JRA1 start up meeting
WP 3, Seamless Cavity Production

W.- D. Möller, DESY

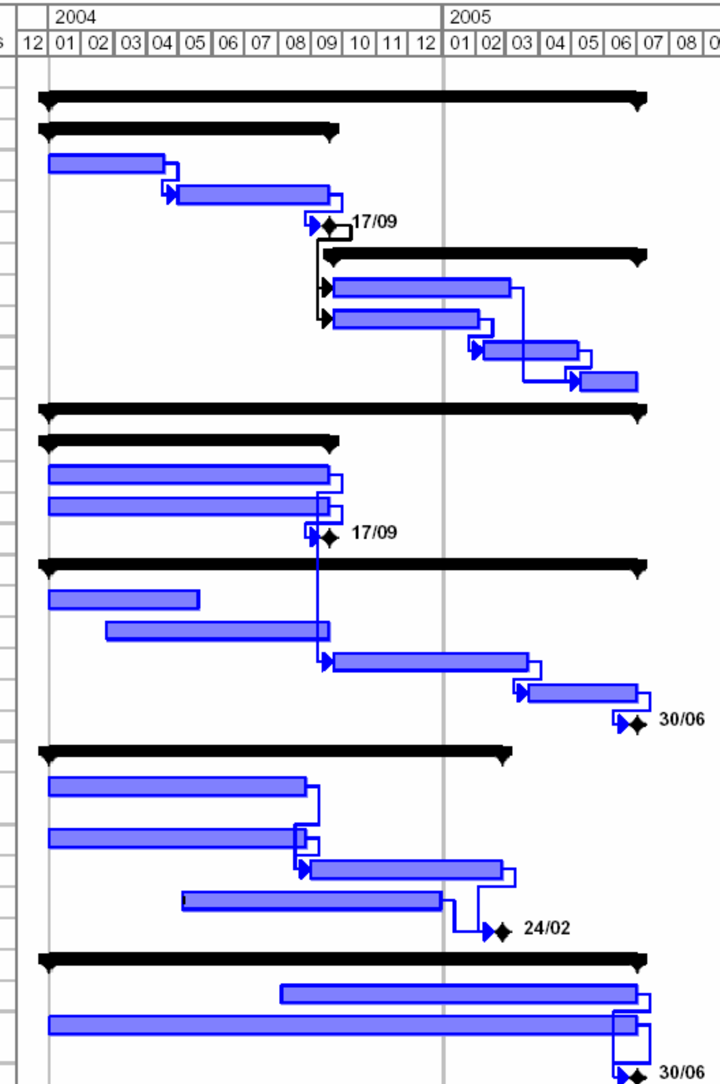
- WP1 follows the idea to fabricate the actual cavity (excluding the end groups with auxiliary components like input coupler ports, higher order mode dampers…) by a method that avoids welding.
- This would eliminate possible performance degradation by a low quality weld.
- There are two methods of seamless production: spinning and hydro-forming.
- Very encouraging results are obtained with single cell cavities.
- This technology will be extended to multi-cell cavities.

Deliverables for WP3

- spinning
  - Design, commissioning and operation of a machine for spinning multicell cavities
  - Deliverables: Description of optimum parameters for spinning and production of prototypes Seamless cavity production by hydroforming
- hydroforming
  - Design, commissioning and operation of a machine for hydroforming of multicell cavities.
  - Deliverables: Description of optimum parameters for hydroforming and production of prototypes

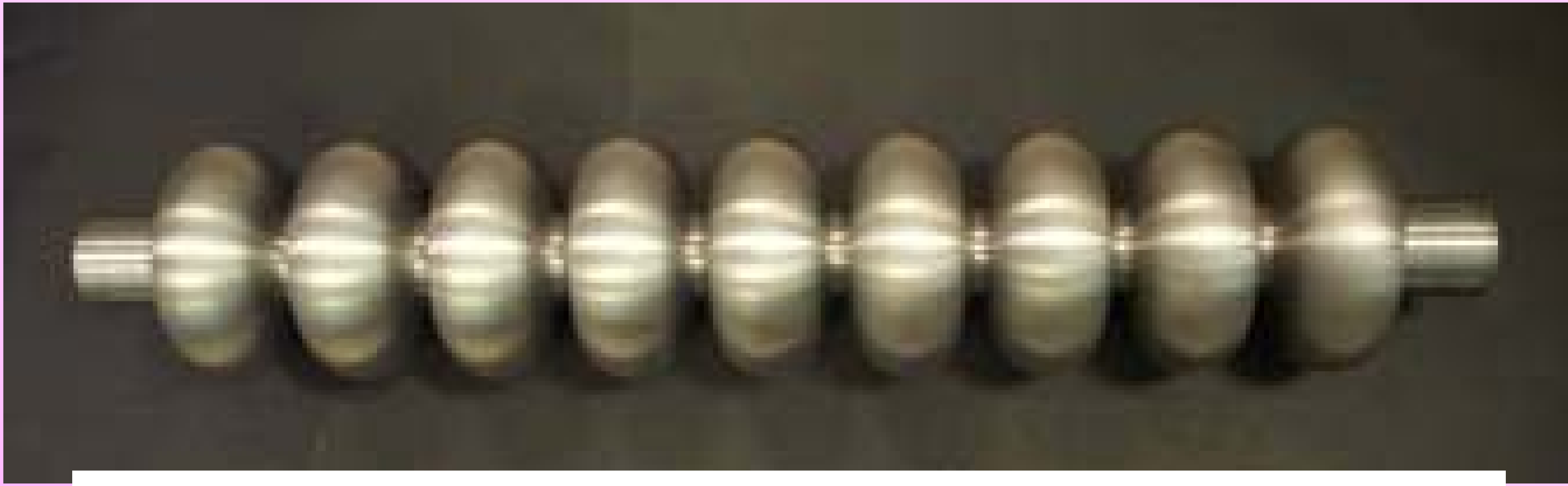
Time Schedule for the next 18 Month

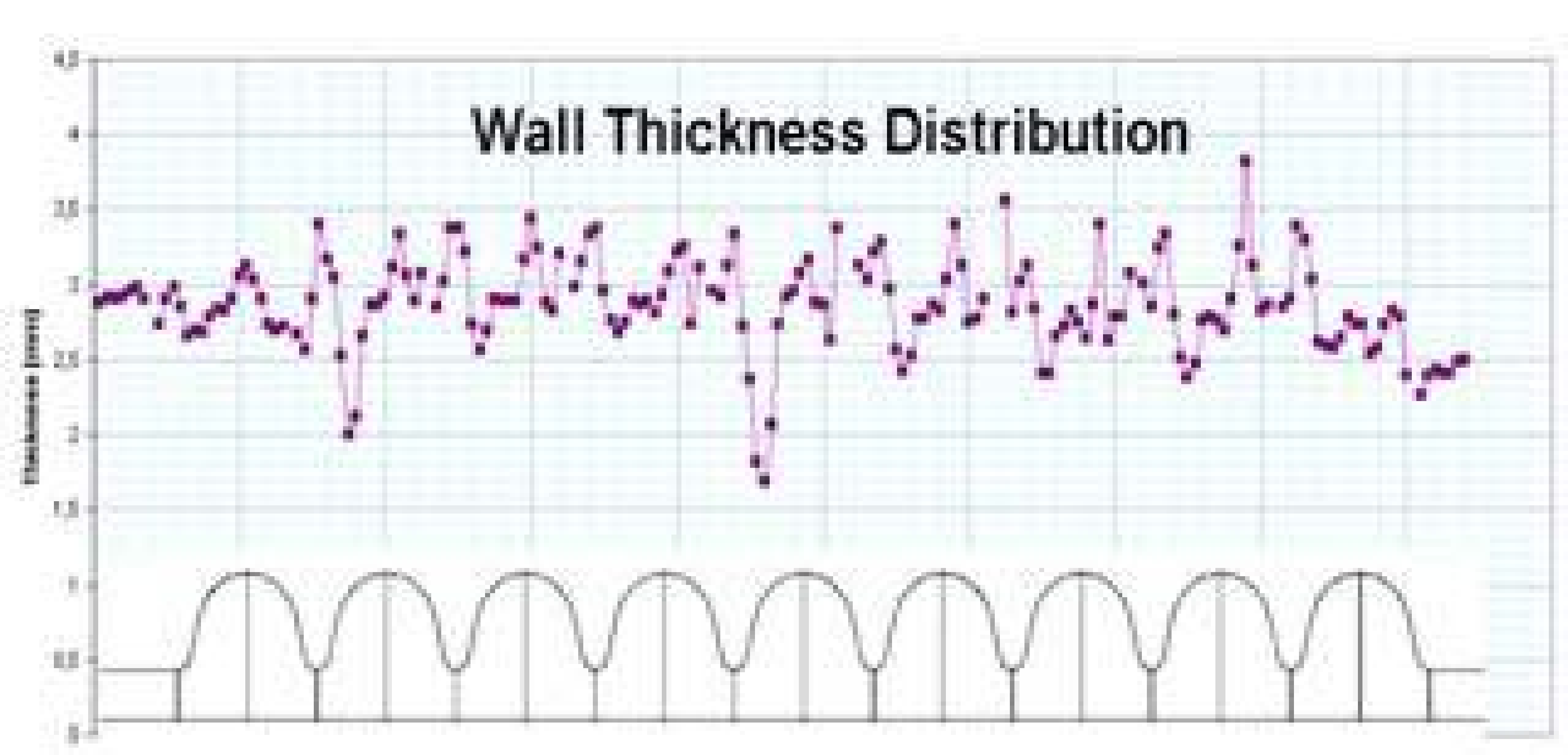
Task Name	Milestones	Deliverables
WP3 Seamless cavity production		
3.1 Seamless by spinning		
3.1.1 Design spinning machine		
3.1.1.1 Drawings of the matrices		
3.1.1.2 Drawings of the support system		
3.1.1.3 Design finished	**Design finished**	
3.1.2 Construction of spinning machine		
3.1.2.1 fabrication of machine parts		
3.1.2.2 Software for the machine		
3.1.2.3 assembly of machine		
3.1.2.4 Commissioning of the machine		
3.2 Seamless by hydroforming		
3.2.1 Design hydroforming machine		
3.2.1.1 Drawings of the matrices		
3.2.1.2 Drawings of the support system		
3.2.1.3 Design finished	**Design report**	
3.2.2 Construction of hydroforming machine		
3.2.2.1 Hydraulic for machine		
3.2.2.2 Software for the machine		
3.2.2.3 Machine fabrication		
3.2.2.4 Commissioning of the machine		
3.2.2.5 Commissioning finished	**Hydroforming machine ready**	
3.2.3 Construction of tube necking machine		
3.2.3.1 Drawings of the support system and turning mechanism		
3.2.3.2 Drawings of the necking mechanism		
3.2.3.3 Construction of the tube necking machine		
3.2.3.4 Software for the tube necking machine		
3.2.3.5 Necking machine ready	**Necking machine ready**	
3.2.4 Development of seamless tubes for 9-cell cavities		
3.2.4.1 Fabrication and inspection of bulk Nb test tubes		
3.2.4.2 Fabrication and inspection of bimetallic NbCu test tubes		
3.2.4.3 Seamless tubes ready	**Prototypes of tubes finished**	



JRA1 WP3 Task 3.1
Seamless cavity production by spinning.

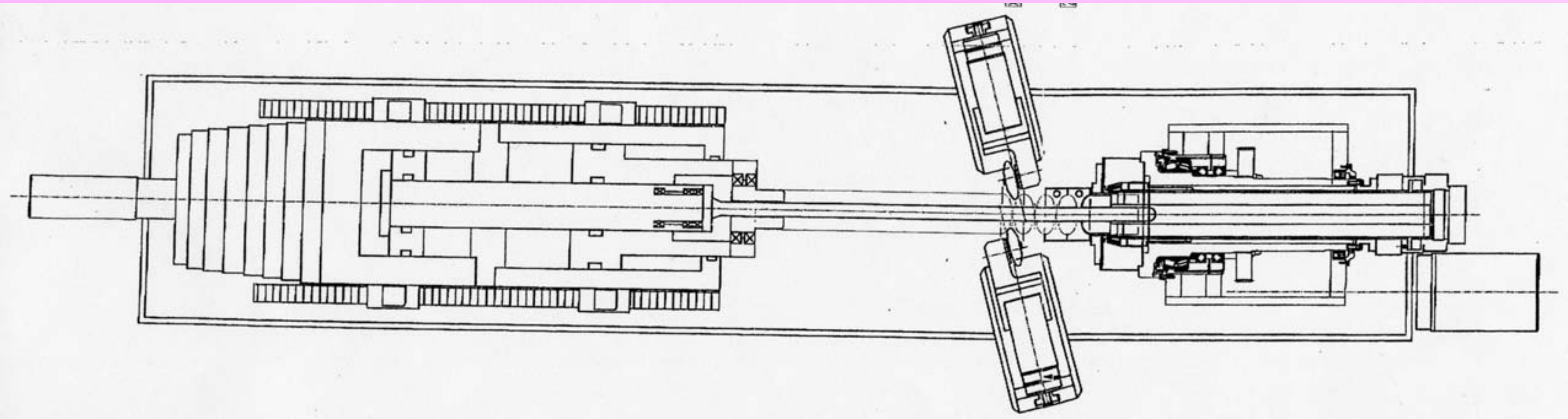
Enzo Palmeri





Wall Thickness Distribution
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0

What we plan to do is to modify a standard spinning lathe in order to have a machine peculiar for 9-cells



A standard machine will be adapted by increasing the pressure between headstock and tailstock; a second roller tower will be added if it will be not possible to make the roller pushing also backward

Scientific Programme:

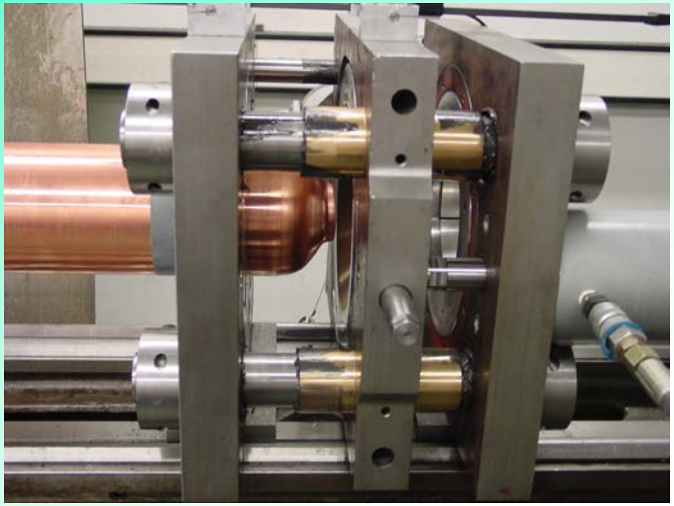
Pre-Industrialization of the spinning technique by:

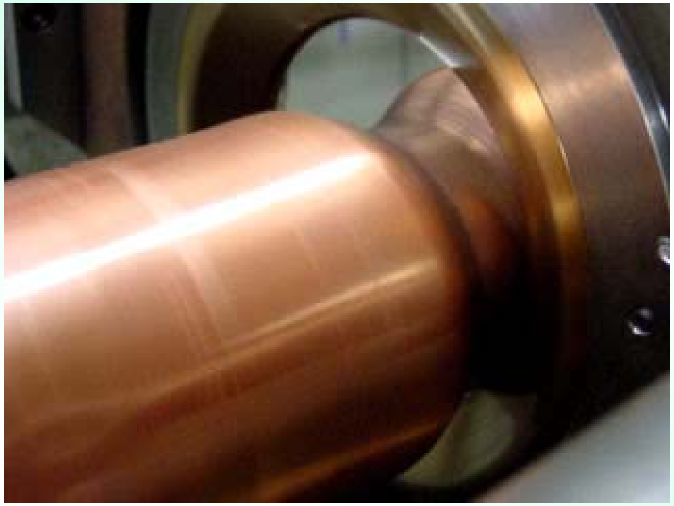
- Construction of other 9-cell prototypes with an improved internal finishing after forming.
- Reduction of spinning time

JRA1 WP3 Task 3.2
Seamless cavity production by hydroforming.

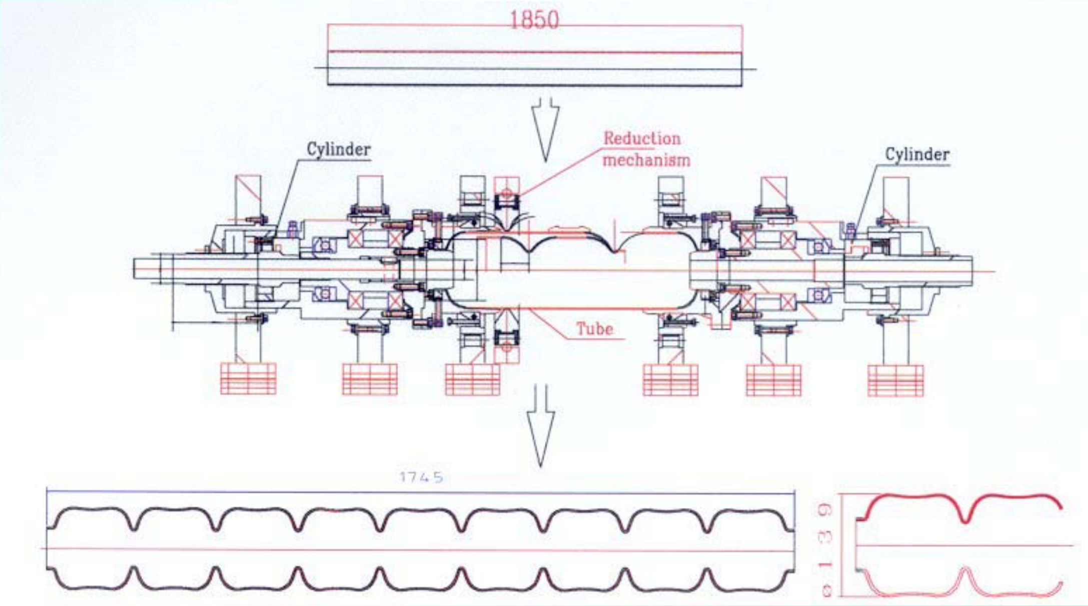
W. Singer

Necking machine: new PC controlled necking procedure with profile ring.





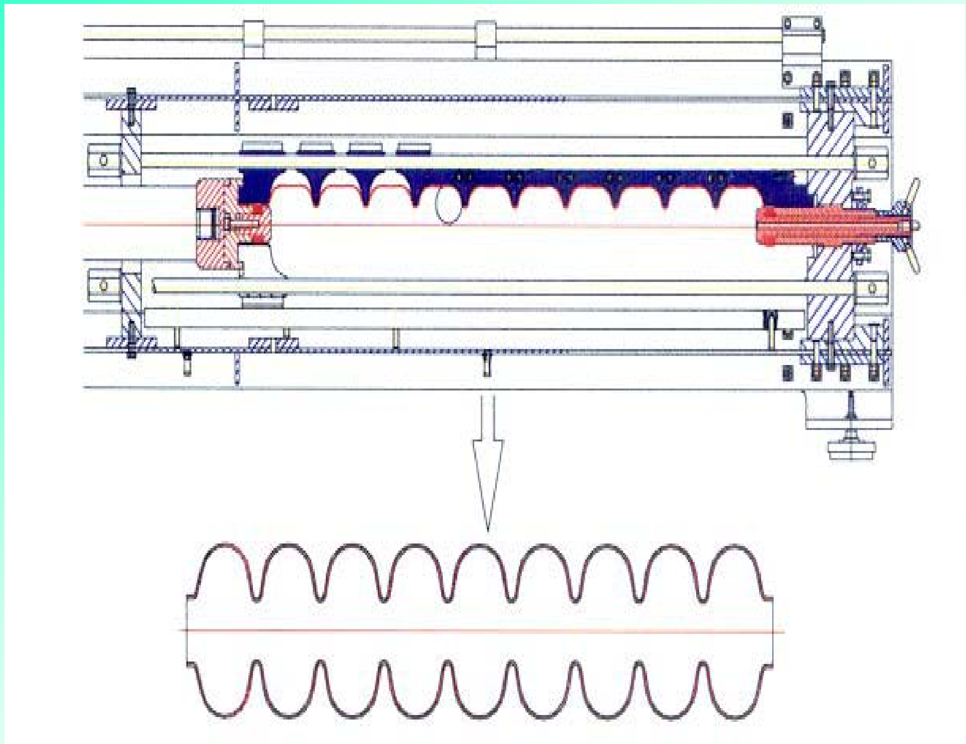
Necking mechanism.



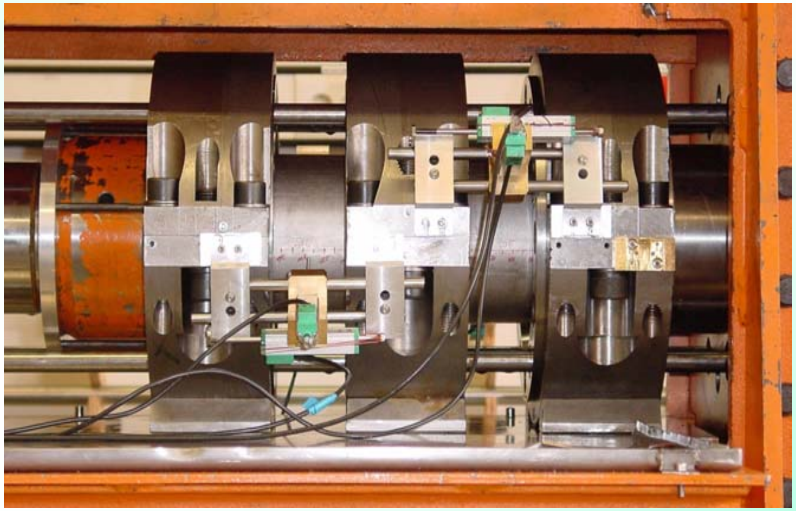
Principle of tube diameter reduction in the iris area

The equipment construction and set up of the parameters, especially regarding iris area, should be done

Hydroforming machine (reconstruction)



Principle of the tube expansion
with intermediate matrix



Heart of hydroforming machine

Equipment allowing reliable simultaneous fabrication of three cells

Equipment allowing fabrication of any desired number of cells

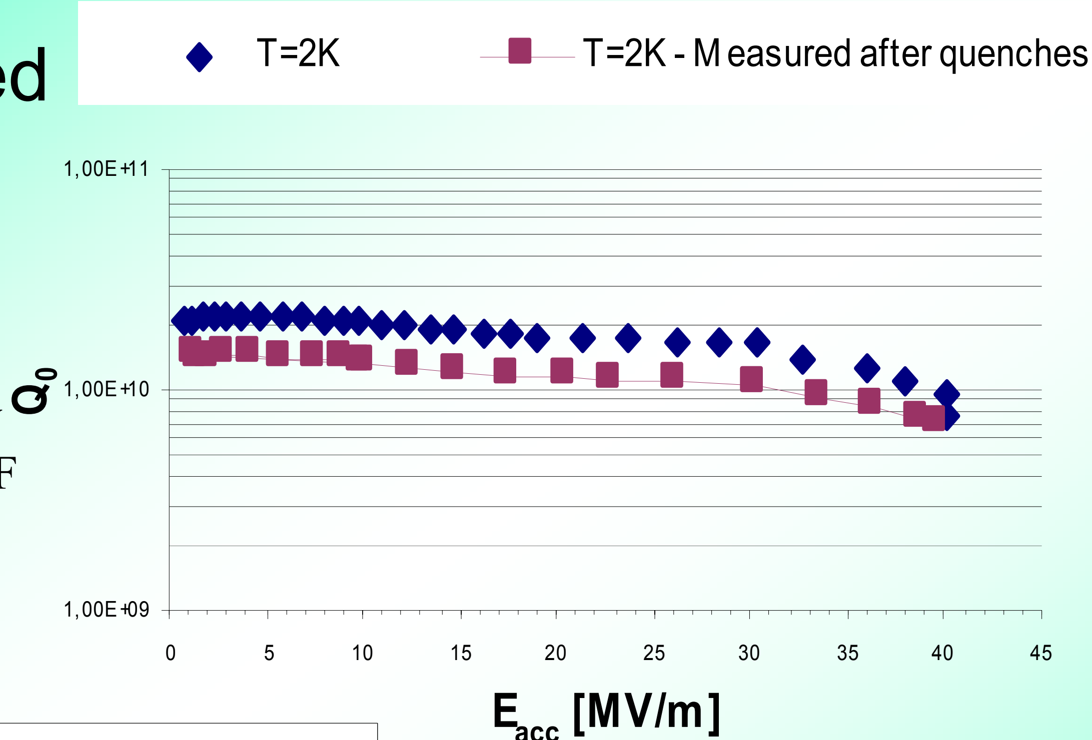
Fabrication of seamless tubes

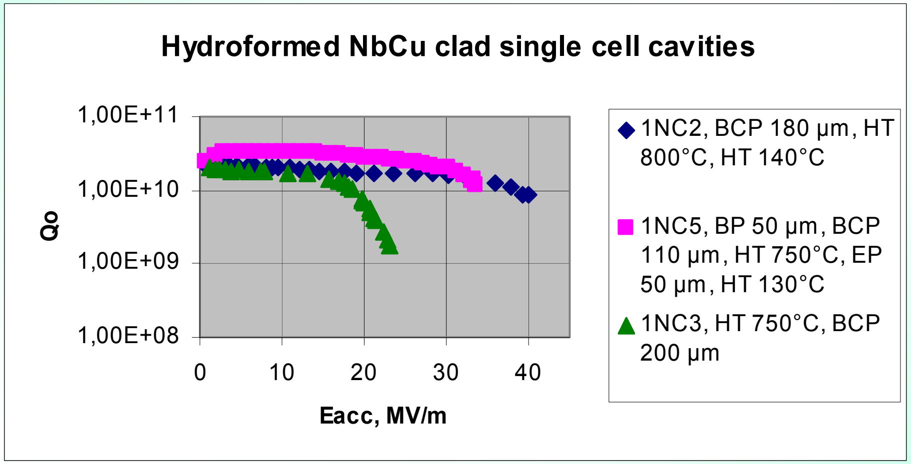
- Bulk Nb tubes

- NbCu bonded tubes

Explosively bonded NbCu tubes

NbCu single cell cavity 1NC2 produced at DESY by hydroforming from explosively bonded tube. Preparation and HF tests at Jeff. Lab: 180 µm BCP, annealing at 800°C, baking at 140°C for 30 hours, HPR.

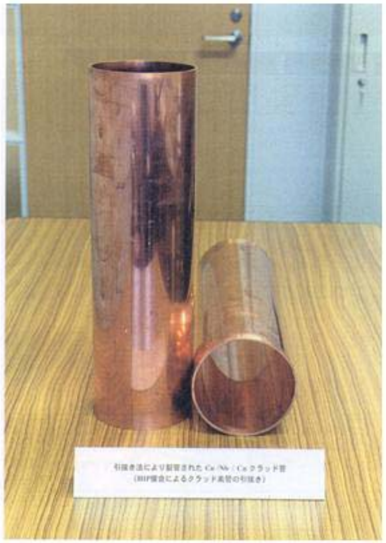


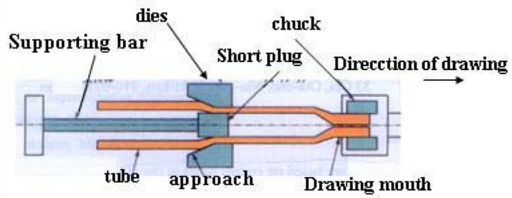


Summary of HF tests on NbCu explosively bonded cavities. Preparation and RF tests at JLab, KEK, DESY

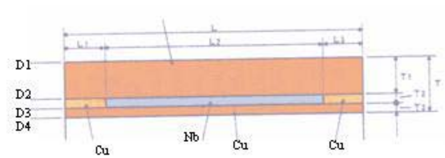
Experiences: It is difficult to keep the explosive bonding parameters under control.

Coextruded NbCu tubes (another fabrication procedure)





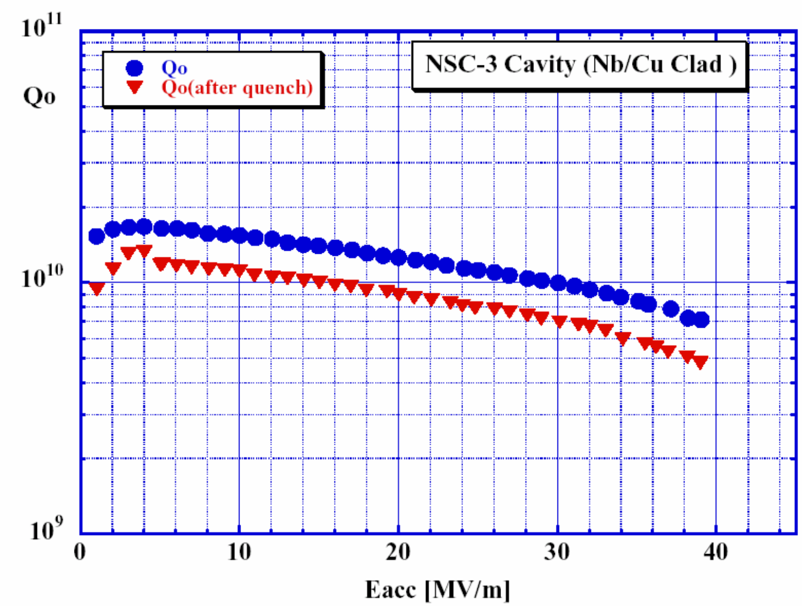
Principle of the tube drawing technology



Cu-Nb-Cu Sandwiched Tubes (KEK)

Fabrication principle of sandwiched Cu-Nb-Cu tube

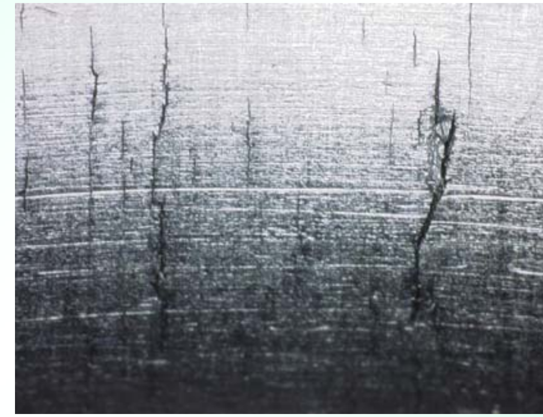
NSC-3: Barrel polishing, CP(10microns), Annealing 750°C x 3h, EP(70microns) by K.Saito



Single cell NbCu cavities produced at DESY from KEK sandwiched tube. The best achieved result Eacc = 39MV/m

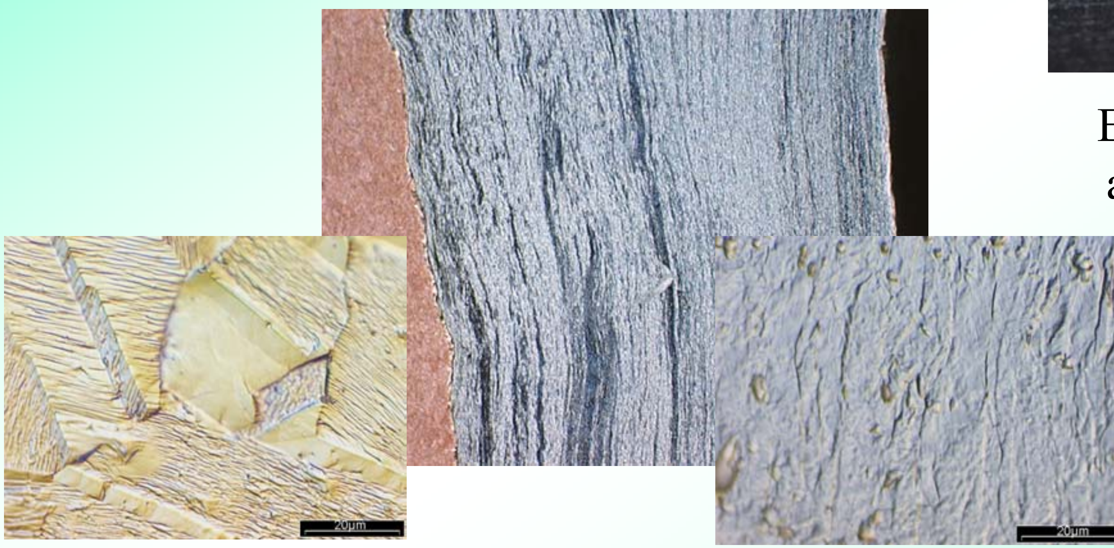
E_{acc} of best sputtered NbCu cavities is <25 MV/m

Fight against dangerous of cracks in iris area appeared during hydroforming.



Example of cracks at iris area after hydroforming

The difference in recrystallization temperature of Nb and Cu is significant



Microstructure of Cu and Nb after annealing at 560°C for 2 hours. Nb is not recrystallysed.

Possible solution:

using specially dotted Cu with high recrystallization temperature