Fabrication of Superconducting cavities for SNS

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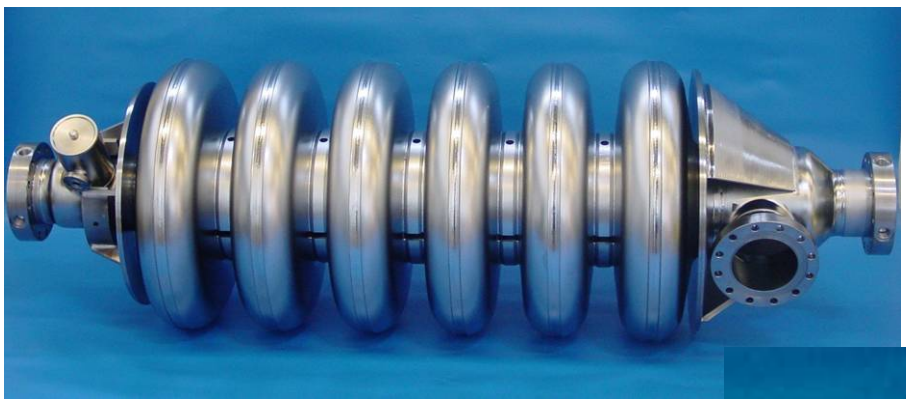
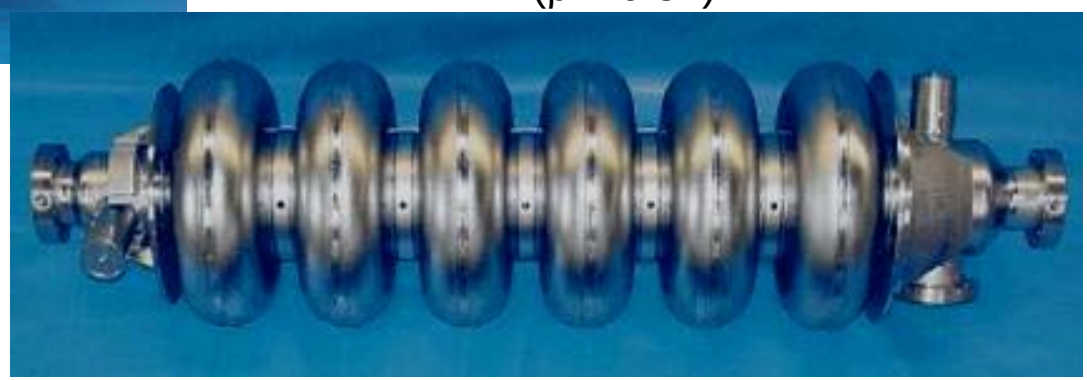


35 medium beta cavities
(β = 0.61)

74 high beta cavities
(β = 0.81)



Scope of production

Cavity manufacturing

- Engineering review of manufacturing procedures of the prototype cavities
- Development of production drawings
- Establish QA plan for cavity production and detailed workshop travelers
- Design and manufacturing of all tooling for metal forming, turning, milling, electron beam welding, leak check, inner and outer BCP, tuning

Surface removal by buffered chemical polishing BCP 1:1:2

- 30 µm from outer surface
- 100 µm from inner surface

Cavity tuning

- Tuning of field flatness
- Adjustment of external Q of fundamental mode of HOM coupler to > $1 \cdot 10^{12}$

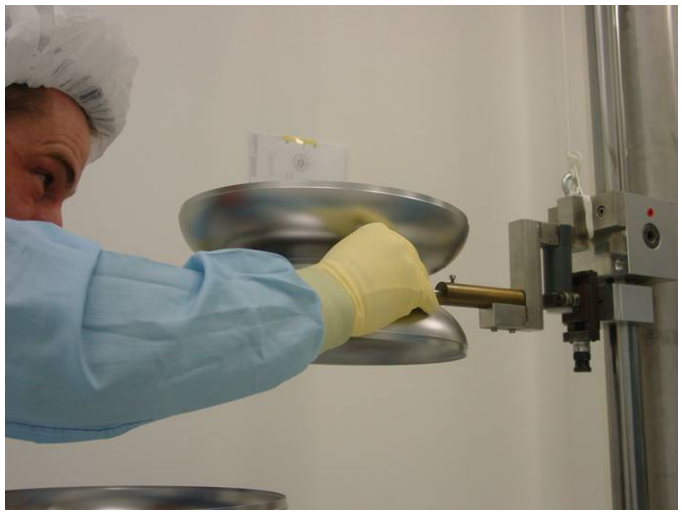
Cavity Production

Development of raw end groups from one niobium sheet (RRR40), helps to reduce required welds

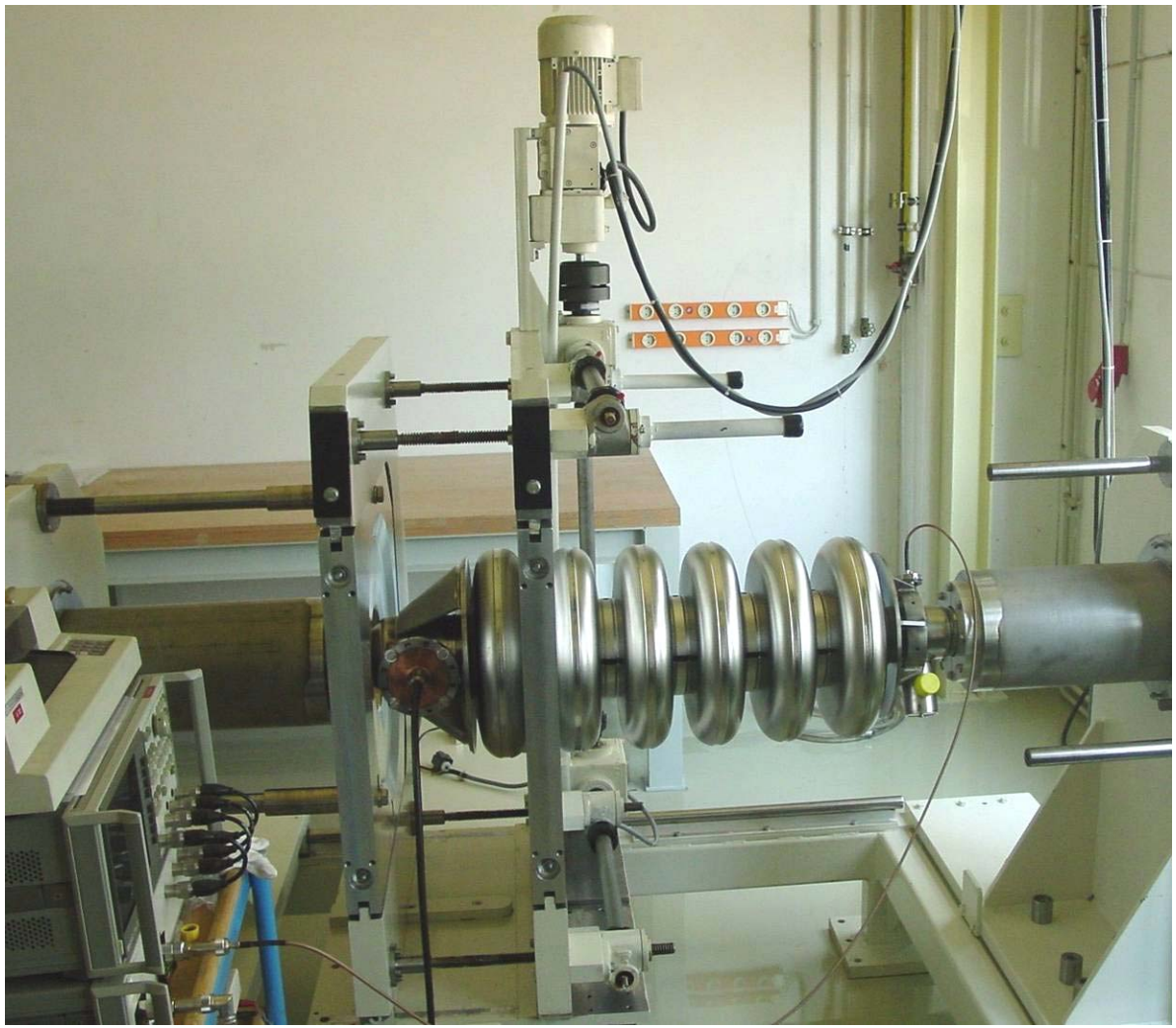
RF measurement of dumbbell frequencies and final machining of dumbbell depening on RF result helps to meet correct frequency and reduces tuning effort of completed cavities

Electron beam welding

Welds located in high magnetic field region: assembly in clean room to avoid contamination



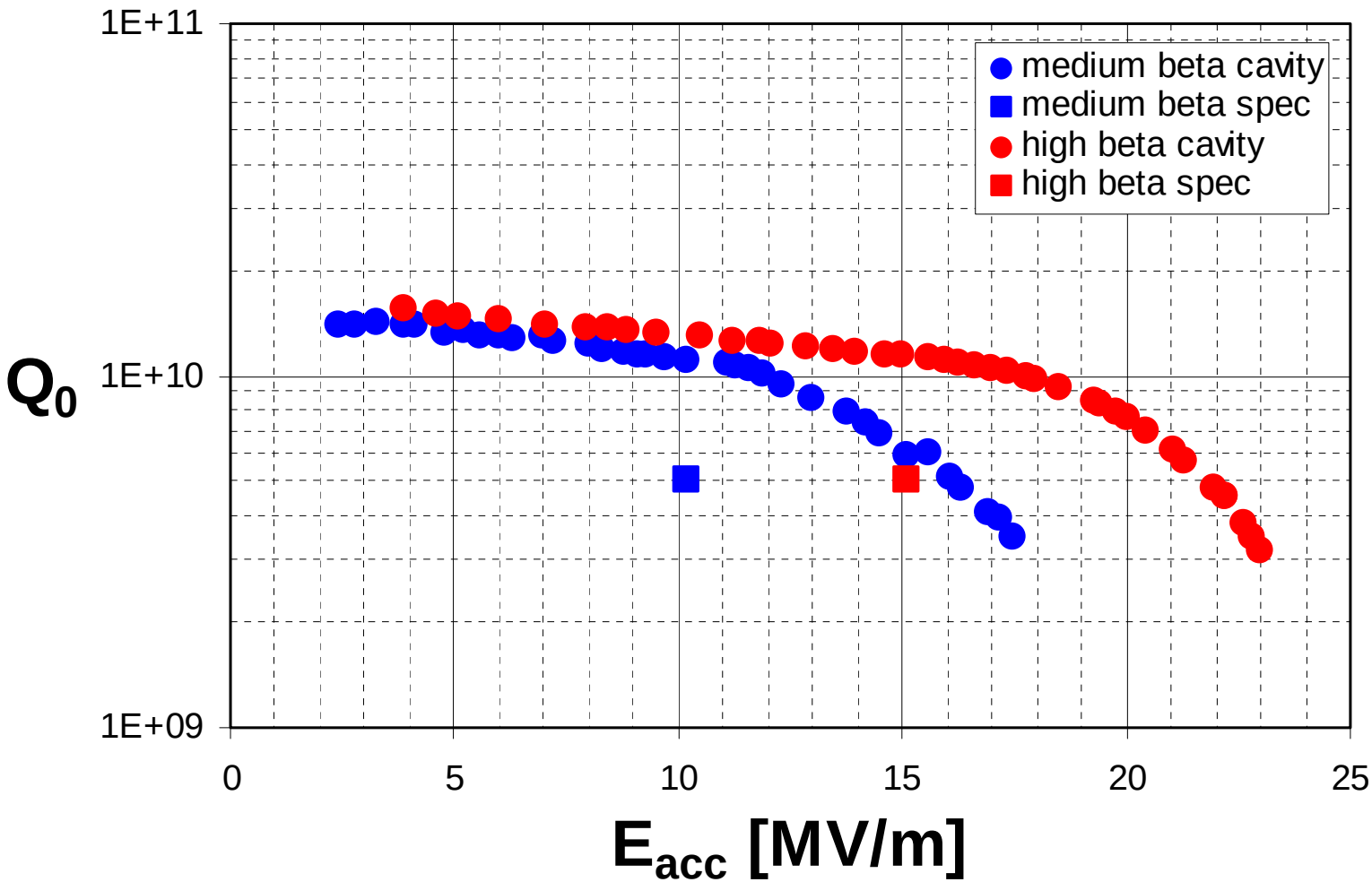
Cavity Tuning



Field flatness of 1 % easily achieved

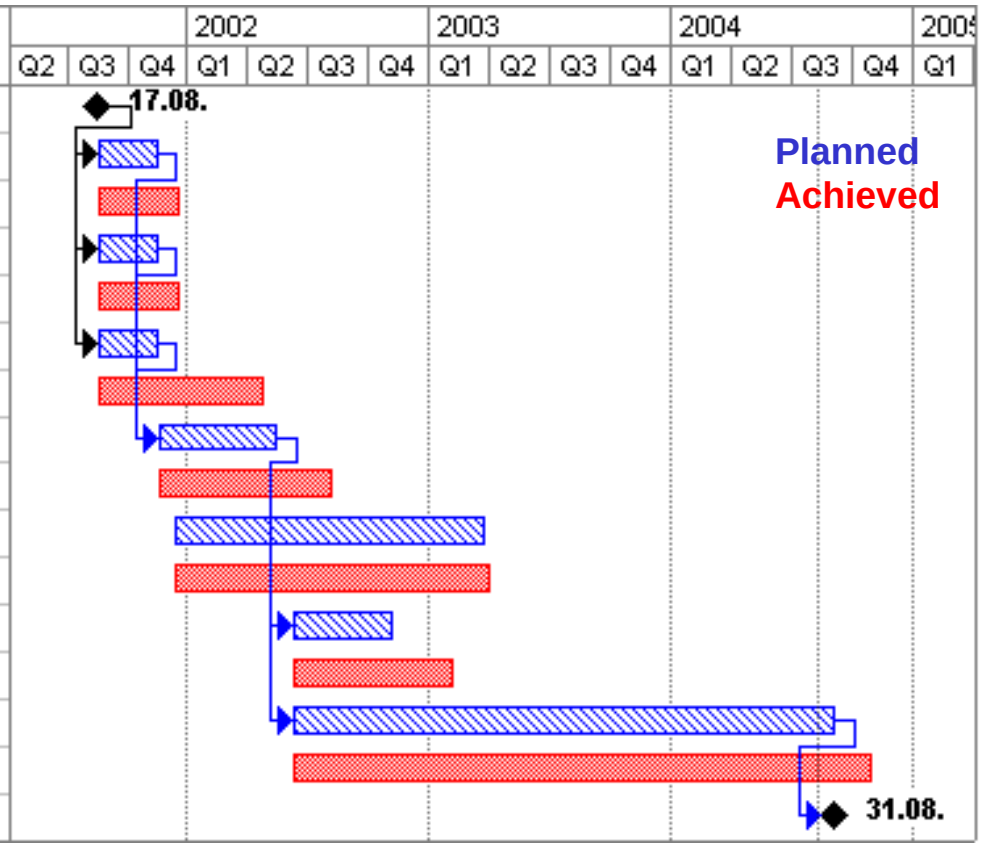
Due to dumbbell RF measurement field flatness of 25% already after final welding

RF Test results (JLAB)

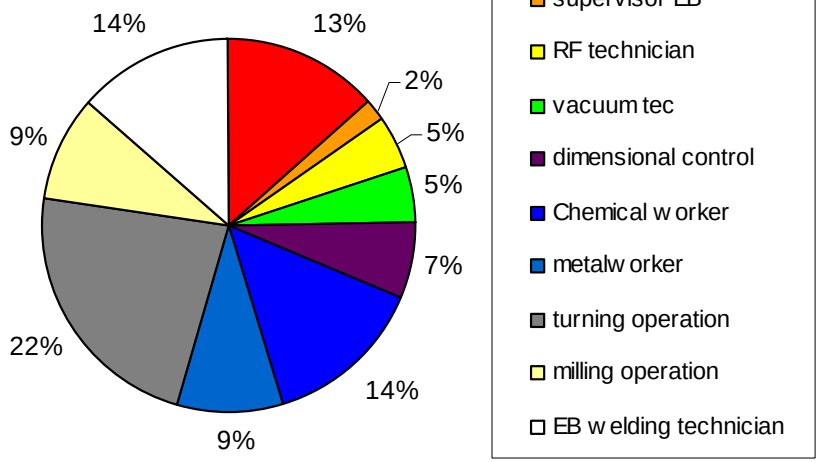


Time schedule

Vorgangsname
contract award
production of manufacturing drawings
QA plan, travellers
design and prodcution of tooling
Production first article medium beta cavity
Series production of 34 medium beta cavities
Production of first article high beta cavities
Series production of 75 high beta cavities
Project end



Required personnel / Future cavity series production



- **Only maximum of 73 similar cavities produced (still small number); not yet implemented highly efficient mass production tools. Less engineering per cavity needed for higher cavity numbers**
- **The two first article cavities and design of tooling also required relative high percentage of engineers involved in the production**
- **Tooling for electron beam welding and electron beam welding machine itself have still potential for further optimization. Reduction of electron beam welding time per cavity possible**
- **All involved machines and services not exclusively dedicated to this project during whole contract period. Storage of parts and internal transport can be reduced when machines and locations are dedicated to only one big mass production project.**
- **Milling and turning capacity can be easily enlarged for high cavity numbers by establishing a two or three shift operation.**

SNS cavities were produced in one shift, 5 days week
6 cavities delivered to JLAB every 6 weeks

Past similar projects

CEBAF/JLab: Series Production of 360 Cavities in 3 years

Scope:
Development of manufacturing technologies
Manufacturing
RF Measurements
BCP
Guaranteed performance

Production Rate:
12 Cavities / Month

Acknowledgement

We thank Peter Kneisel and Tim Cannella from JLAB for the fruitful collaboration during this work.

We thank Joe Ozelis from JLAB for providing SNS cavity cold test results.

Thank you