

RF Measurements for Quality Assurance During SC Cavity Mass Production.

SRF Technology - Cavity

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Outline

European

2/18

- Introduction to Quality Assurance (QA):
 - major phases of cavity life cycle;
 - goal of QA, based on RF measurements;
 - RF measurements choice.
- Realization:
 - documents & new technique;
 - acceptance levels;
 - QA structure;
 - database analysis.
- Results & Statistics:
 - main parameters (Fpi, L) adjustment;
 - improvement of HOM suppression (TM011);
 - HOM coupler notch filter (in Modules).

Resume













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RF Measurements for Quality Assurance During SC Cavity Mass Production European Introduction: XFEL RF Measurements Choice



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Why do we need RF measurements for QA ? ->

- 1. To measure and calculate RF characteristics (frequencies, field, quality-factors, ...);
- 2. RF measurements are more flexible and do not required mechanical contact with inner cavity surface;
- 3. They have very high sensitivity to mechanical deviations:
 - longitudinal: 1kHz \rightarrow ± 3 µm, 3 µm/1.5 m = 2E-6 = 0.0002 %,
 - transverse: 1kHz \rightarrow ± 0.1 µm, 0.1 µm/0.2 m = 0.5E-6 = 0.00005 %.





RF Measurements for Quality Assurance During SC Cavity Mass Production European XFEL Documents & New Technique

Normative documents for RF measurements:

- XFEL Specification:
- → XFEL/003 quality assurance and quality control;
- → XFEL/014 frequency measurements on dumb-bell, half cell, end group and cavity;
- → XFEL/014 technical specification for welding in the helium tank;
- → XFEL A-D series surface and acceptance test preparation,
- → manual for Half Cell Measurement Machine (HaZeMeMa)
- \rightarrow manual for the Cavity Tuning Machine CTM
- Manufacturers internal instructions for:
- → RF control of subcomponents (with HaZeMeMa),
- → RF measurements of a cavity,
- \rightarrow operation with the Cavity Tuning Machine.











RF Measurements for Quality Assurance During SC Cavity Mass Production **Realization:** Acceptance Levels (AL)

- Points in fabrication, where DESY has to accept before next step:
- Cavity sub-components fabrication,
- Cavity welding

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- \rightarrow AL 1. "Fresh" Cavity
- Main cavity surface treatment,
- Cavity tuning,
- Integration into helium tank (HT),
- Pressure test (PT)
- \rightarrow AL 2. Cavity in Helium Tank
- Final surface treatment,
- Assemble of all antennas
- \rightarrow AL 3. "Full Equipped" Cavity









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SRF2015 Thill Identified Contenso on Dispersional Statistics



RF Measurements for Quality Assurance During SC Cavity Mass ProductionEuropeanRealization:XFELDatabase analysis (Acceptance Level 3)





17th International Conference on RF Superconductivity, Whistler, Canada, September 13-18, 2015 Alexey Sulimov, MHF-SL, DESY (Hamburg), 16 September 2015





DES









- Based on statistics of mass production and cryo tests, some reference values from specification XFEL/ A-D (table TC13) had to be changed;
- High production rate increases delay of feed back improvement.





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RF Measurements for Quality Assurance During SC Cavity Mass Production **Results & Statistics:** Improvement of HOM suppression for TM011





LINAC 2014 [THPP022]: Efficiency of HOM extraction in the European XFEL linac

SRF 2015 [THPB068]: Practical aspects of HOM suppression improvement for TM011



Alexey Sulimov, MHF-SL, DESY (Hamburg), 16 September 2015

European







- Production of more than 800 cavities for the European XFEL project is almost finished.
- Automation of RF measurements for Quality Assurance allows fabrication and control in average 8 cavities/week.
- Adjustment of cavity parameters is quite inertial, because of high mass production rate. But it really works!
- The Quality Assurance for the European XFEL cavities was possible only due to close collaboration between industry, DESY and the research institutes from France, Italy and Poland !







XFEL ACKNOWLEDGEMENTS

Many thanks to all European XFEL Cavity Teams:



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XFEL More information in Posters



[THPB023]: The statistics of industrial XFEL cavities fabrication at E.ZANON

[THPB031]: Operation experience with half cell measurement machine & cavity tuning machine in 3 years of the European XFEL cavity series production

[THPB066]: RF analysis of equator welding stability for the European XFEL cavities

[THPB067]: HOM coupler notch filter tuning for the European XFEL cavities

[THPB068]: Practical aspects of HOM suppression improvement for TM011

Thank you all for attention !



