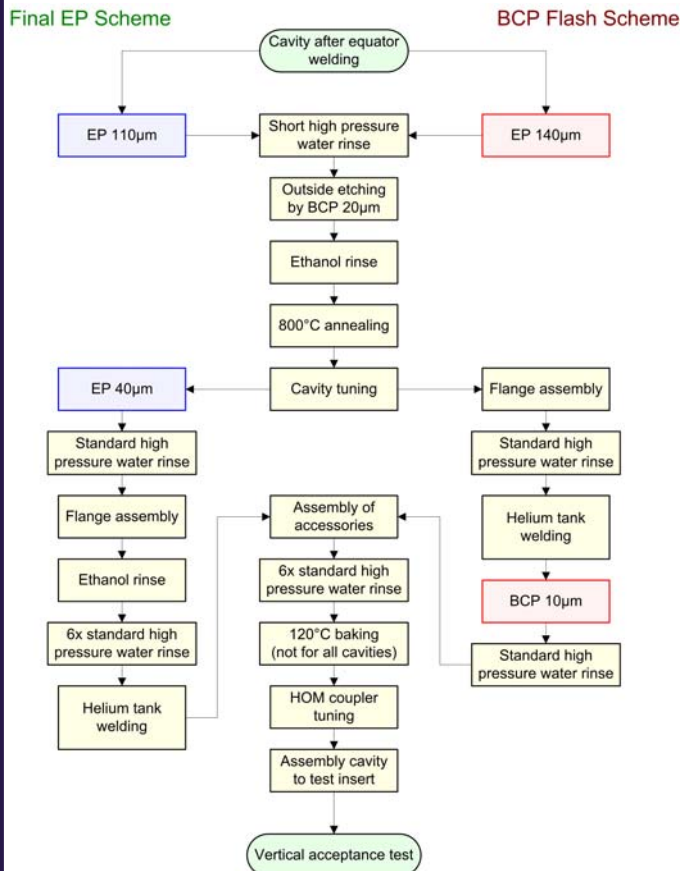


Abstract

About 50 nine-cell cavities of the recent fine-grain niobium cavity productions have been analysed with respect to maximum and usable gradient in the first and final vertical acceptance test, respectively. Parameters of the analysis were the manufacturer of the cavities, the location of the main EP (\Rightarrow industry or in-house), the final surface treatment (\Rightarrow final 40 μ m EP or short 10 μ m "flash" BCP) and the cavity preparation strategy (\Rightarrow vertical acceptance test with or without He-Tank welded). Moreover, the effect of a re-processing of field emission loaded cavities by additional ultra pure high pressure water rinsing has been investigated.

Baseline of analysis

- About 50 cavities of 4th and 6th production analyzed
- Cavity preparation strategies:
 - "without He-tank": He-tank welding after preparation process + vertical RF acceptance test
 - "with He-tank": modified preparation strategy



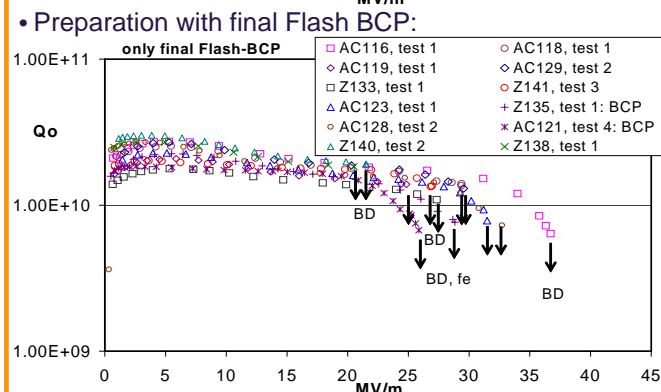
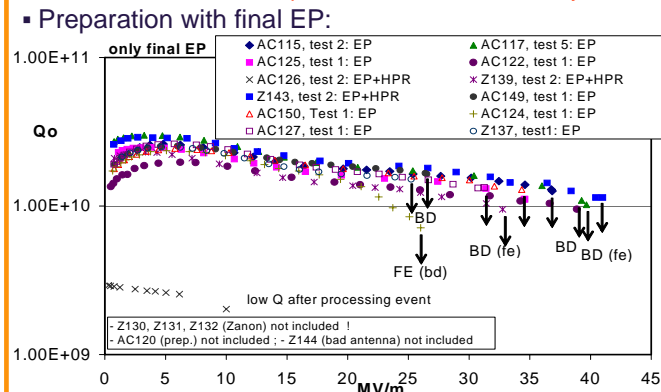
- Analysis wrt.
 - maximum gradient $E_{acc,max}^1$
 - usable gradient $E_{acc,usable}^1$
 - field emission

\Rightarrow Definition of usable gradient:

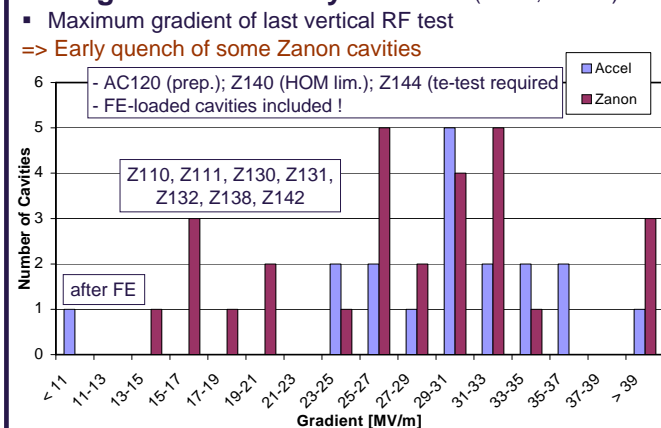
- Lowest gradient in vertical acceptance test of quench or x-rays ($> 10^{-2}$ mGy/min) or RF losses ($> 100W$ CW)
- Dependence on
 - cavity vendors,
 - location of main EP,
 - final EP vs. final "Flash BCP",
 - vertical RF acceptance test with or without He-tank,
 - first vertical RF test (\Rightarrow goal for XFEL) and last vertical RF test (\Rightarrow as used so far for FLASH modules)
 - reprocessing after field emission: additional HPR

Typical Q(E)-performances

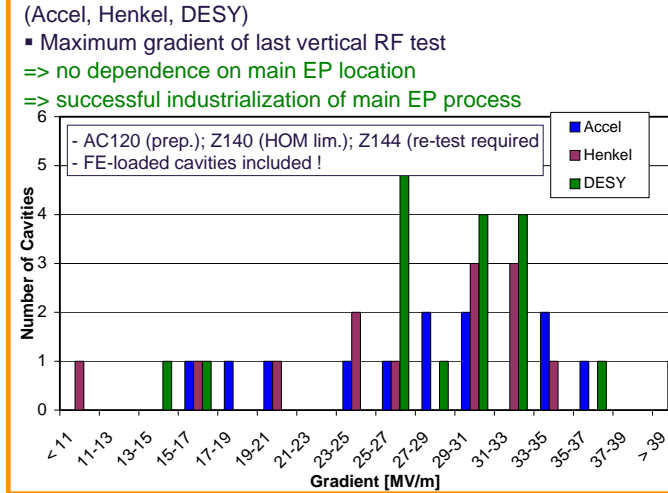
- \Rightarrow final EP: + gradients > 36 MV/m possible
- \Rightarrow final Flash BCP: - Q-slope w/o field emission not fully cured



Max. gradient of cavity vendors (Accel, Zanon)



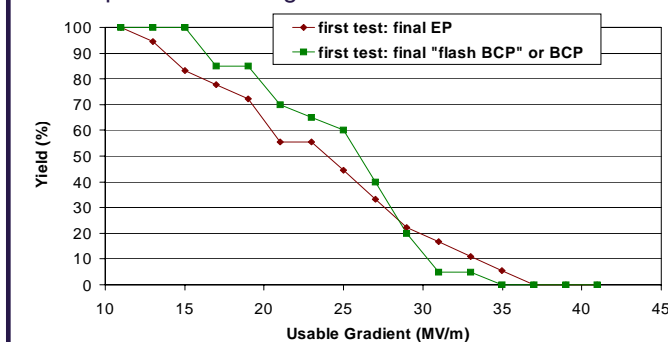
Max. gradient depending on Main EP location



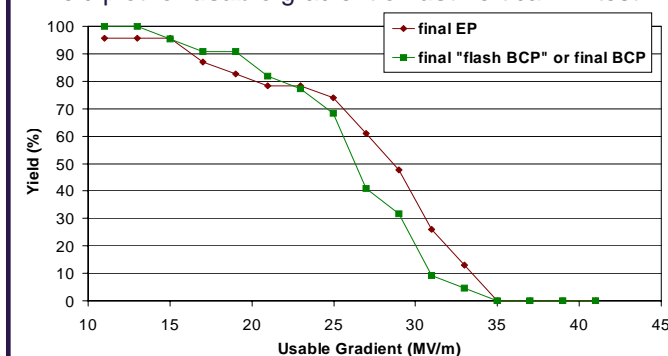
Maximum and usable gradient depending on final treatment (final EP vs. final "Flash BCP")

- analysis of about 18 – 25 cavities per treatment
- for 10 cavities only one test done \Rightarrow first + last test identical
- \Rightarrow yield for 23.6 MV/m (usable): (70 – 80)% in last test (50 – 65)% in first test (limited by Zanon cavities + field emission)
- \Rightarrow Max gradient: Final EP with obvious high potential for gradients $> 30-35$ MV/m
- \Rightarrow Usable gradient: Field emission at high gradients levels advantage of final EP

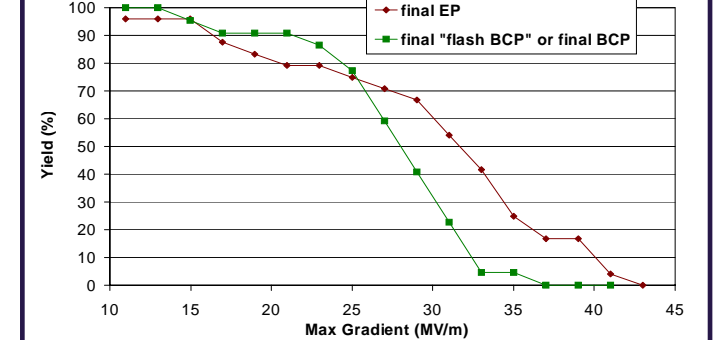
Yield plot for usable gradient of first vertical RF test:



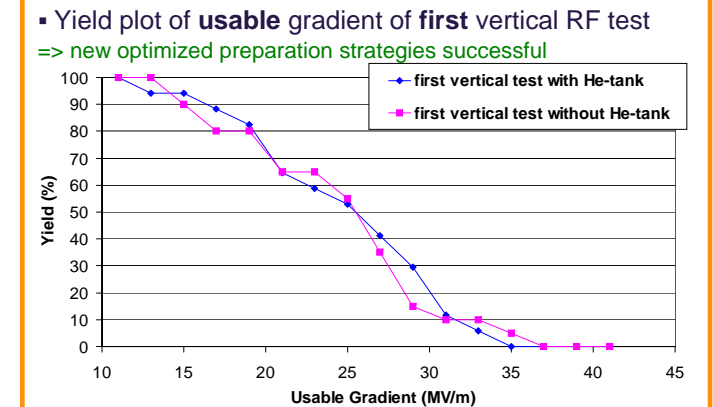
Yield plot for usable gradient of last vertical RF test:



Yield plot for max gradient of last vertical RF test:

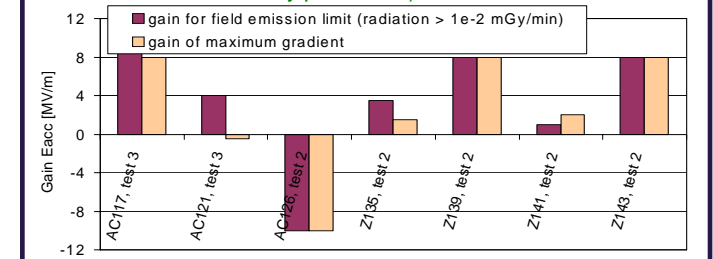


Preparation strategies "with He-tank" and "without He-tank"



Re-processing of field emission loaded cavities by HPR

- \Rightarrow successful for 6 of 7 cavities of 6th cavity production (confirms earlier results of 4th cavity production)



Summary

- Broad scatter of max. and usable gradient in vertical acceptance test:
 - \Rightarrow some Zanon cavities with early quench
 - \Rightarrow field emission limits in about 1/3 of tests
 - \Rightarrow yield of usable gradient at 23.6 MV/m: 50 – 80 %
 - \Rightarrow higher yield of final EP for gradients > 30 MV/m
- Industrialization of Main EP successful
- Re-processing with only HPR effective against field emission
- Optimized preparation scheme "with He-tank" successful
- Q-slope w/o field emission not fully cured by "120C bake" for final "Flash BCP"

