



This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

# I.FAST Period 2 Review, July 15 2024

## Report on task 7.5:

# CompactLight Prototype Accelerating Structure

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on behalf of Task 7.5 Collaboration

iFAST

# CompactLight Prototype Accelerating Structures

## Objective:

Build and test, at low and high RF power, two prototypes of the X-band (12 GHz) accelerating structure designed for the CompactLight (XLS) project, a new class of linac-driven FEL facility.

## Deliverables:

**D7.5: Construction of the XLS accelerating structure pre-prototype.**

Development of production process and RF tests of the pre-prototype, Dic. 2023

**D7.6: Construction of the XLS accelerating structure full prototype.**

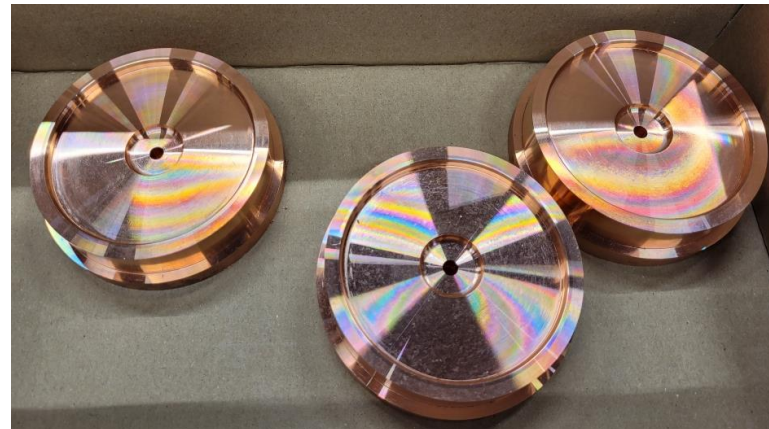
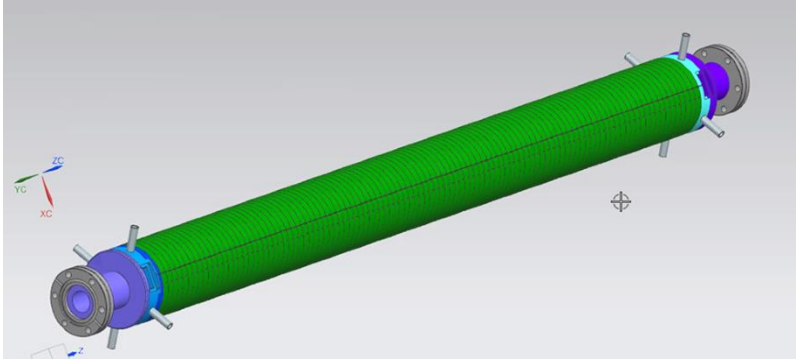
Production process analysis and validation, RF tests of the full prototype, Apr. 2025

## Task 7.5 partners:



# Task 7.5 Status

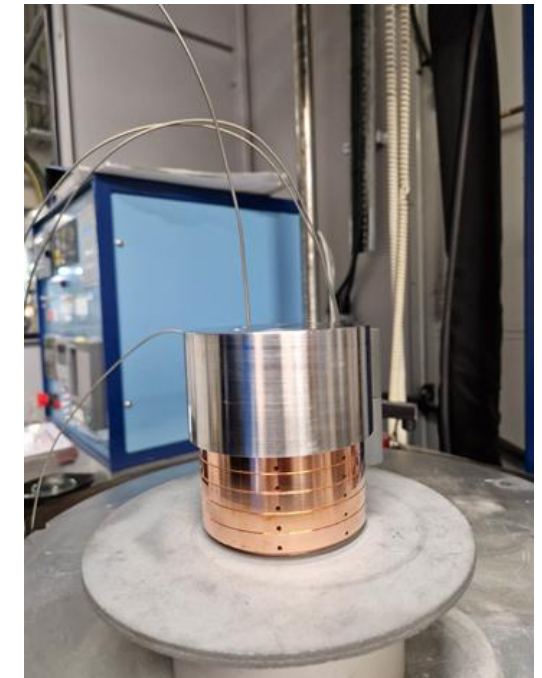
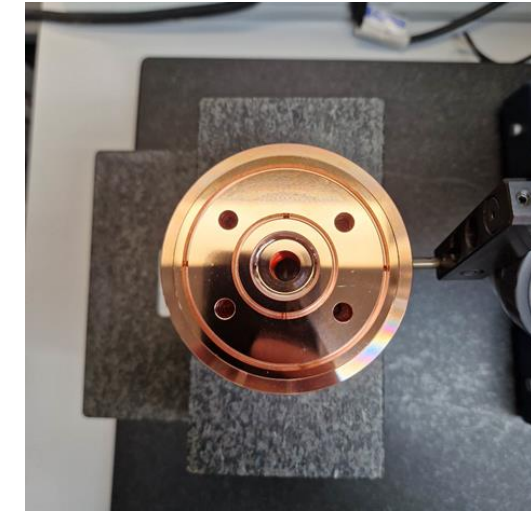
- Components of the first accelerator structure have been completed at VDL.
- Those for the second structure are scheduled for completion in September 2024.





# Mechanical and dimensional testing of cells


- Verify the shrink-fit assembly
- Validate the assembly method
- Check the correct positioning of the cells after the heat cycle
- Check the BFM to be used in the final prototype (material composition and ratio)



 **ZEISS CALYPSO**  
7.6.0403



Metrology crosscheck

  
CERN-METROLOGY

iFAST xband disk 049

EDMS N°: 2977953

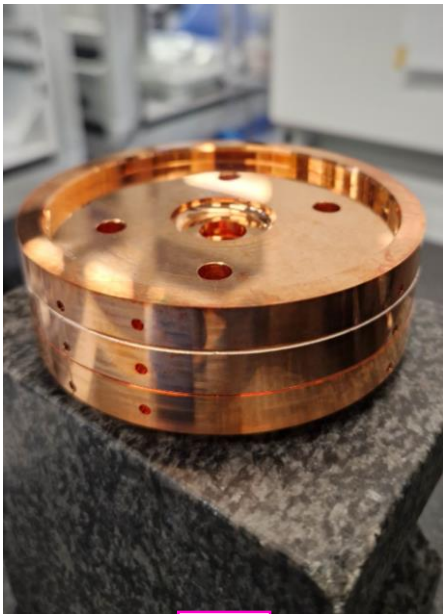




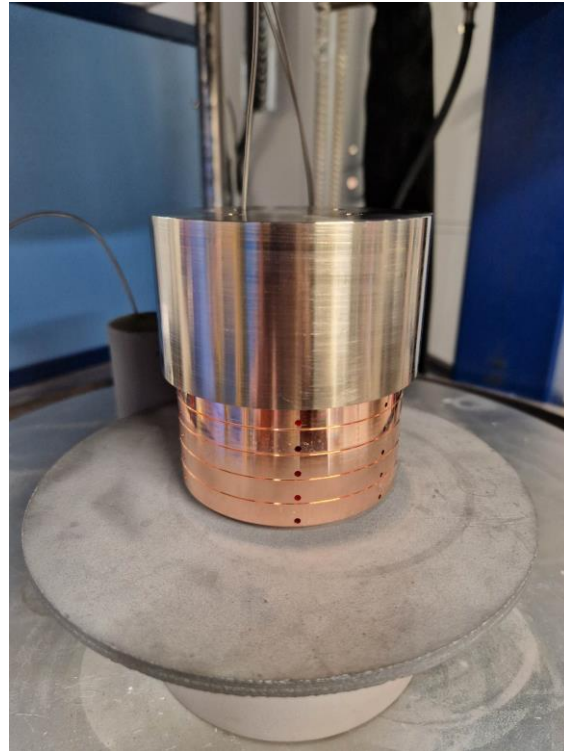
# Brazing tests

## 3 Trials have been carried out with different conditions:

- Machinability
  - Interlocking alignment
  - Brazing material
  - Leak tightness
  - Weight
- The alignment and flatness of the structure were kept as expected after the cycle with the 40kg on top.



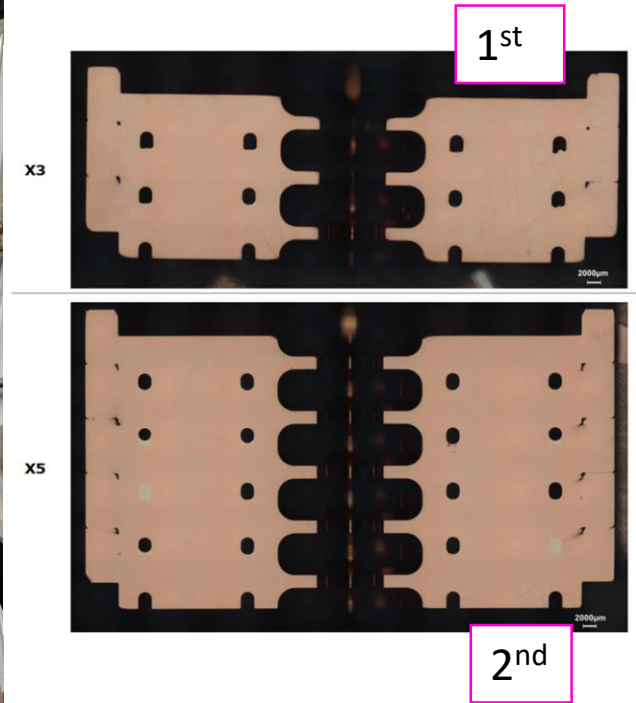
1<sup>st</sup>



2<sup>nd</sup>

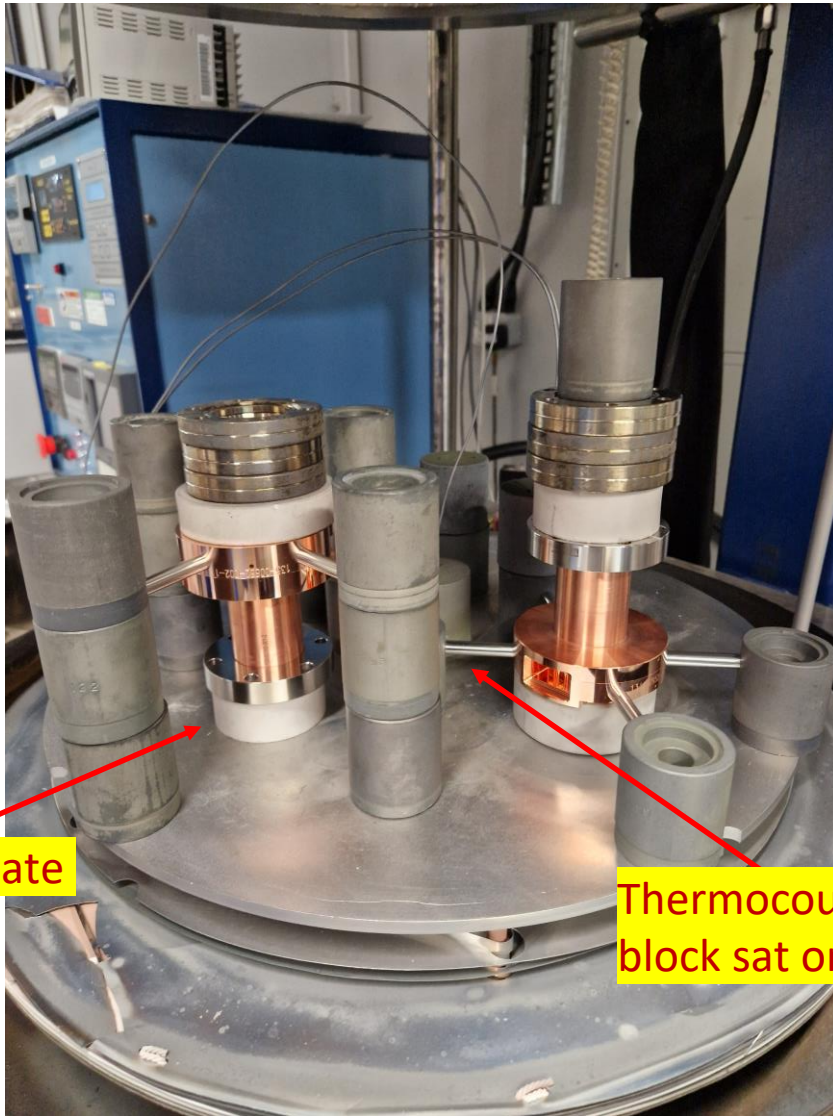


3<sup>rd</sup>



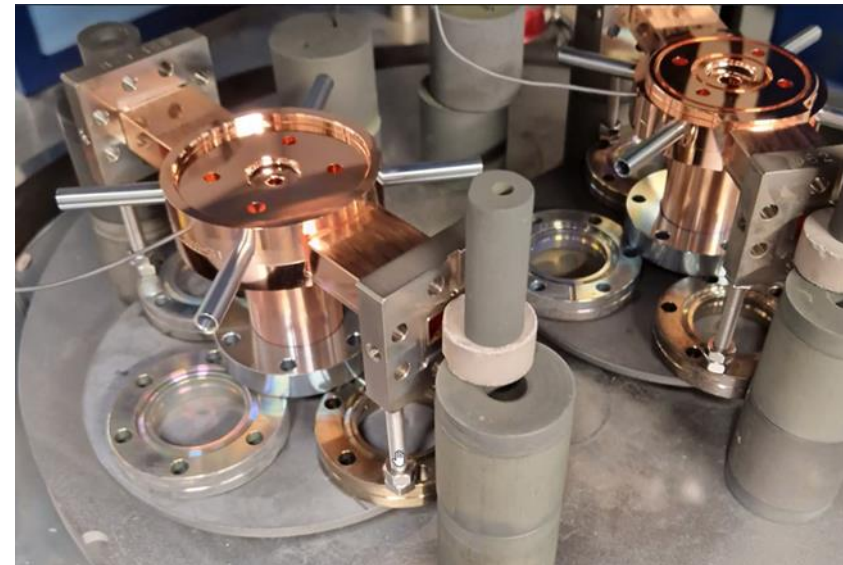
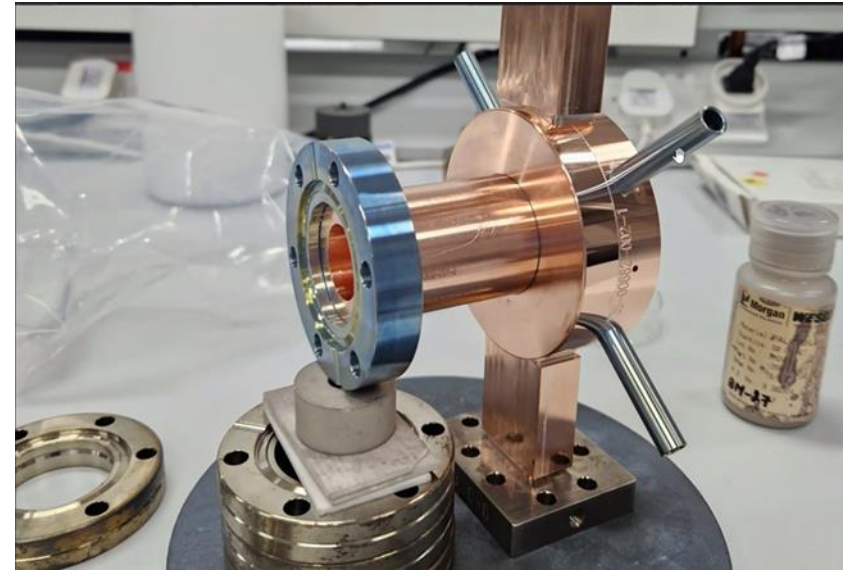


# End of stack brazing



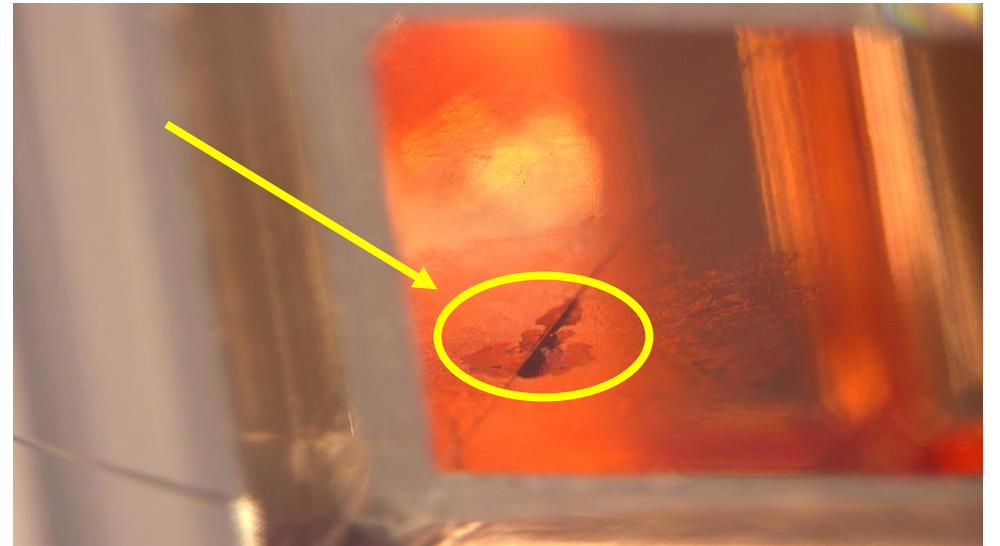
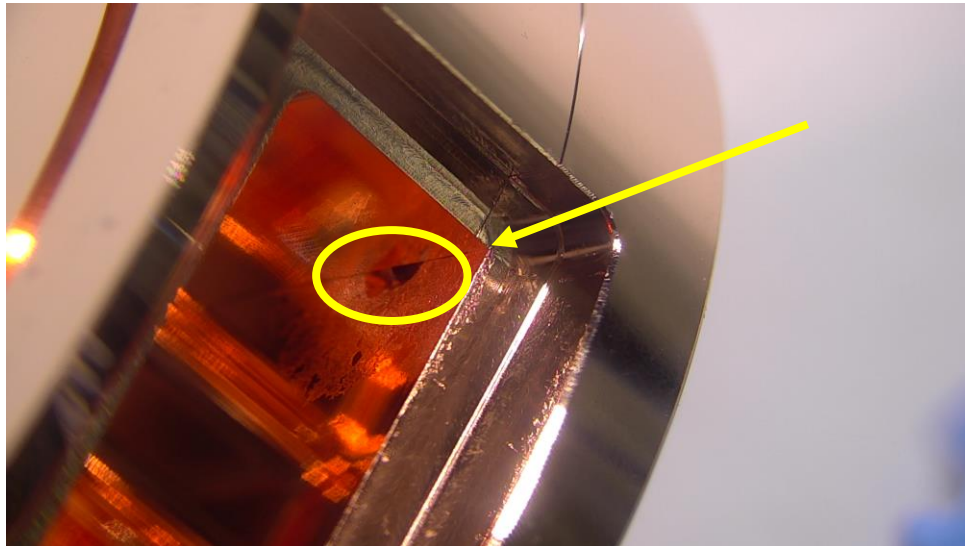
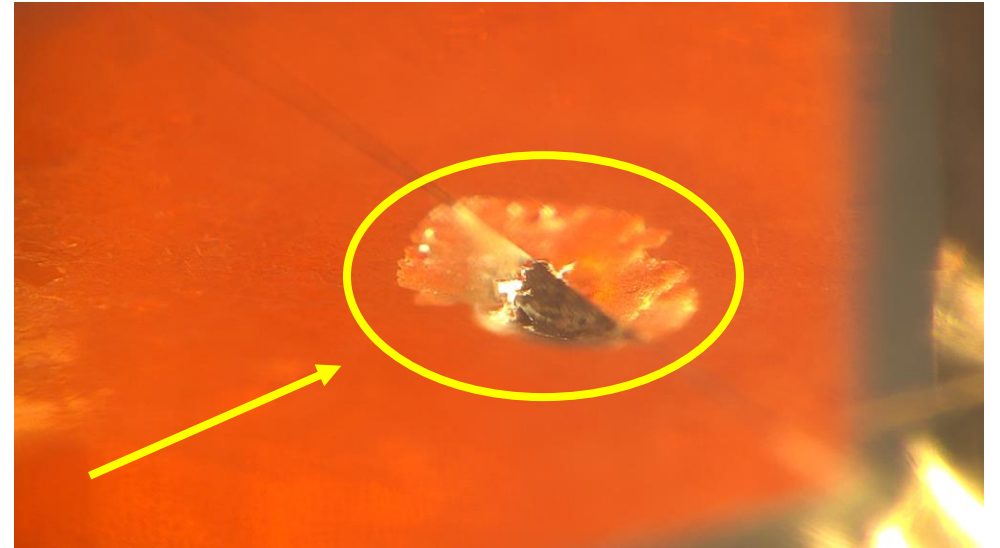
Lifted off baseplate with ceramic

Thermocouple in steel block sat on baseplate



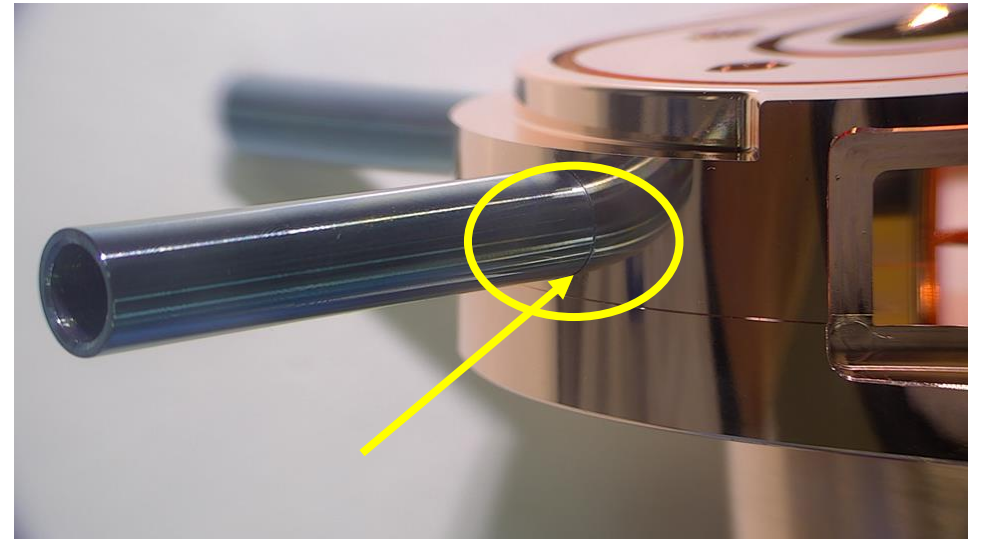
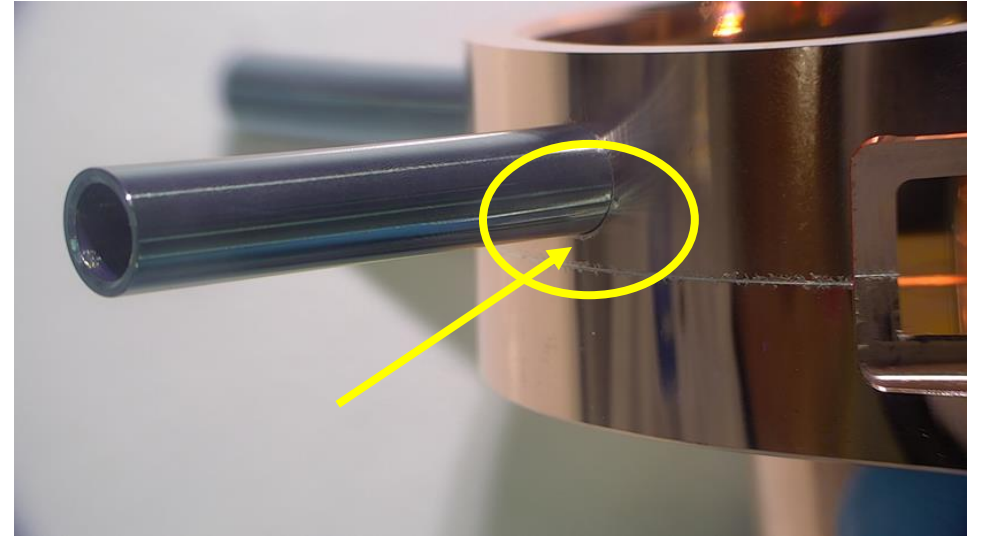
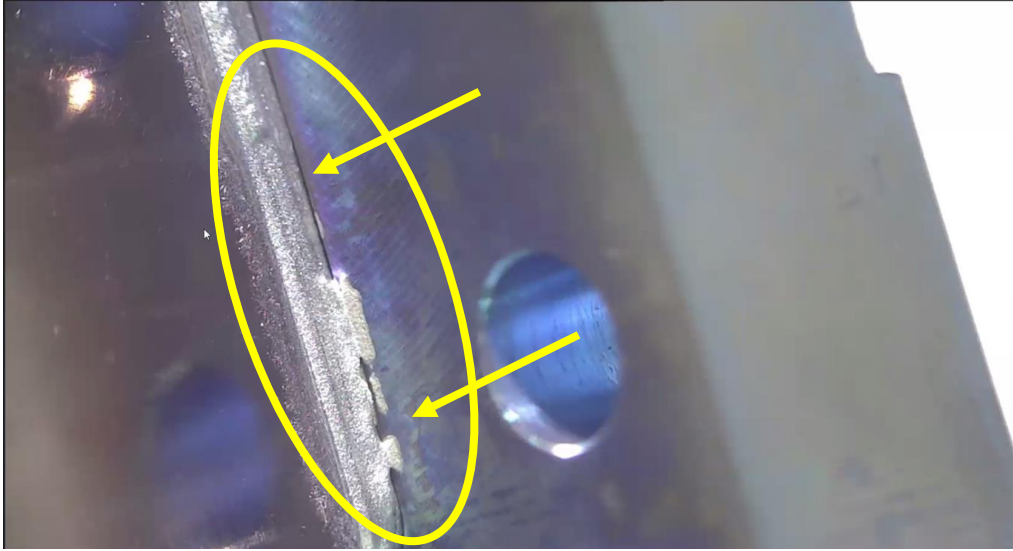
## We were having a lot of problems with the brazing of the end stacks

- One end stack brazed well, and both stacks had visible evidence of the braze flowing.
- Clear evidence however of the braze eating into the copper in second end stack.
- Visible hole in cavity wall in 2 places, not present in other side of disk.






# Cooling pipes brazing





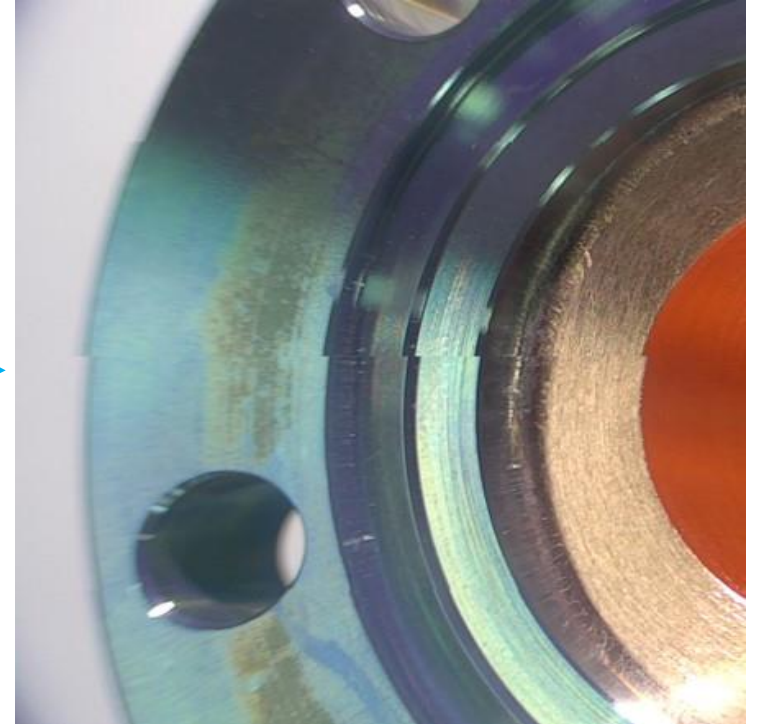
# Furnace leaks

## Problems found on the furnace used for brazing:

- Leaks in the hydrogen piping which probably caused the formation of “air bubbles” that probably were pumped in together with the hydrogen during the brazing process.
- This may have weakened/influenced the bond strength of the braze.
- In addition, hydrogen contamination with oxygen causing oxidation of the flange (**blueing ~300°C**). 
- Large variations and low accuracy in temperature profile measurements (taken at different heights in the furnace).

For these reasons, TMD is repairing the furnace before proceeding with the other brazing work.

Further testing and brazing cycles are planned at TMD after the leaks have been repaired.



## Next steps

- TMD is proceeding with furnace repair and additional brazing tests before the brazing of two new couplers.
- VDL, which is completing the accelerating cells for the second structure, will prepare the parts for two new couplers, which should be ready by the end of August.
- In September we plan to braze the two new couplers and complete the brazing of the first accelerating structure.
- This structure will be tested on a microwave bench to verify the correctness of the adopted procedures.
- We expect to braze the second structure by the December 2024, after validating the brazing procedures of the first structure, and test it with RF power in the first quarter of 2025.



## Task 7.5 Revised schedule and deliverables

- At the start of the project the duration of Task 7.5 was planned to be 3 years (May 2021-Apr 2024), with two deliverables:
  - **D7.5: Construction of the XLS accelerating structure pre-prototype, M 24 (Apr. 2023).**
  - **D7.6: Construction of the XLS accelerating structure full prototype, M 36 (Apr. 2024).**
- Unfortunately, in mid-August, Mathieu Breukers, one of the founding fathers of the ultra-precision machining activities at VDL-ETG, responsible for the production of the XLS structure, passed away.
- For this reason, all activities in preparation for the production of discs, brazing of structures, etc. were stopped to allow VDL-ETG to review its work plans.
- The activity was resumed at the end of January 2022 and the duration of Task 7.5 was extended by one year, from April 2024 up to April 2025, end of the I.Fast project (staying within the four years project limit), and the two deliverables were rescheduled:
  - **D7.5: Construction of the XLS accelerating structure pre-prototype, M 32 (Dec. 2023)**
  - **D7.6: Construction of the XLS accelerating structure full prototype, M 48 (Apr. 2025)**

**Due to the brazing issues highlighted at TMG, we are forced to move D7.5 (development of manufacturing process and RF testing of pre-prototype), from Dec 2023 to Dec 2024 (with a 12 months delay).**

**D7.6\_Construction of the XLS accelerating structure full prototype, manufacturing process analysis and validation of the full prototype, remains scheduled for Apr 2025.**

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# Thank you!



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