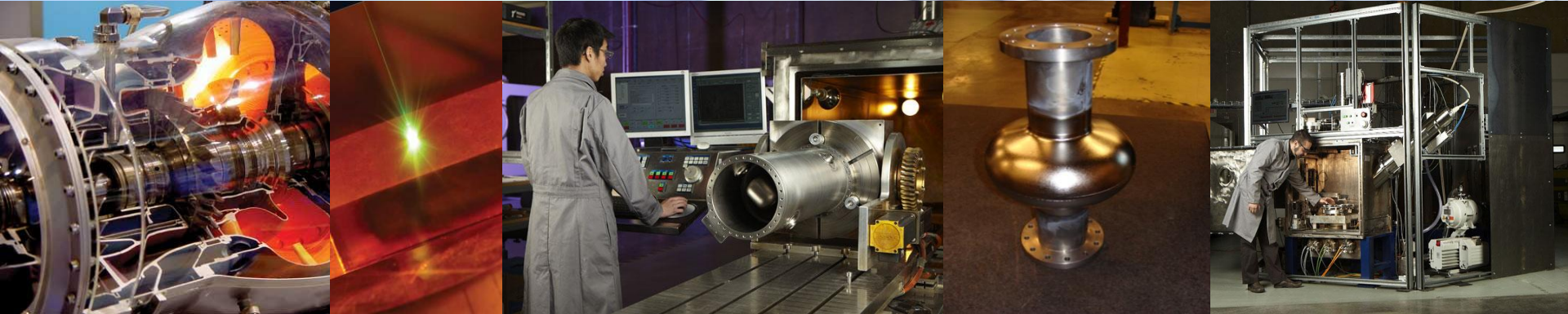


Direct and Indirect Process Feedbacks for the Fabrication of 1.3GHz Elliptical SRF Resonators to Improve Production Yields



6th SRF Materials Workshop
February 18-20, 2010, Tallahassee, FL
Presented by Ralf Edinger



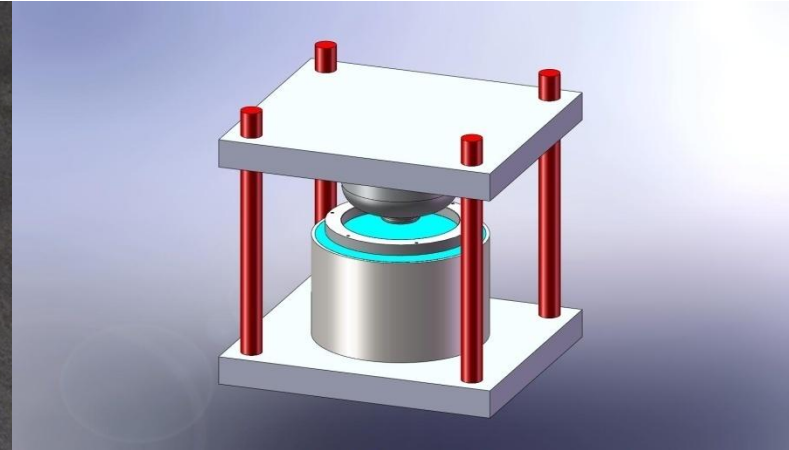
Start Condition Nb Sheets



- Varying surface finishes have impact on the quality of the formed part
- The number of defects (imprints) on sheets before fabrication starts must be reduced



Forming Tooling



“HARD DIES”

- Establishing pressure curves
- Mapping changes in material thickness
- Dimensional scan shape of half cell
- RF surface condition after forming

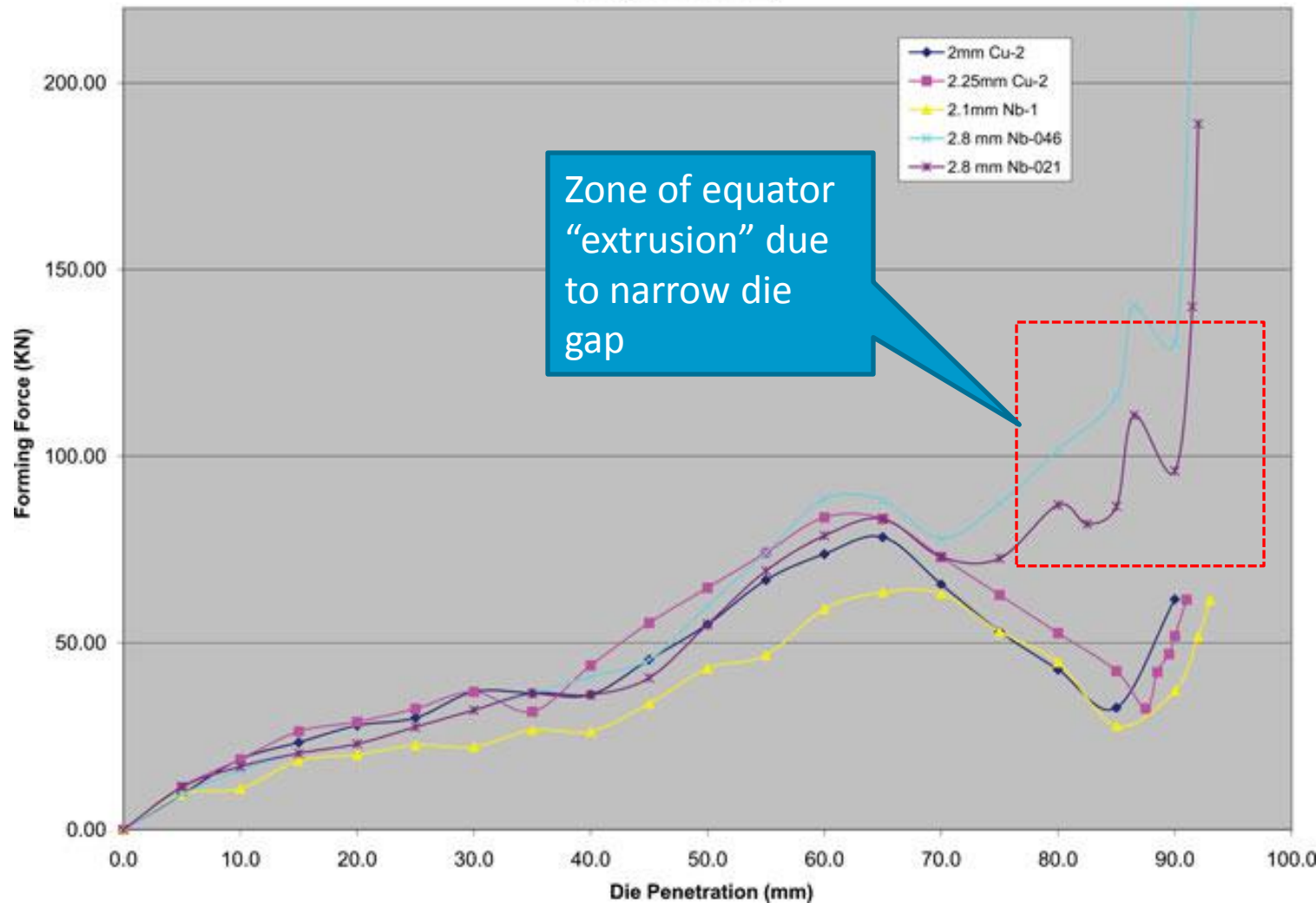
“POLYMER TOOL”



Possible Defects from Forming 1

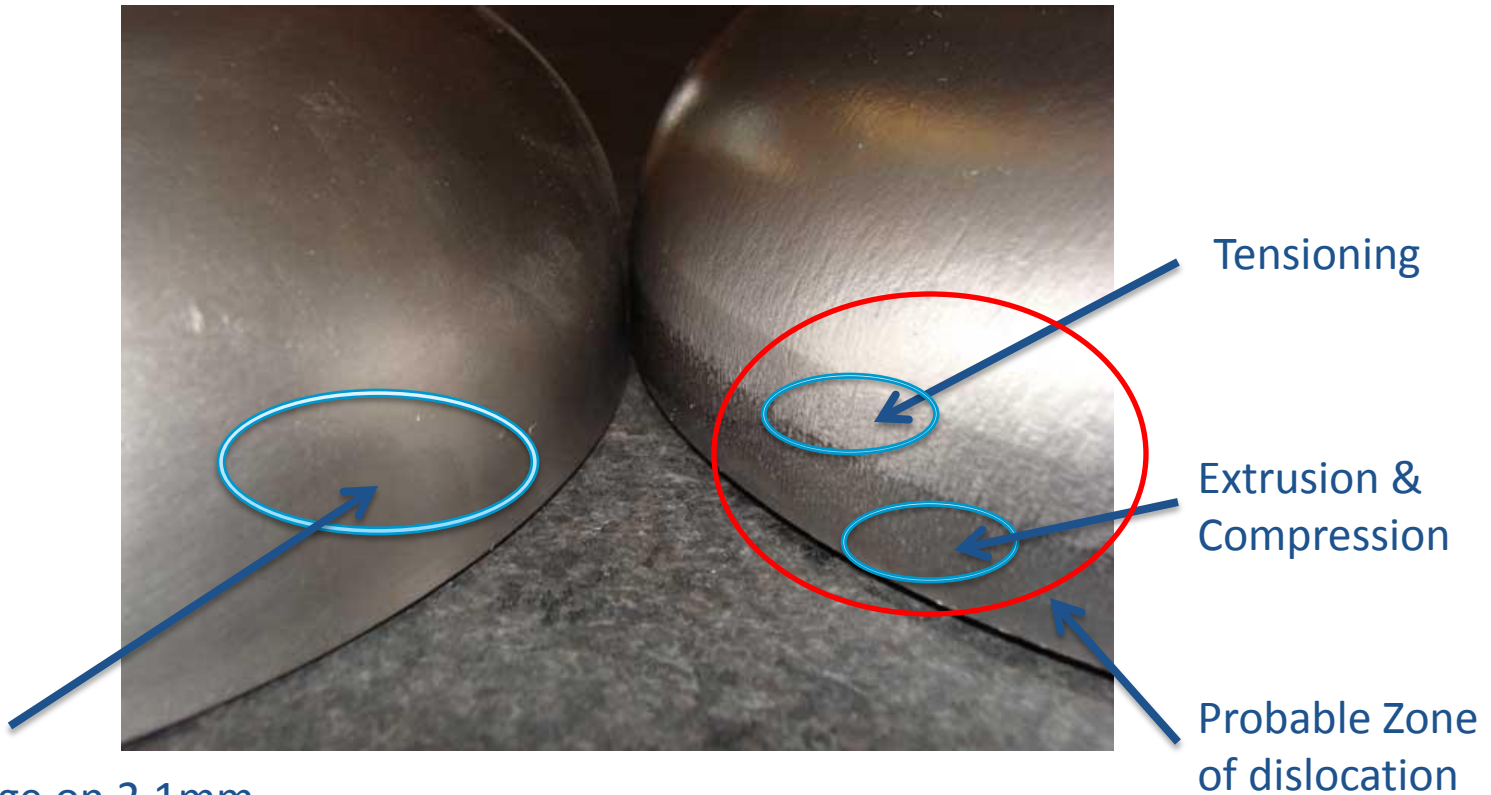
(Copper & Niobium)

HARD DIES



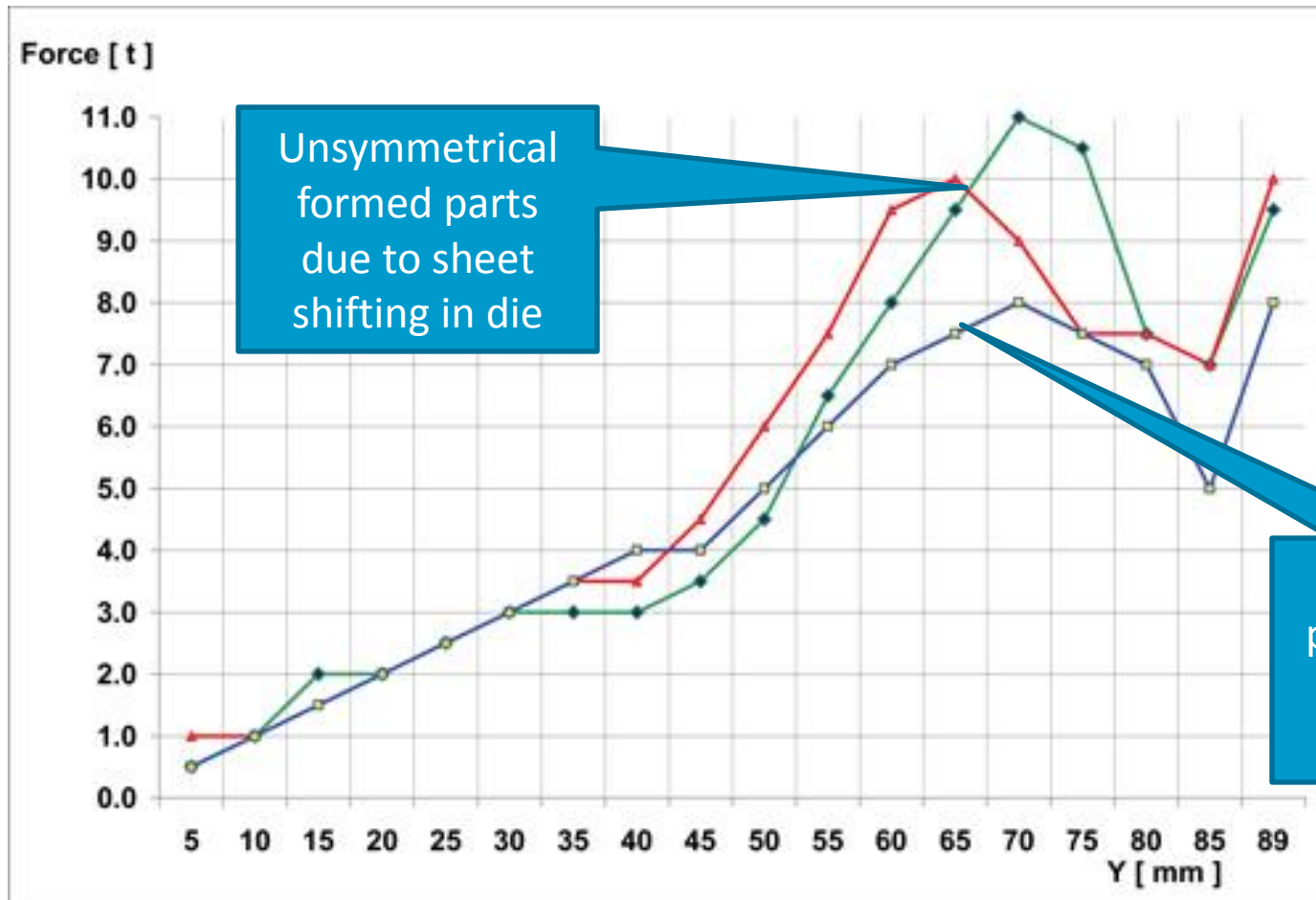


Equator Effects caused by Dies





Possible Defects from Forming 2





Mapping of Material Thickness



Iris compression/ thinning
resulting from forming
Decrease in thickness at Iris ~15%;



Equator thickening
resulting from forming
Increase in thickness of 10%



Pre-Condition Impact



Strong surface structuring due to forming (orange peeling)

Surface finish very smooth; no structuring due to forming visible



RF-Surface Condition



RF-surface finish is depended on a number of variables

- Start condition of Nb Sheet
- Grain structure and direction
- Type/design of forming tool
- Surface finish of dies during forming; Al very problematic for production runs

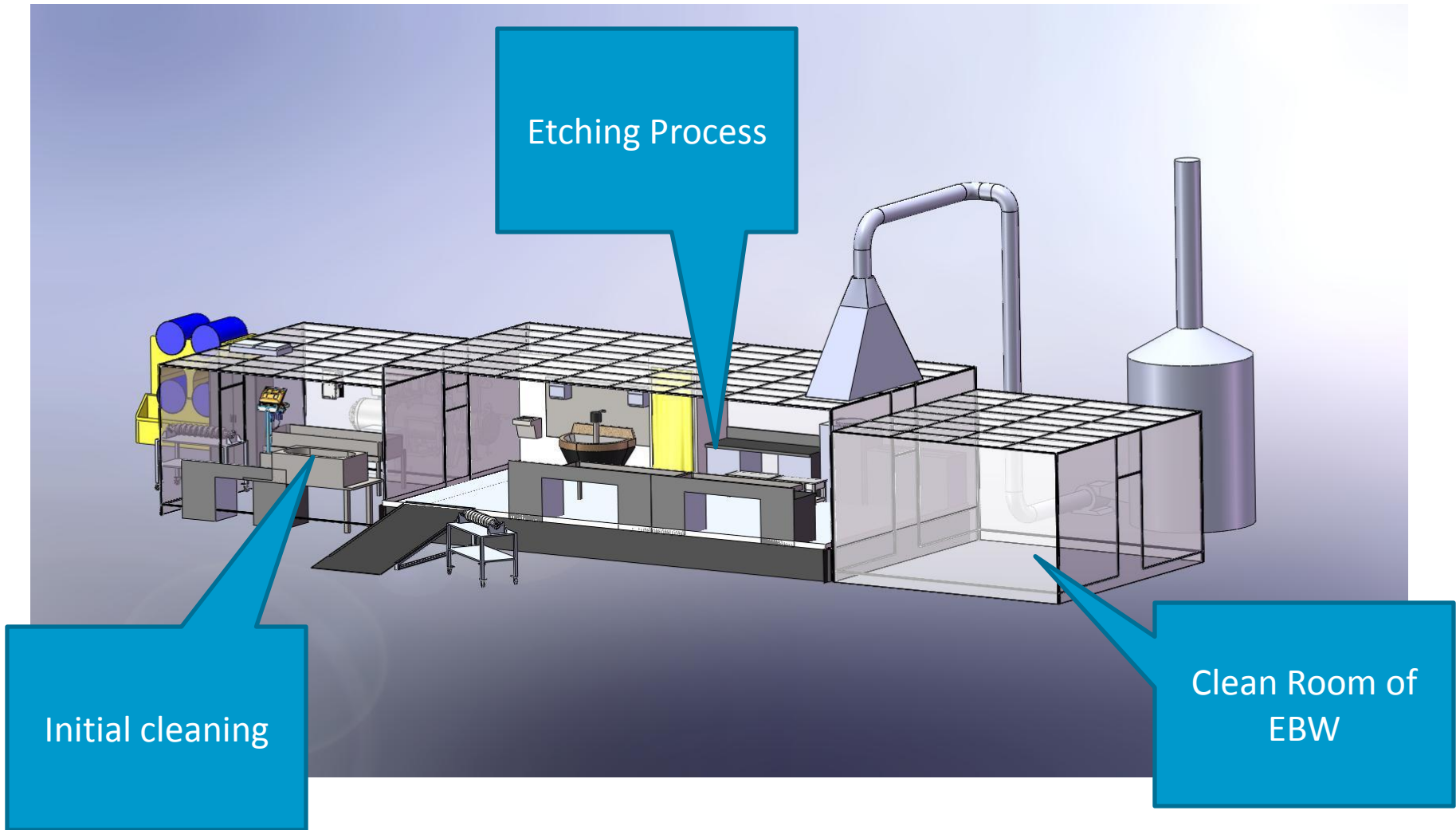


Question Forming

Heat treatment of half cells after forming?



Etch / EBW Line Concept





Question Pre-EBW

Half-cell- / Nb assembly bake after etching & rinsing before EBW?

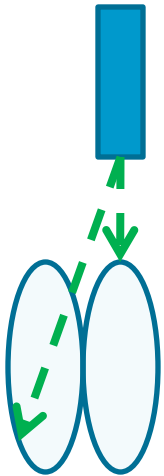
Pre-weld bake and “hot assembly” used
Sensor/aerospace industry (30 to 80°C)



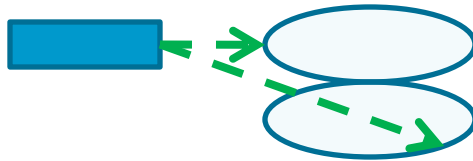
EBW & Fixture

BEAM - ARRANGEMENT

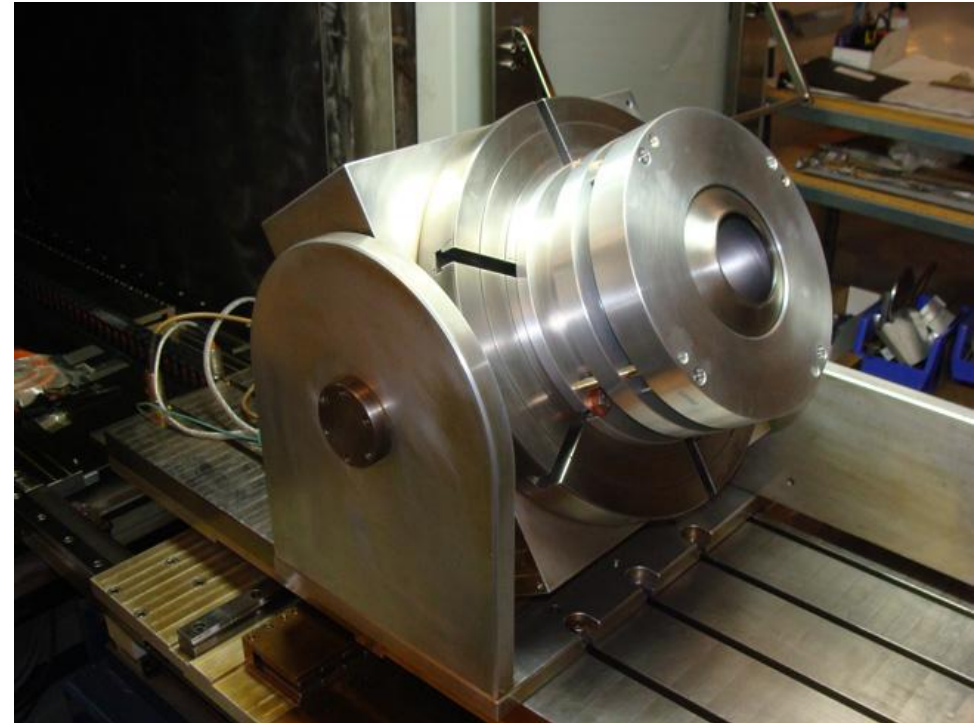
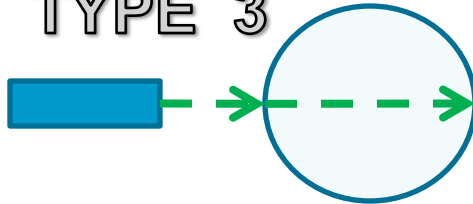
TYPE 1



TYPE 2



TYPE 3

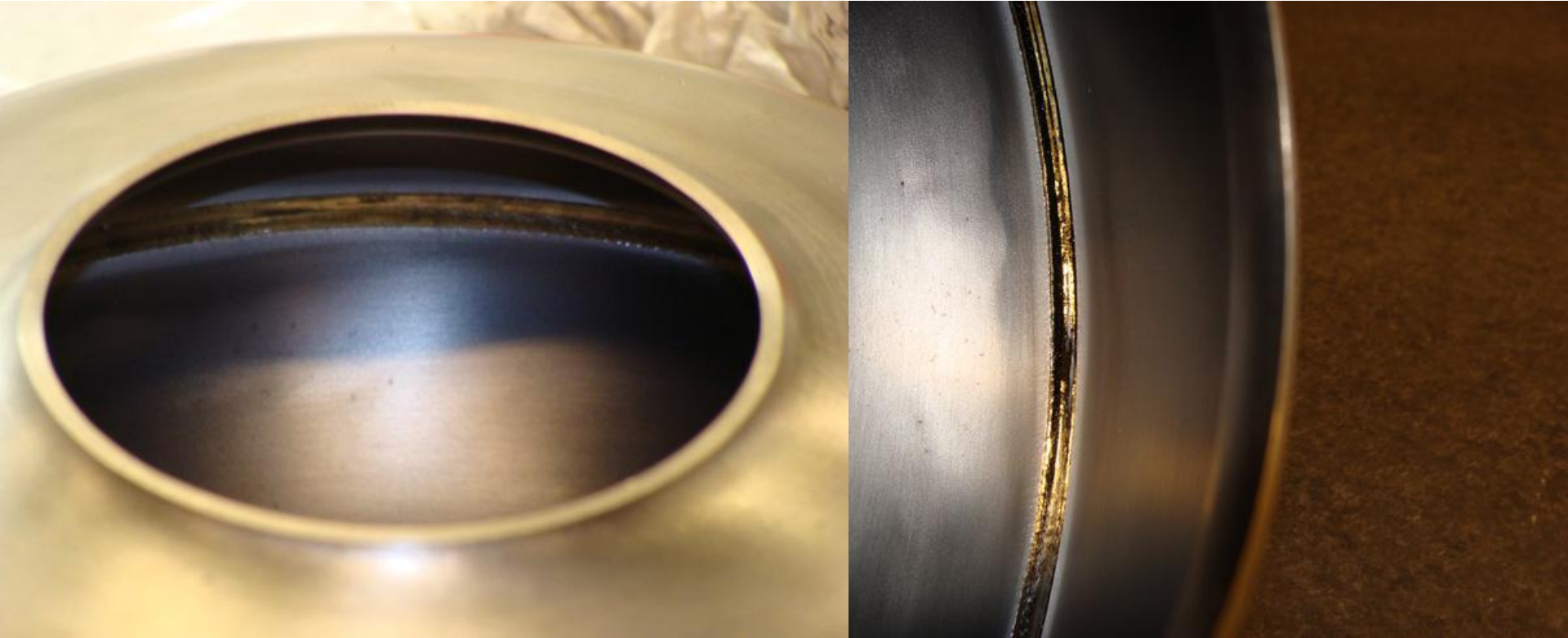


EBW fixture to secure half cell close to equator during welding. Integrated dynamic weld preload (springs) for length compensation.

Effect: Colder surfaces (steeper ΔT) reduces adhesive bonding of weld deposition.



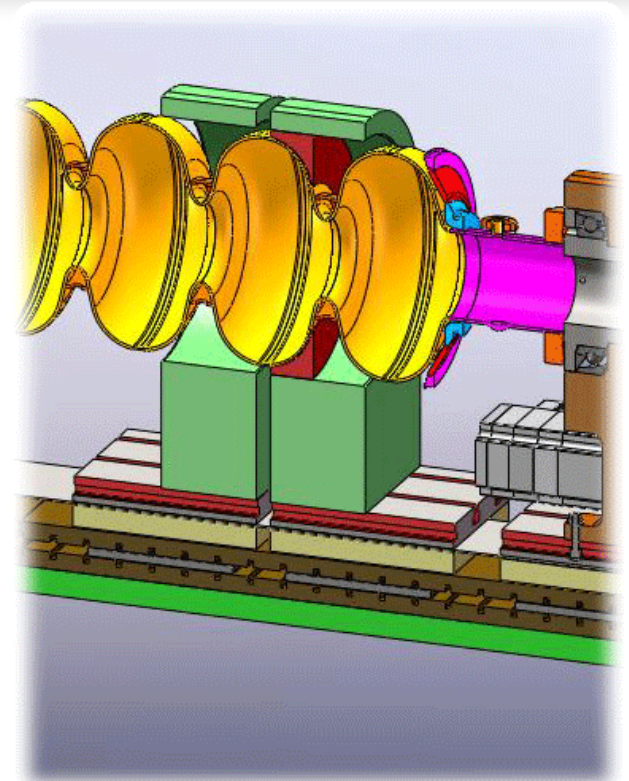
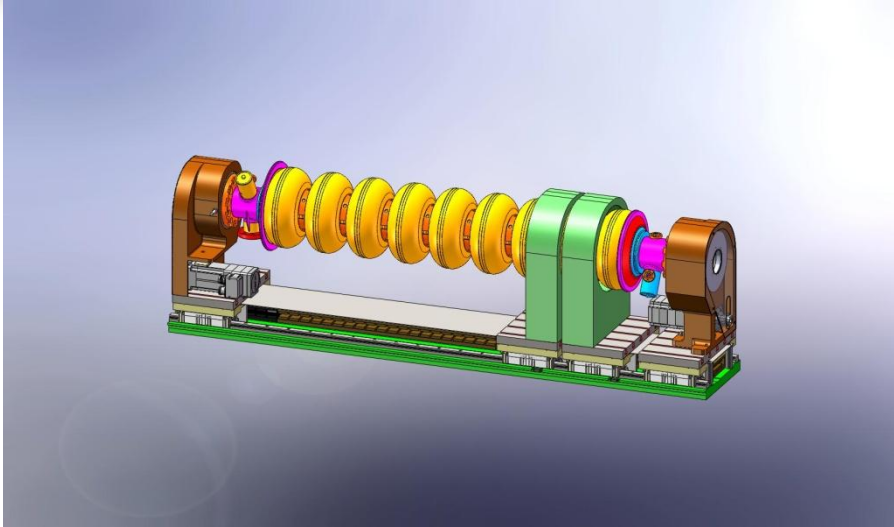
EBW Smart-bell



First results show very good weld surface formation inside the cavity. New modified welding parameters reduced the amount of weld deposition (solid and vapor)



New EBW Concepts



Monitoring of load on cavity during assembly and EBW in order to capture fabrication data.

Define contact points on surfaces for control.

Is higher temperature gradient during EBW better?





Summary

- Dumbbell / Smartbell both strategies are possible; what is the perfect weld / cavity surface for SRF?
- Smartbell configuration - blending of Iris possible
- Control forces / integrated data collection during the fabrication of cavities (forming, welding etc.)
- Heat treatment after forming?
- Baking after etch/rinse prior EBW; (H-guarantee)
- Integrated data collection over cavity processing and handling during fabrication at any given time to improve reliability