

## Exchange and Repair of Titanium Service Pipes for the EXFEL Series Cavities

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## Abstract

Longitudinally-welded 72 mm ID service pipes (HSP) made from titanium grade 2 is used by the two suppliers of the helium tanks for the EU-XFEL accelerator. From the perspective of the PED DESY is legally designated as the manufacturer and is responsible for conformity to all relevant codes. During module assemblies at CEA Saclay the orbital welds of the interconnection bellows between cavities showed pores with dimensions outside the specifications set by DESY. These welds needed to be redone which caused a project delay of several months. The X-ray examination of the HSP showed that the pipes already exhibited many out-of- DESY spec pores in the longitudinal welds and were most likely the main cause of the problems in the orbital welds. It was decided to replace the extremities of the service pipes with seamless itanium tubes both on "naked" helium tanks as well as on tanks with cavities already welded in. At DESY more than 750 service pipes were exchanged over a period of 2 years. The qualification of the repair line according to PED regulation and the prove with RF test at 2 K that the repairs do not influence the high performance of the s.c. cavities were done.





## Additional repair in the "chimney area"

 about 70 tanks also showed non acceptable pores located in the so called "chimney area"
Repair procedure:

1. X-ray re-examination of chimney area

- 2. Marking of pores area on tube
- . Grinding of the affected tube to remove

Manual welding with filler

- 5. Visual testing and leak check of weld area
- 6. X- ray examination for verification of manual weld and removal of pores

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## Summary

- 816 helium tanks have been fabricated in industry for the EU-XFEL resonators.
- Up to 180 service pipes were exchanged completely with seamless pipes during ongoing fabrication of helium tanks.
- On the 700 tanks already finished, from which 443 were already welded to the cavities, the extremities of the service pipes were exchanged at DESY, complying with the PED regulations and the DESY quality requirements (no pores bigger than 0.4 mm are allowed).
- Pores out of specifications located in the region between the exchanged extremities were locally repaired by the company E. Zanon S.p.A
- RF tests of cavities after cutting and welding the service pipes and lots of transports showed that cavities did not change their RF performance or showed small changes in the region of acceptance gradient for module.



