MOPB094

European XFEL

Inspection and Repair Techniques for the XFEL Superconducting 1.3 GHz Cavities at Ettore Zanon s.p.a: methods and results

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INTRODUCTION

The quality control of the inner surface of superconducting RF cavities is essential in order to assure high accelerating gradient and quality factor.
E. Zanon S.p.A. (EZ) has implemented an inspection and repair system in order to recover performance limited cavities of the 1.3 GHz European XFEL project. To qualify the technical inspection and repair, E. Zanon used two series of cavities; for both cavities, *CAV00595* and *CAV00731 HiG* the method has been successful.

GRINDING MACHINE PLANT

GRINDING MACHINE

The **grinding machine** set up EZ, consists of the following components:

- support frame for cavity,
- support rod for grinding operation,
- support rod for inspection tools.

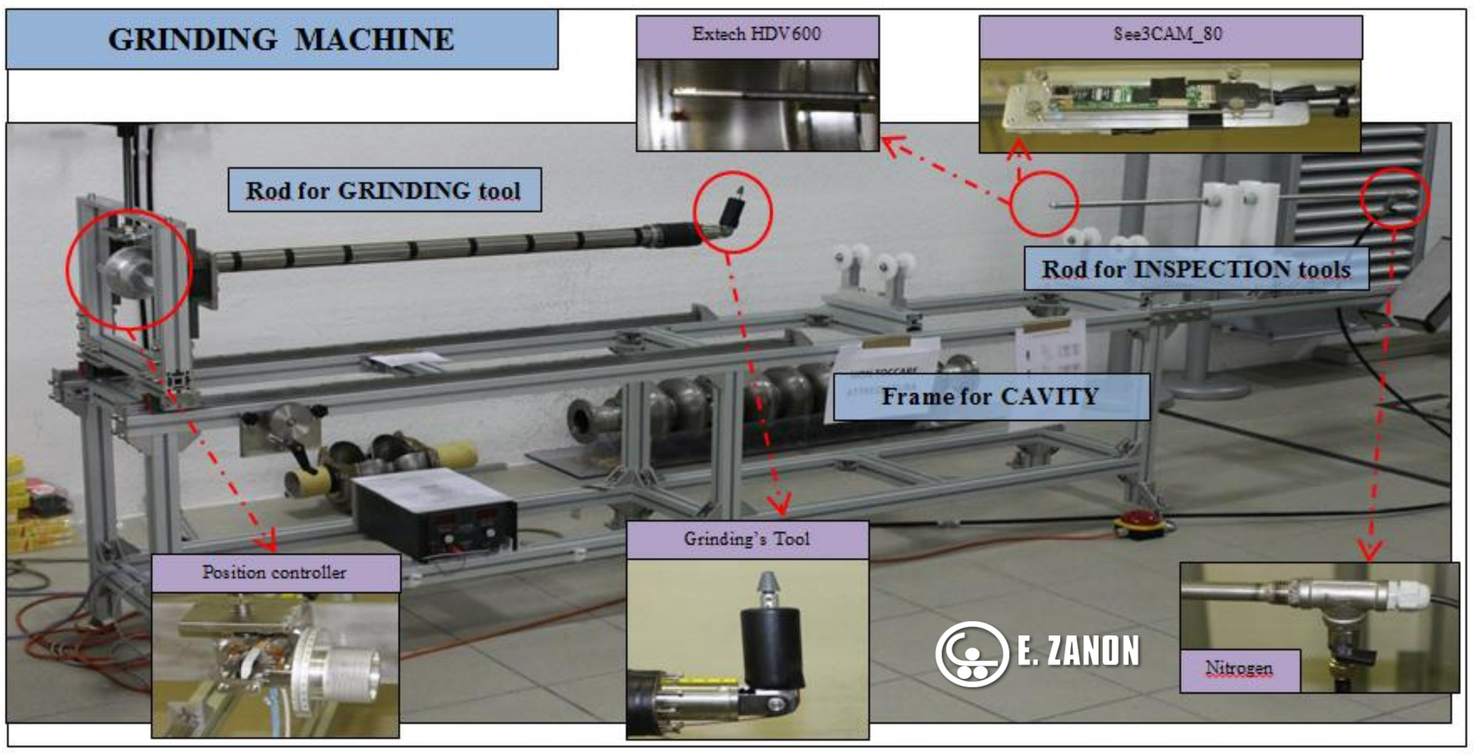
OPTICAL INSPECTION

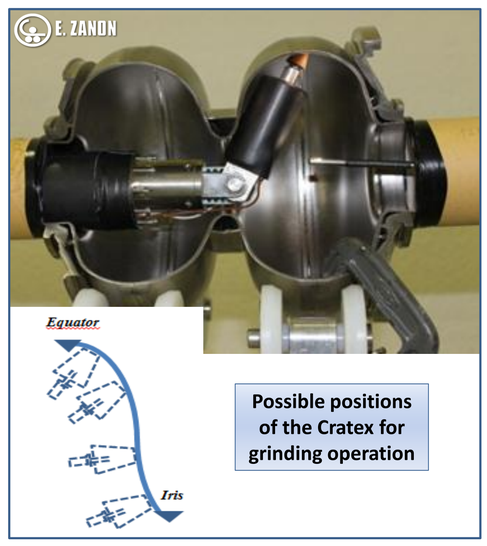
Two types of cameras are used for optical inspections.

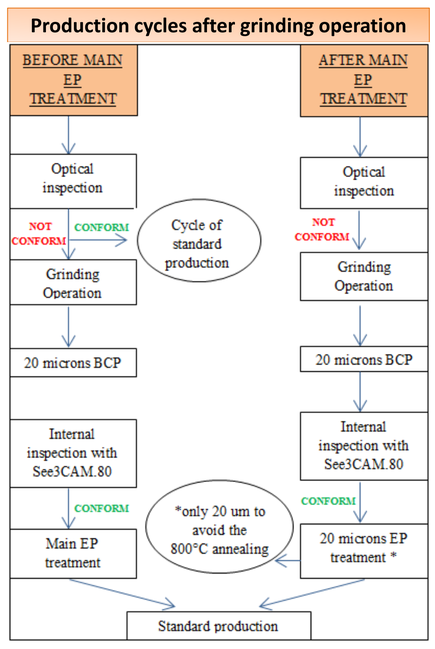
- **Extech HDV600**, used during the grinding operations. It is connected to an external monitor and thanks to a rotating probe, it makes it easier monitoring during the repair operation. The resolution is of **640x480 pixels**.
- **See3CAM_80**, used for final inspection in order to verify the complete removal of the defect. It is connected to the PC. The resolution is of **3264X 2448 pixels**.

The removal of the suspects of surface irregularities, found during the internal visual inspection, is performed through the abrasive cones coarse-grained, mounted on rod for grinding.
The system, as it is, is able to remove the defects on the equator weld, iris weld and on tapered area of the cell.
After grinding operation, in order to obtain a good surface finish, the repair proceeds using abrasive cones of different particle size in the following order: medium, fine and extra-fine.

When the quality of surface is satisfactory, foreseen in the standard production cycle. The following up preparation steps are different depending on whether the grinding operation must be applied before or after main EP treatment (140 microns). If the grinding must be performed before EP, standard process with main EP and BCP flash is applied. In case defect appears after main EP, grinding procedure is following by a sequence of BCP and light EP (40 microns).

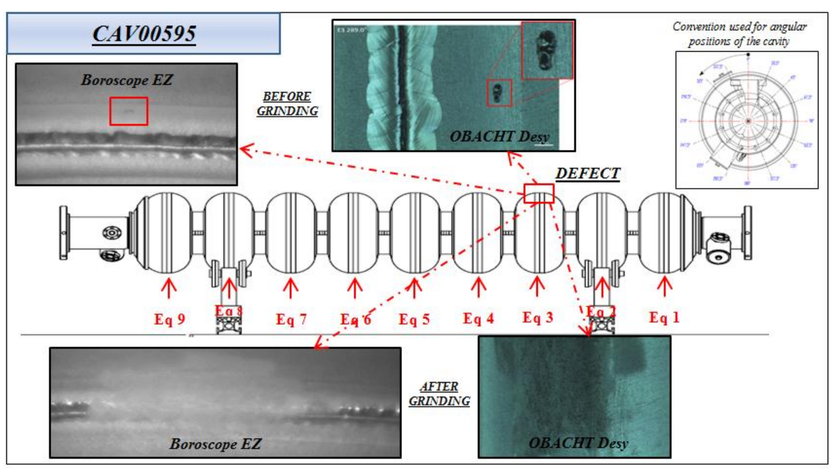


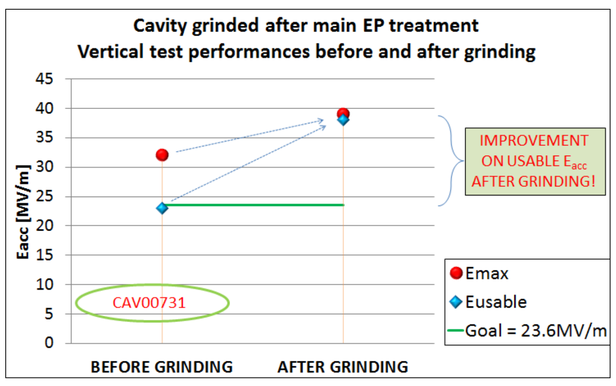


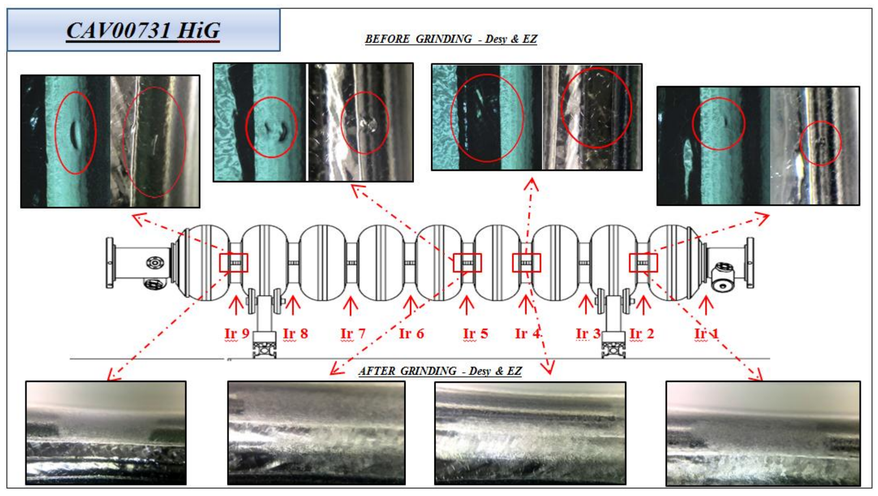


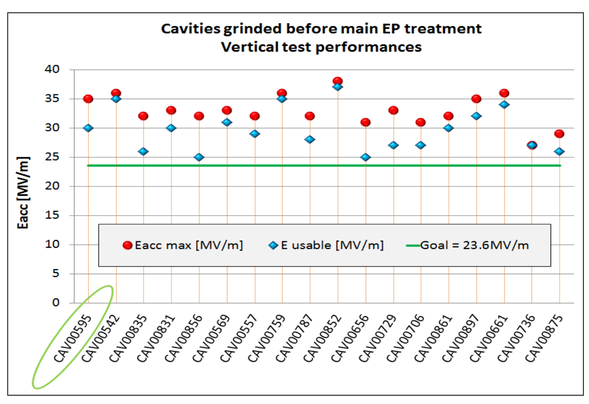
RESULTS AND CONCLUSIONS

GRINDING BEFORE MAIN EP









The optical inspection of **CAV00595** showed a spatter weld close to the equator weld. The defect was removed satisfactorily .
The vertical test was performed at Desy and the cavity performance was up **to Emax 35 MV/m** and **Eusable 30MV/m**, limited by some field emission.
This result has qualified the procedure, which was applied on eighteen cavities afterwards. The results of vertical test of each cavity show a very good result.

GRINDING AFTER MAIN EP

The 1st vertical test of **CAV00731 HiG** was performed at Desy and the cavity performance was up to Emax 32 MV/m and Eusable 23 MV/m, limited by quench and strong field emission.
Even after HPR reprocessing at Desy this result didn't improve. The optical inspection by camera EZ and Obacht Desy system, showed scratch on Iris 2, 4 and 5 at angular position 120° and a incision on Iris 9 .The defects have been removed successfully with the technique of grinding.
The 2nd vertical test was performed at Desy and the cavity performance was up to **Emax 39 MV/m** and **Eusable 38 MV/m**, limited by low field emission.

EZ has realized an inspection and repair system, in order to ensure high accelerating gradient and high quality factor.
Until now, all the cavities repaired with this technique by EZ, have shown an accelerating gradient well above the EXFEL goal.