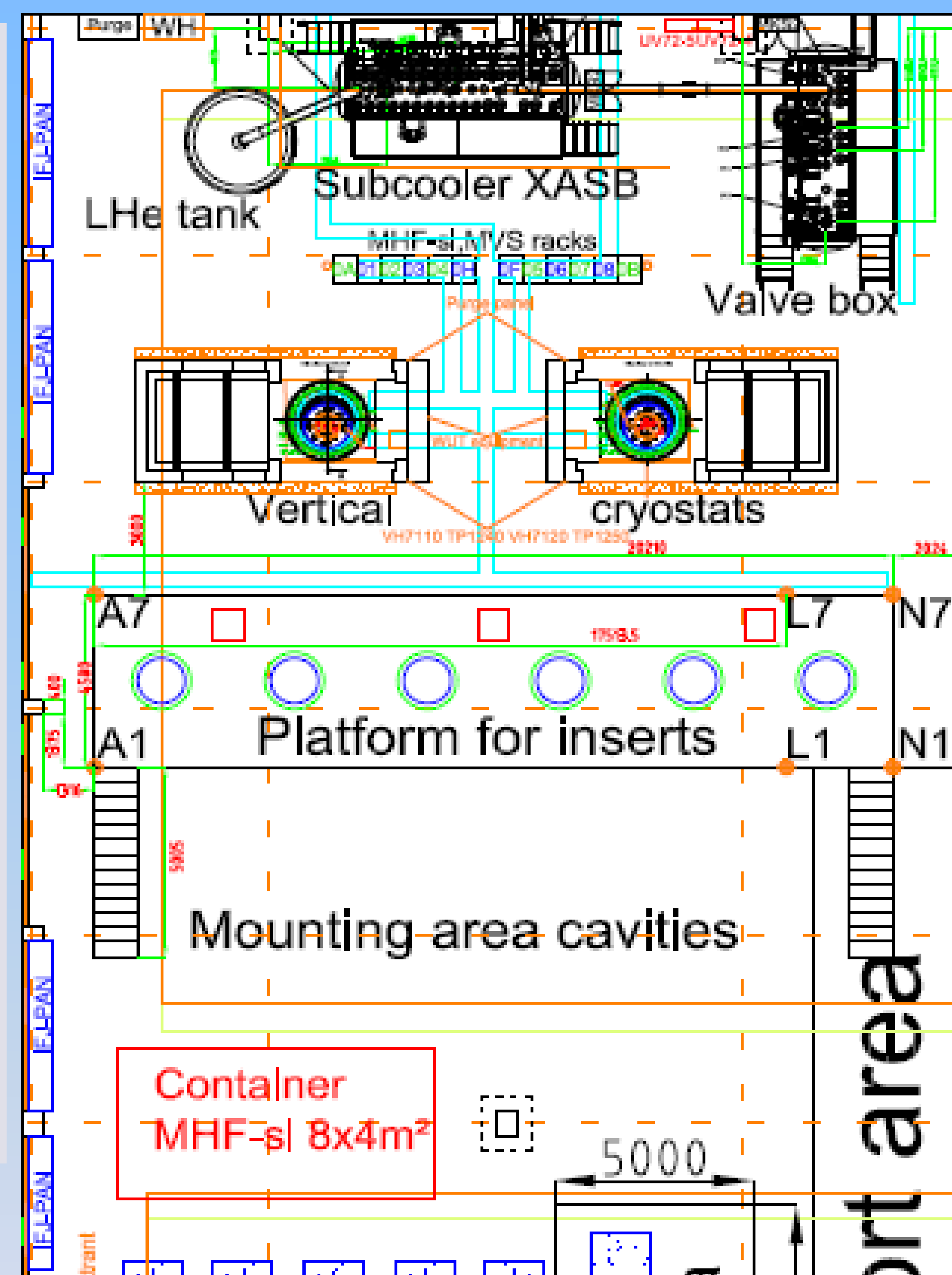
The European XFEL is a new research facility currently under construction at DESY in the Hamburg area in Germany. From 2016 on, it will generate extremely intense X-ray flashes that will be used by researchers from all over the world. The main part of the superconducting European XFEL linear accelerator consists of 100 accelerator modules with 800 RF-cavities inside. The accelerator modules, superconducting magnets and cavities will be tested in the accelerator module test facility (AMTF) at DESY. This paper gives an overview of the test sequences for the superconducting cavities, applied in the preparation area and at the two cryostats (XATC) of the AMTF-hall, and describes the complete area. In addition it summarizes the tests and lessons learnt until the middle of 2014.

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Peer-review under responsibility of the organizing committee of ICEC 25-ICMC 2014.

In total, 800 cavities have to be integrated in the European XFEL linac. To guarantee adequate cavity shape, verify the performance and to set up the accelerator in an optimal way, all cavities have to take a comprehensive quality control in the Accelerator Module Test Facility (AMTF) before being integrated into the accelerator modules. The purpose of this paper is to describe the test sequences from the arrival of the cavities from the manufacturer to the preparation for the shipment for module assembly. The status of the current cavity production for the European XFEL will be briefly described.

Preparation area for European XFEL cavities in AMTF



To verify conformity with the specification for manufacture and criteria for the module assembly, several test procedures were defined, which are applied between arrivals of the cavities from the manufacturer until the preparation for shipment for module insertion. The complete test sequence for cavities is divided into three main parts – the incoming inspection, the cold test and the outgoing inspection. An overview of the relevant selection of the AMTF hall, where the tests are done, is given on the left.

## Incoming inspection:

All cavities arrive under vacuum in specially designed transport boxes from the manufacturer, fully equipped with HOM-antennas, pick-up antenna and fixed high Q antenna – ready for the cold test at 2K. Immediately after the arrival a brief visual inspection of the cavity inside the transport box is done.



On a special support the cavity is checked for completeness, mechanical deviations, such as deep scratches or dents and other irregularities. A first RF-test at room temperature verifies the inner shape: the frequency spectrum is compared with the obtained one in the last measurements on the manufacturer site and conformity with the tolerances has to be established.

To verify the performance of the cavities at a temperature of 2K, the Q vs. E curve is measured together with the frequency spectrum, radiation measurement for observing field emission and leak tightness. This helps to decide, whether the cavity is accepted for installation to a module or whether it needs an additional re-treatment.



A vertical Insert for the Cavity cold test at the AMTF

Cavities	Number
Arrived	361
Tested	336
Qualified for module assembly	263
Passed 1 <sup>st</sup> test	209

Requirements:

Gradient: 25MV/m

Radiation:

<0.01mGy/min (top)

<0.12mGy/min (bottom)

A test rate of 8-10 cavities/week can be handled currently, so that a suitable stock of cavities for installation in modules with optimal grouping of operating gradient is available. Consequently a steady cavity delivery for module assembly at CEA Saclay can be realized.