Vacuum chambers : TAXN, TAXS

Jaime Perez Espinos, Marco Morrone

10th October 2024

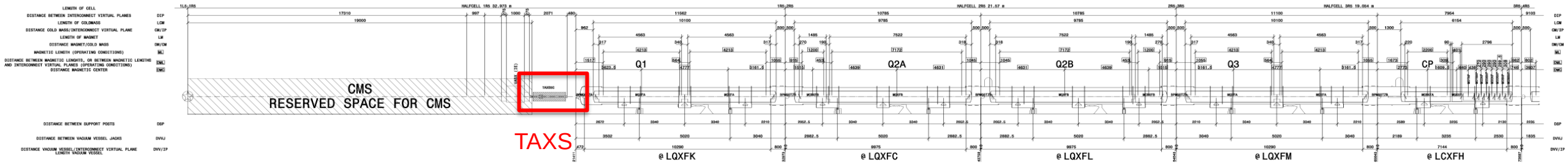
Content of the presentation

- Recall of scope for the TAXN & TAXS chambers
- Status of TAXN chambers
- Status of TAXS chambers
- Conclusions

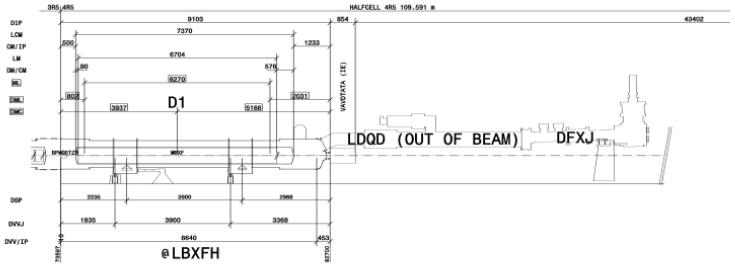
Scope

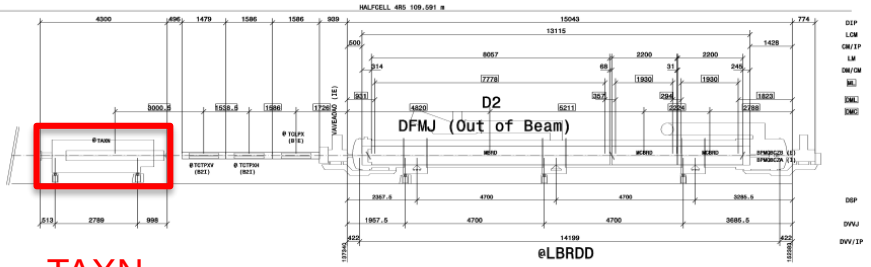
- Originally:
  - TE-VSC contributed with conceptual design, vacuum specification, qualification test and vacuum validation;
  - Detailed design and procurement supposed to be an in-kind contribution from BINP (Russia).
- Later:
  - Decision to have it internalised at CERN ⇒ **TE-VSC contribution to WP8**;
  - Agreement WP8-WP12 on TAXN chamber held in 2021
  - Agreement WP8-WP12 on TAXS chamber, ongoing → DMR (EDMS #3102021) and new version of TE-VSC contribution to WP8 (EDMS #1820996) still under approval

Location of the TAXN and TAXS chambers



VAX position and space occupation is provided only as information and subjected to agreement with the concerned LHC experiment.





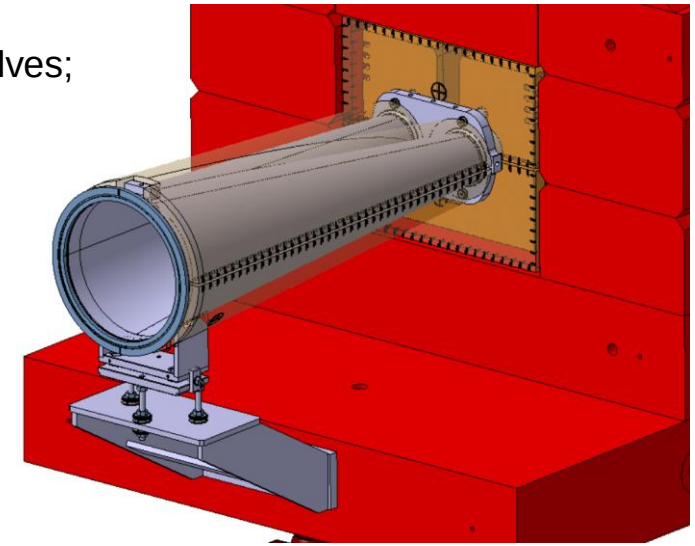
TAXN

TAXN chamber is to be installed about 126 m (IP flange) from the IP in point 1&5.
TAXS chamber is to be installed about 19 m (IP flange) from the IP in point 1&5.

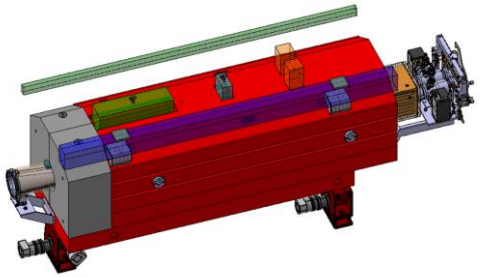
Status of the TAXN chambers

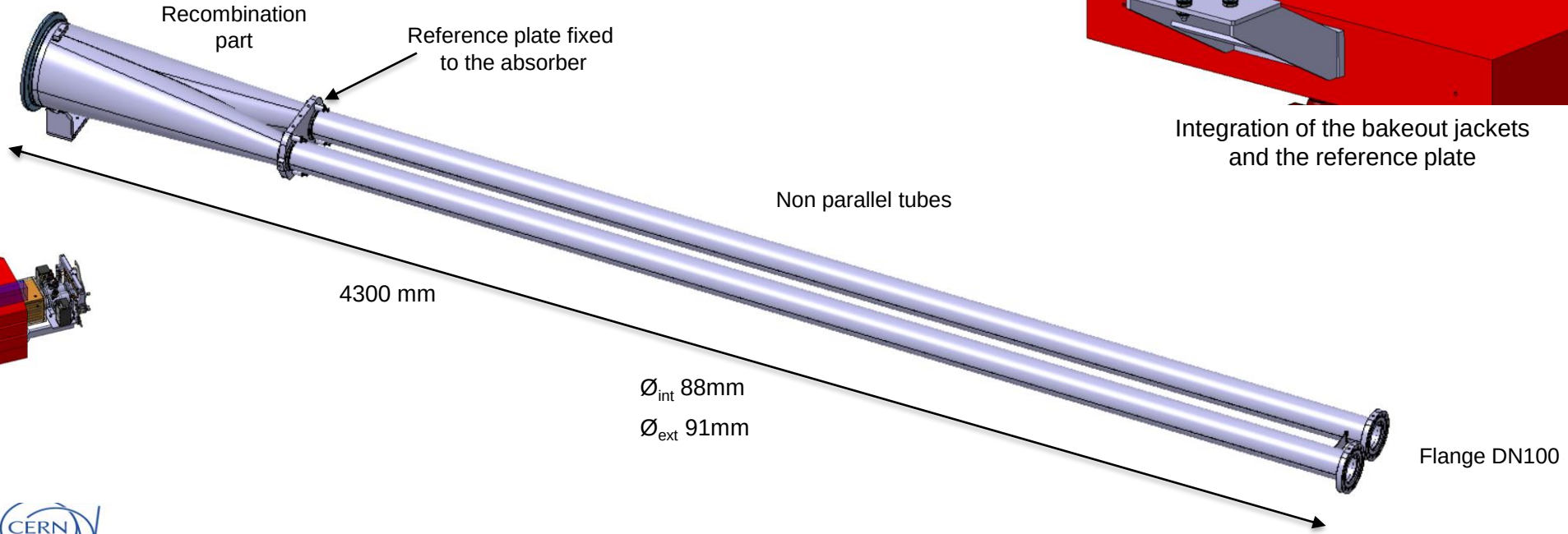
- Design is finished
  - Drawing reference: LHCVCTYF0001 fully approved on 18.09.2023;
  - Chamber bolted to the IP face of the absorber and clamped between the two absorber halves;
  - Made of stainless steel 316 LN, NEG coated and bakeable.

- Production is ongoing (1 spare + 4 series chambers)
  - Manufacturing strategy and post treatments report: EDMS #2997713;
  - 1 spare chamber produced (existing NC being addressed, to be formally reported);
  - Subcomponents for rest of chambers, already produced and/or assembled.

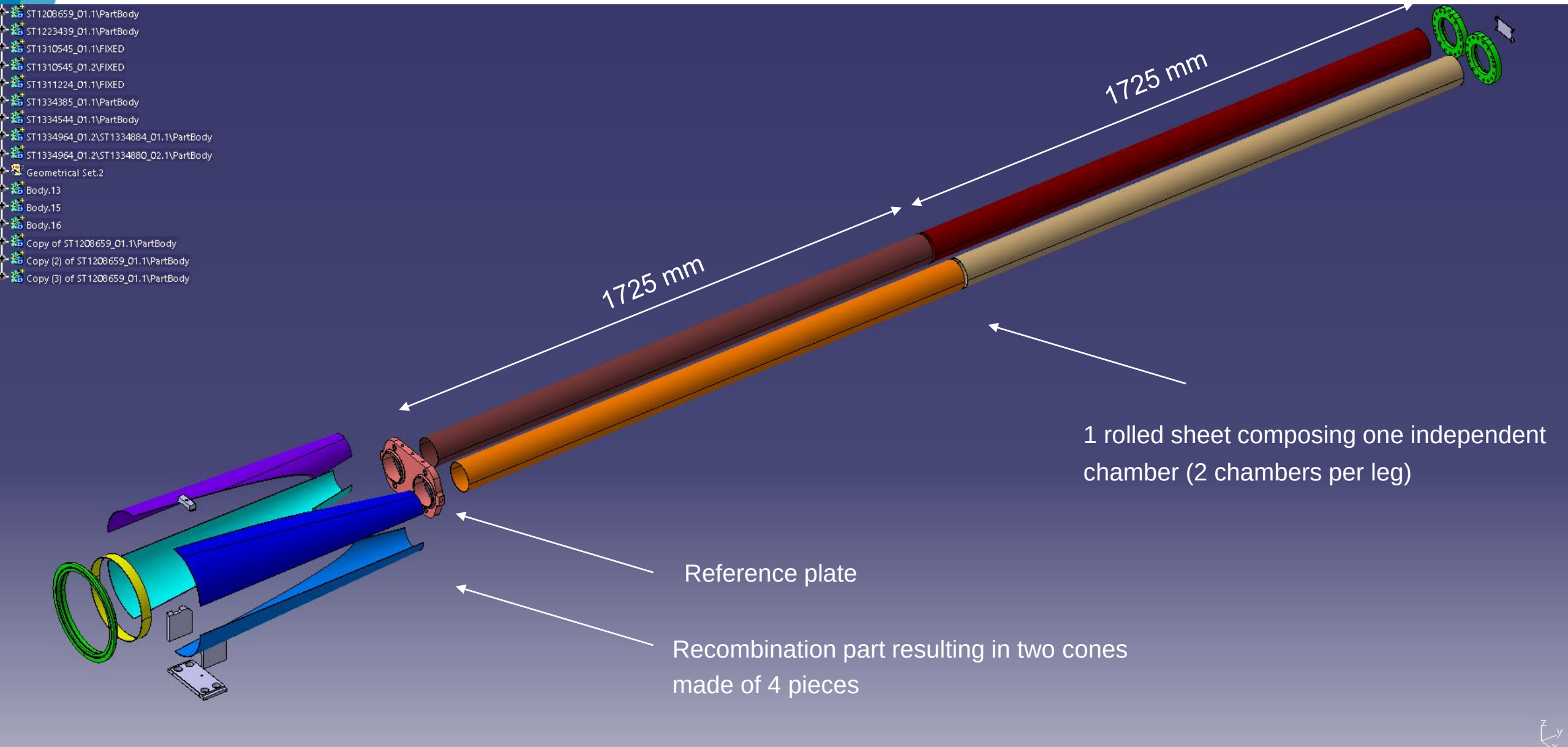


Integration of the bakeout jackets and the reference plate





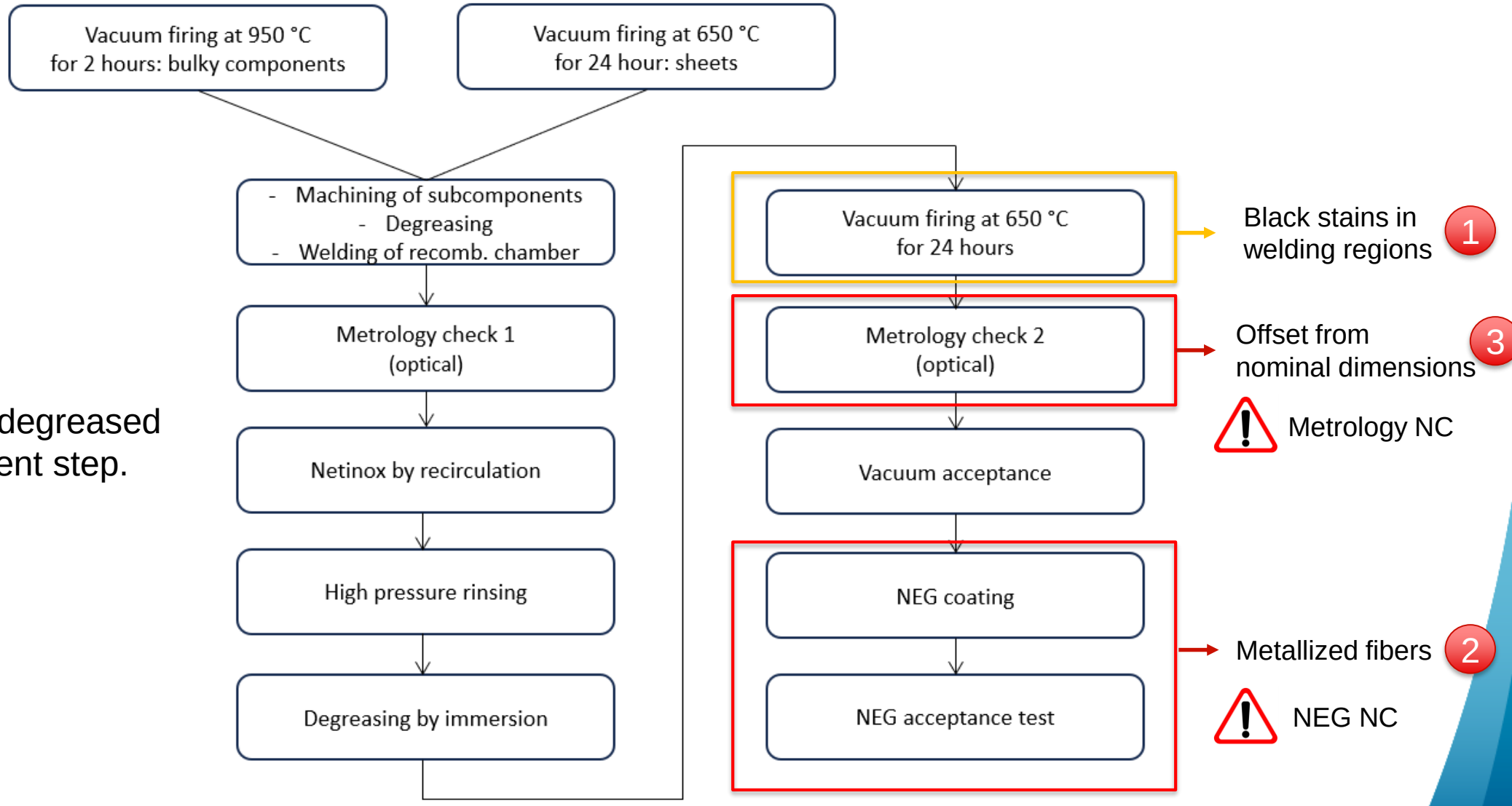
Subcomponents of TAXN chambers



Status of TAXN chambers

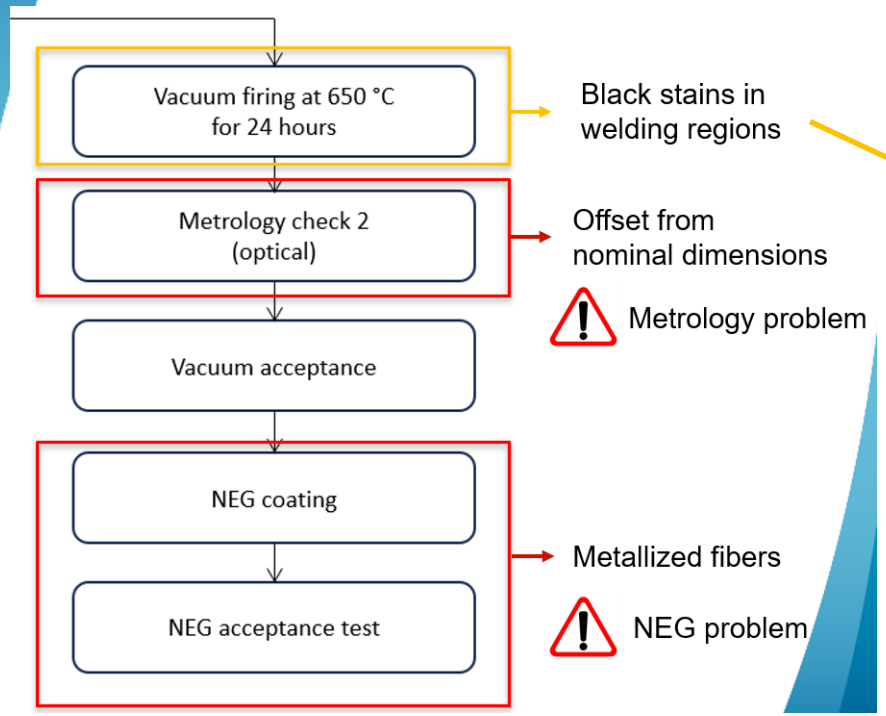
1st chamber manufactured (spare): 2 NCs under discussion

Production and verification sequence of 1st TAXN chamber



Please note:
All components are degreased before any subsequent step.

Status of the TAXN chamber



NEG NC

30.41.20.100.9 - CHIFFON DE NETTOYAGE POUR VIDE

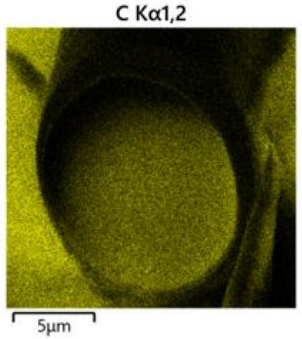
50.47.02 - WIPING TISSUS AND FABRIC - PEEL-OFF FLOOR MAT FLOOR CLEANER FOR CLEAN ROOMS

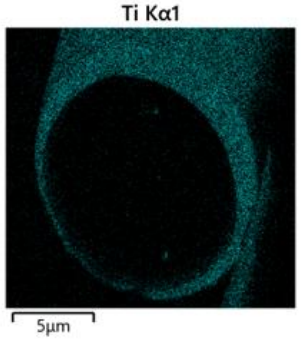
- After vacuum firing some black stains appeared. With the intent to remove these stains some wiping tissues were used.
- Some fibers got stuck on the surface of chamber. They were unnoticed and got metalized during the NEG coating.
- SEM-EDS analyses proved that the fiber surface was NEG but that the core was indeed organic.

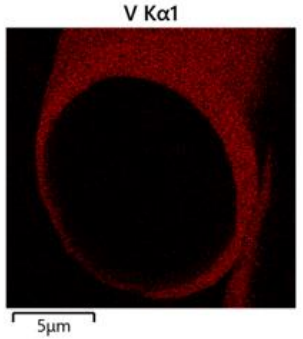
Status of the TAXN chamber

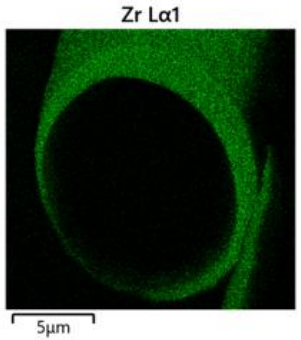
NEG NC

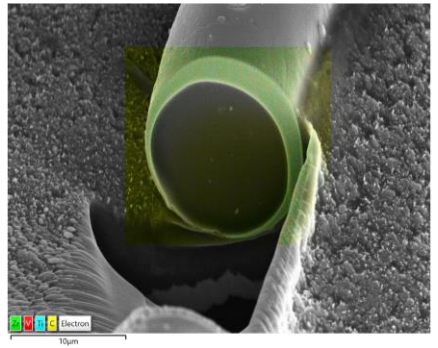
The obtained results clearly indicate that the inspected wire is coated with an asymmetrical NEG coating. The presence of carbon throughout the cross-section of the wire confirms its plastic nature.











Many NEGGED fibers observed after the chamber was coated:
The SEM-EDS was used to analyze the surface (NEG composition) and the core (Carbon).

Status of the TAXN chamber


NEG NC

Action Plan to get rid of the fibers:

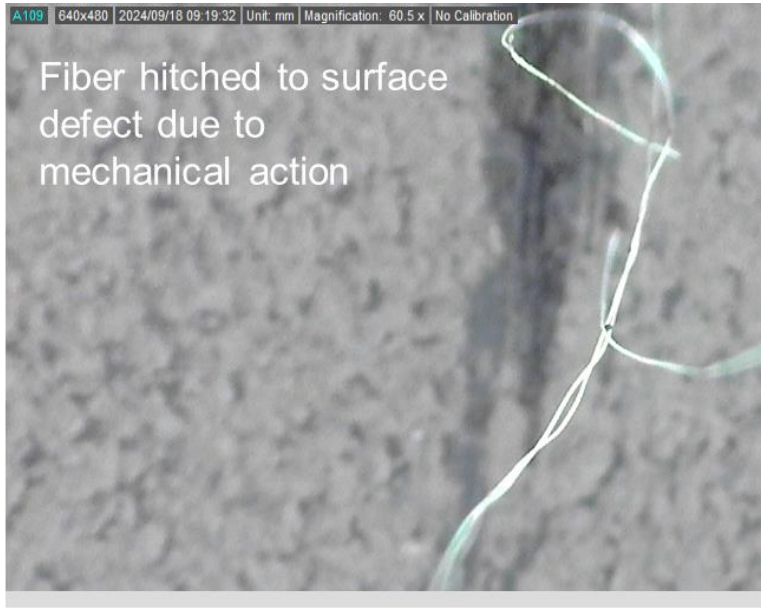
1) NEG stripping (DONE)
2) Vacuum firing @ 650 °C for 24 h to burn the fibers
3) Microscope analysis
4) Cleaning (with reinforced ultra-sound)
5) Microscope analysis
6) Re-NEG

HOLD POINT: continuation of action plan is linked to resolution of metrology NC and potential repair, under study by Main Workshop

Status of the TAXN chamber

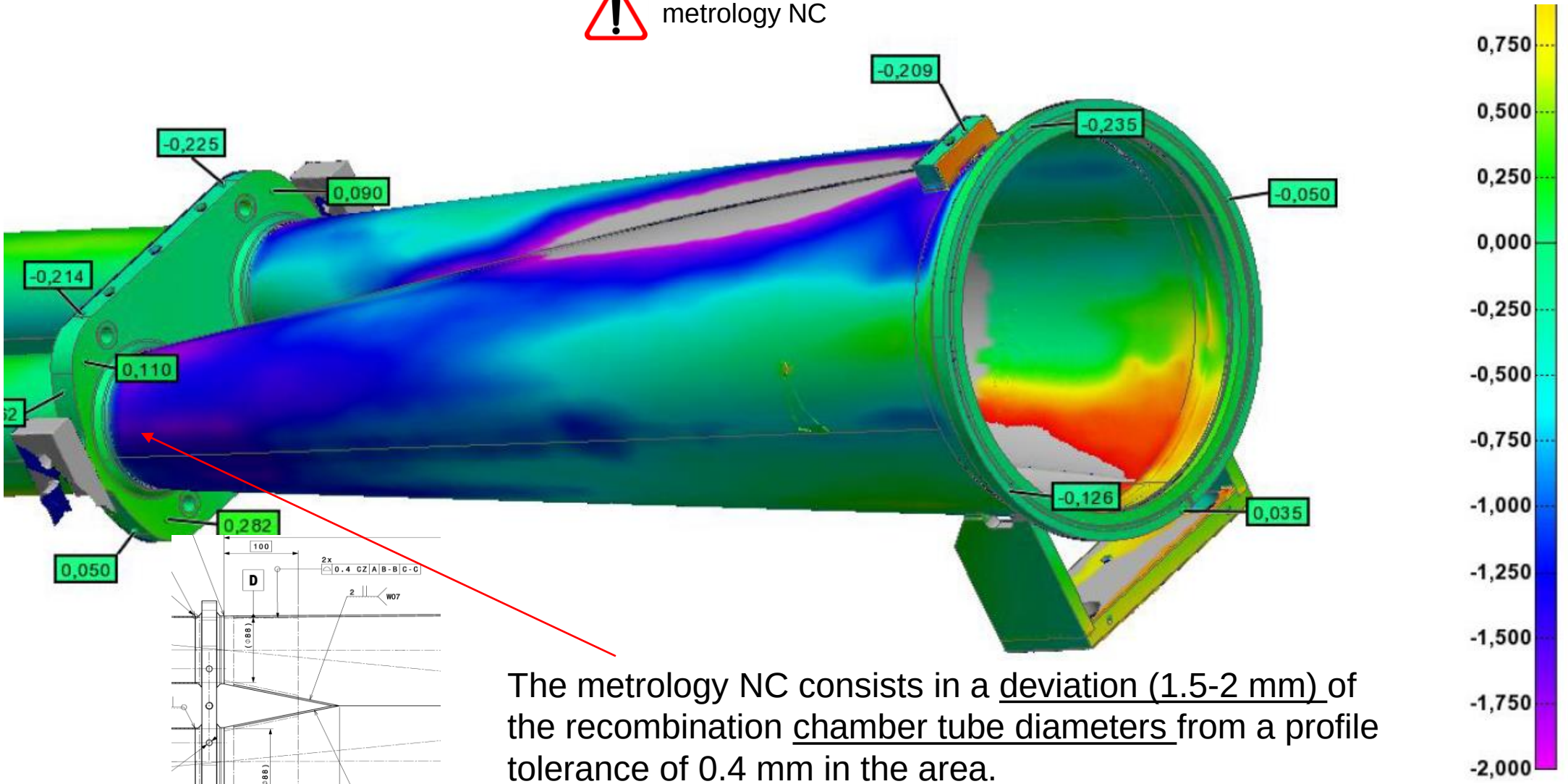
NEG NC

Inspection after stripping the NEG coating



Status of the TAXN chamber

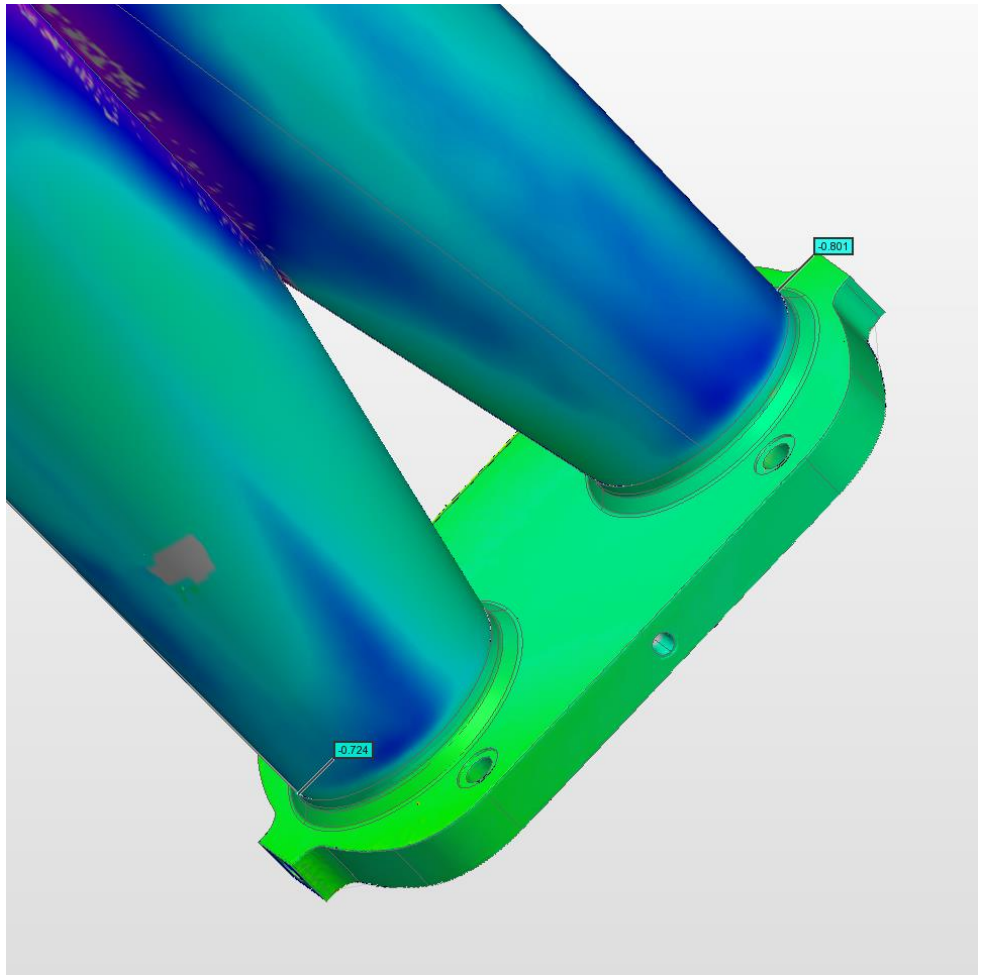
metrology NC

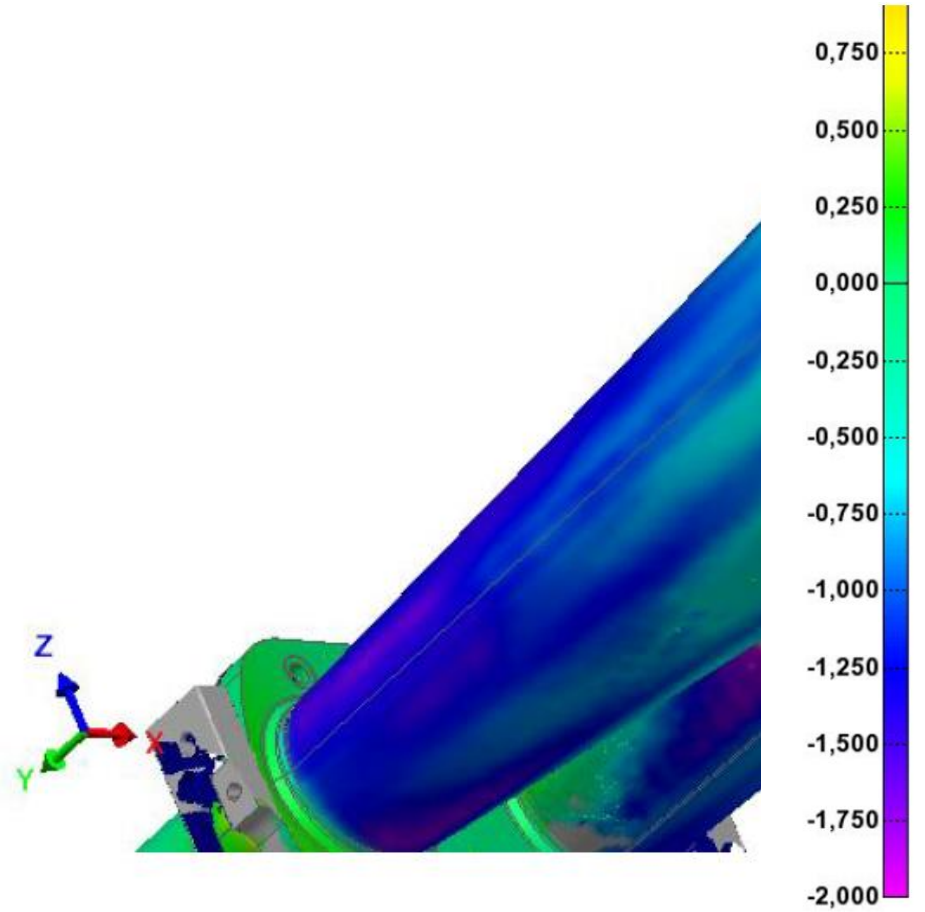


The metrology NC consists in a deviation (1.5-2 mm) of the recombination chamber tube diameters from a profile tolerance of 0.4 mm in the area.

Status of the TAXN chamber

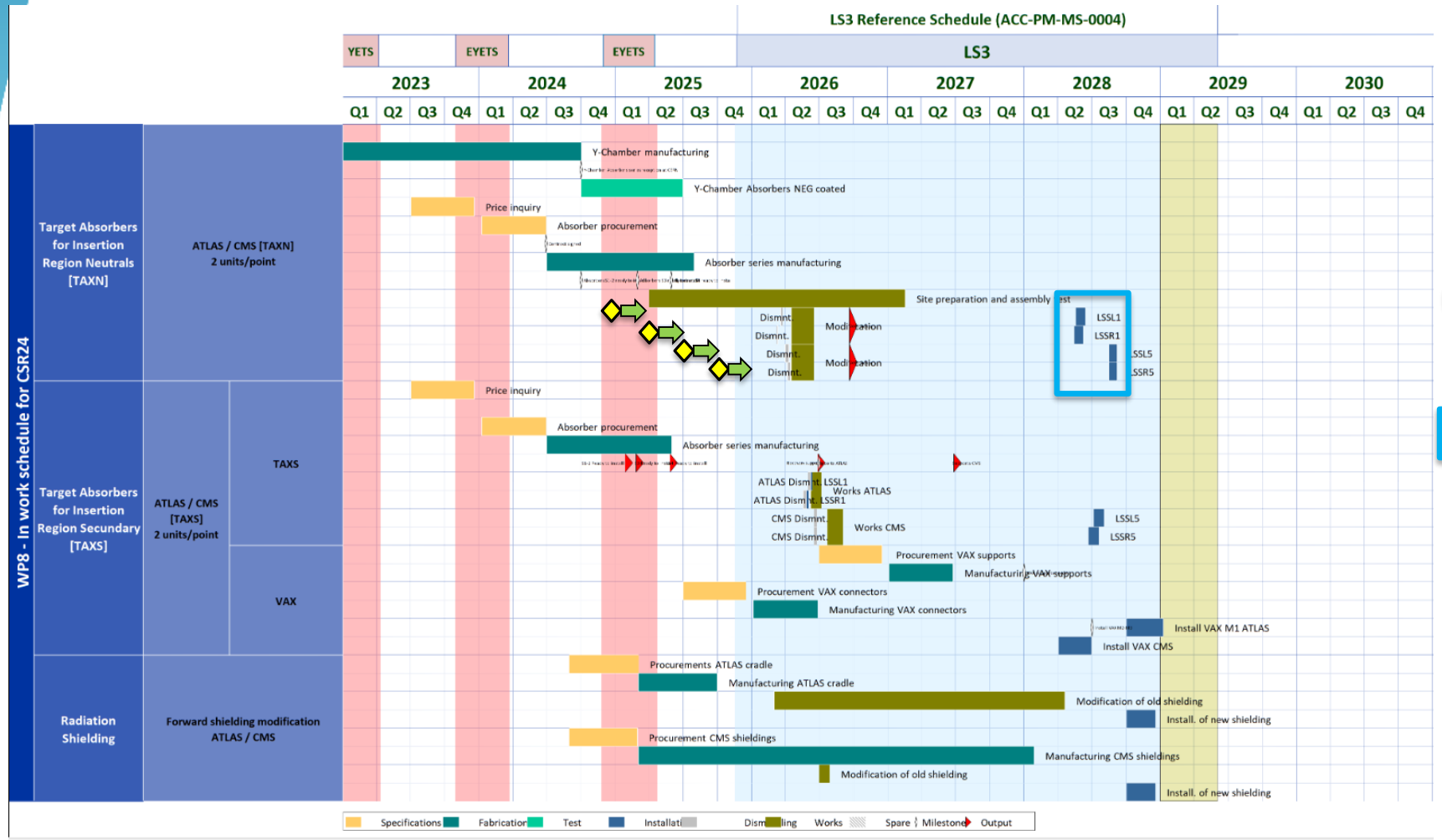
metrology NC





Further manual calliper measurements confirmed MetraScan data

Planning for TAXN chambers



◆ Chamber delivery by Main Workshop (**after Metrology check #2**)

➡ Chamber delivery to WP8 (**after NEG acceptance test**)

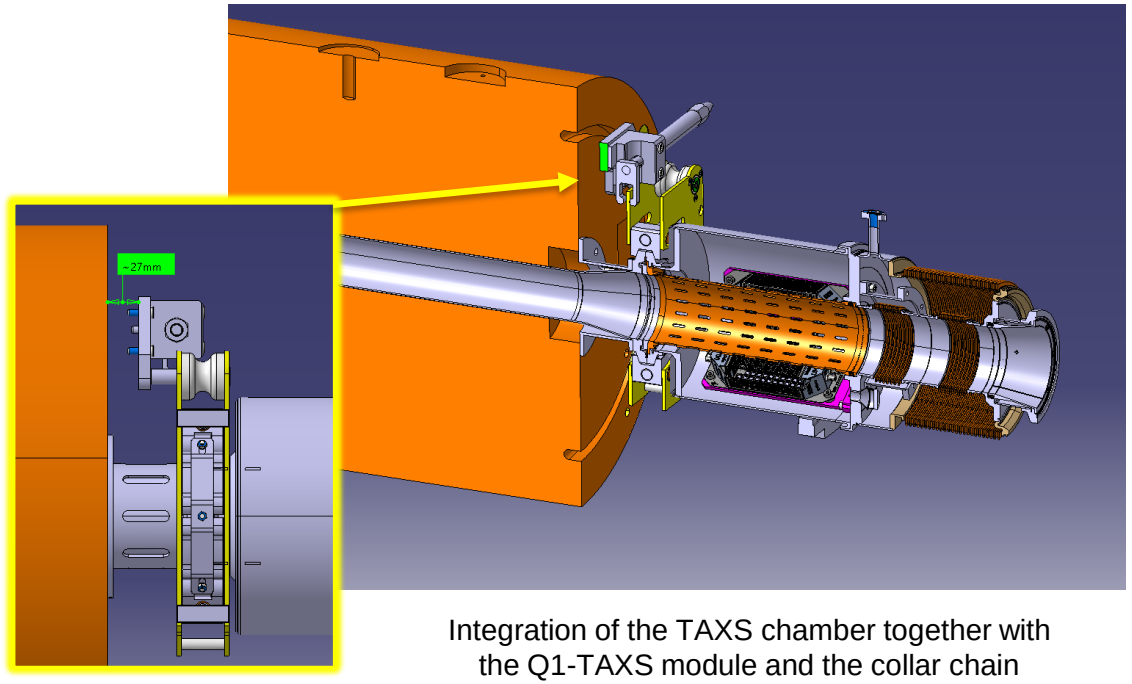
▭ In-machine installation periods for full TAXN

As per TE-VSC contr. to WP8 (EDMS #1820996)

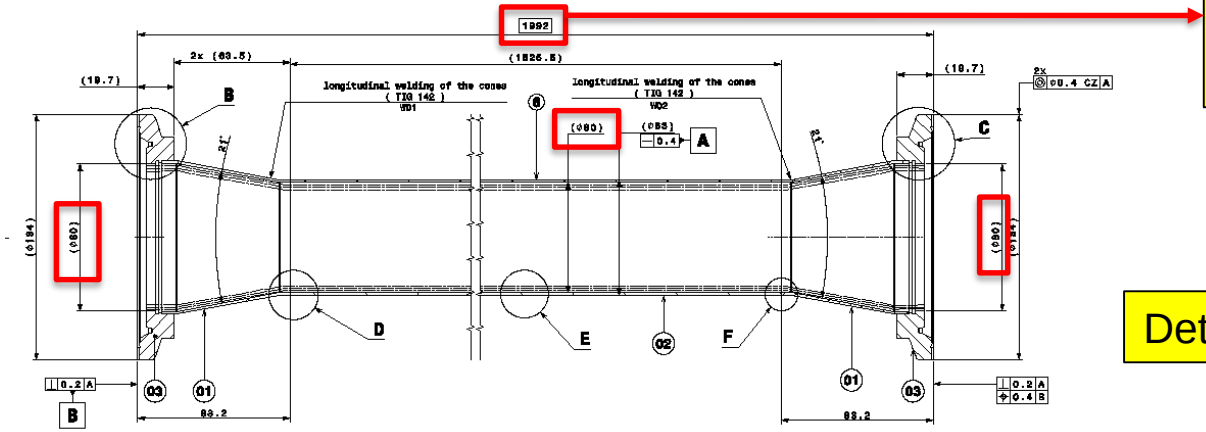
Status of the TAXS chambers

- Design is finished
  - Drawing references: LHCVC1SX0001 for ATLAS and LHCVC5SX0001 for CMS. To be submitted for approval once DMR and contribution document are approved;
  - Chamber bolted to the non-IP face of the absorber and clamped between the two absorber halves;
  - Made of a combination of stainless steels 316 LN and 316L,and coatings (aC + Cu-10 micron + Au-1 micron): non-bakeable.

- JOB for production is created and agreed with Main Workshop (1 spare + 2 series chambers of each type ⇒ 6 chambers in total) ⇒ drawing approval is required
  - Drawing approval is required;
  - Material request is pending of signature until BC is allocated.



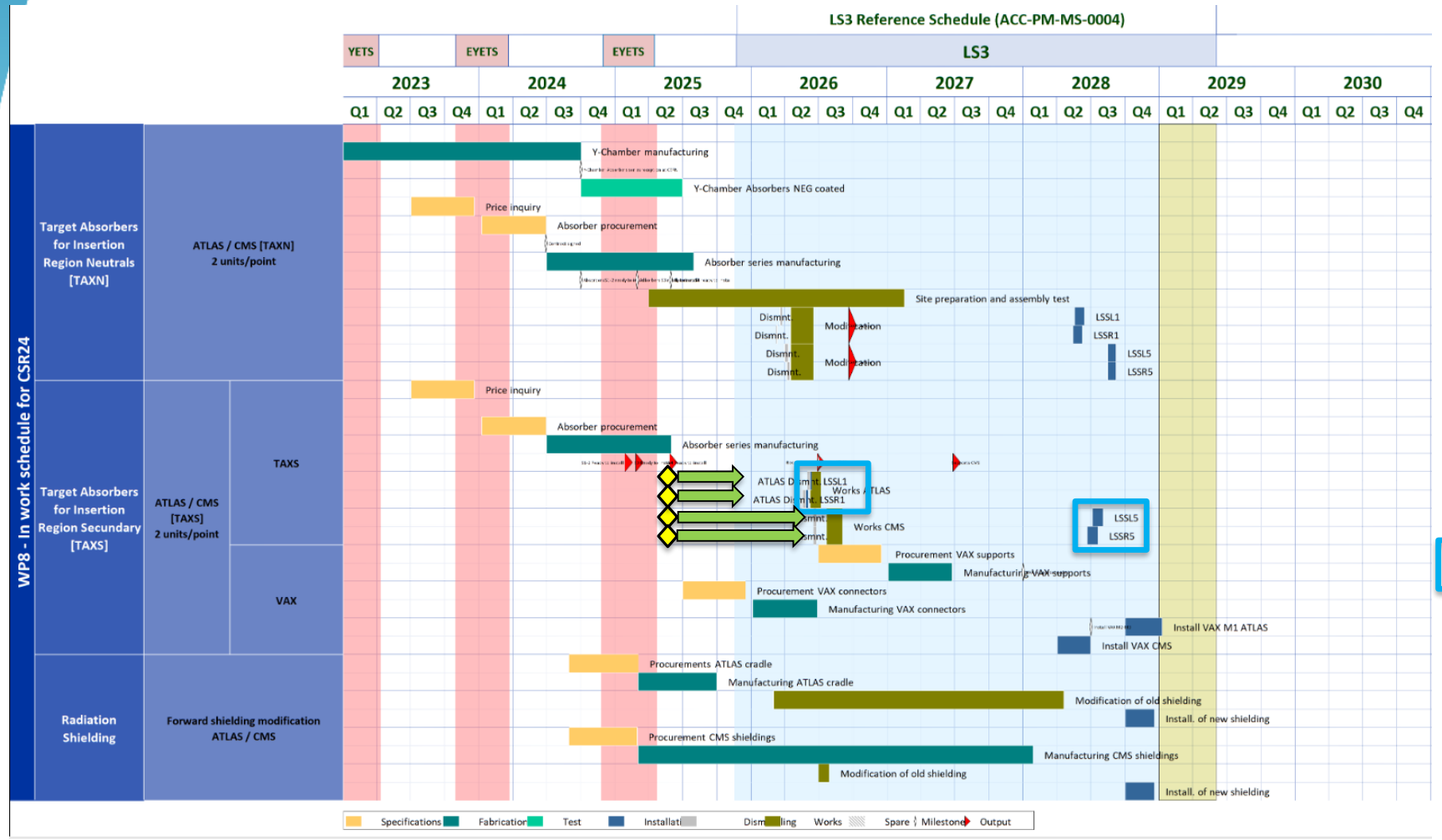
Integration of the TAXS chamber together with the Q1-TAXS module and the collar chain



ATLAS case: 1992 mm long
CMS case: 2071 mm long

Details in DMR (EDMS #3102021)

Planning for TAXS chambers



Chamber delivery by Main Workshop as per JOB agreement (TBC due to delay on signature for material request and drawing approval)

Chamber delivery to WP8 after surface treatment and vacuum acceptance test

In-machine installation periods for full TAXS

As per TE-VSC contr. to WP8 (EDMS #1820996)

Conclusions

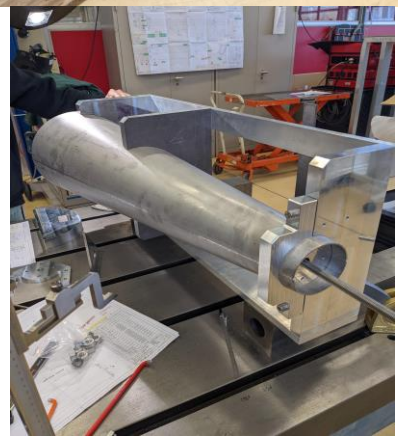
- 1st TAX-N chamber (spare chamber) is manufactured but two NCs are reported: unwanted NEG fibers (minor) and metrology anomaly (major).
  - Although the NEG was coated with good adhesion, some NEG fibers were found stuck to the internal surface of the chamber. These might detach during operation involving potential serious UFO-like problems. VSC is confident that **this problem can be solved**.
  - A major metrology anomaly was identified at the level of the recombination part. The CERN main workshop is currently working on it with the aim to **save the chamber**.
- TAX-S chamber design parameters have been collected.
  - Design of copper coating tooling done internally.
  - Technical drawings of the chambers finalised in cooperation with the main workshop.
  - JOB for production is created and agreed with main workshop.
  - Approval of DMR, TE-VSC contribution document to WP8 and manufacturing drawings are required before production is actually launched.

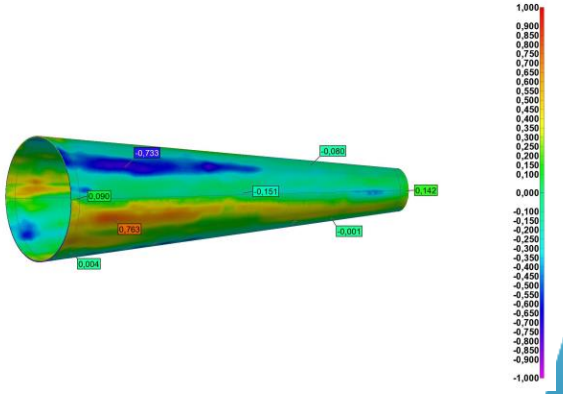
Thank you for your attention

Status of the TAXN chamber

Status of the subcomponents

- **Half-cones (8x) formed and welded**
  - **Shape calibrated, wire cut, and intermediate metrology checked**
  - **Vacuum acceptance test for conical part of the first chamber ok!**

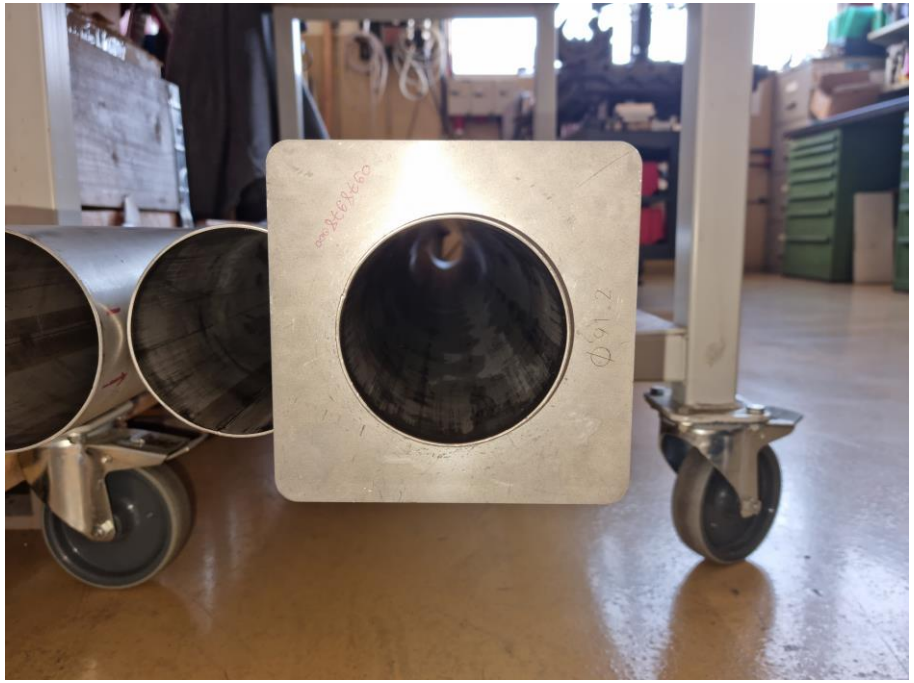




Status of the TAXN chamber

Status of the subcomponents

- **Half tubes (20x) formed and welded (linear weld)**
  - **Shape calibrated, wire cut for prototype chamber.**



Status of the TAXN chamber

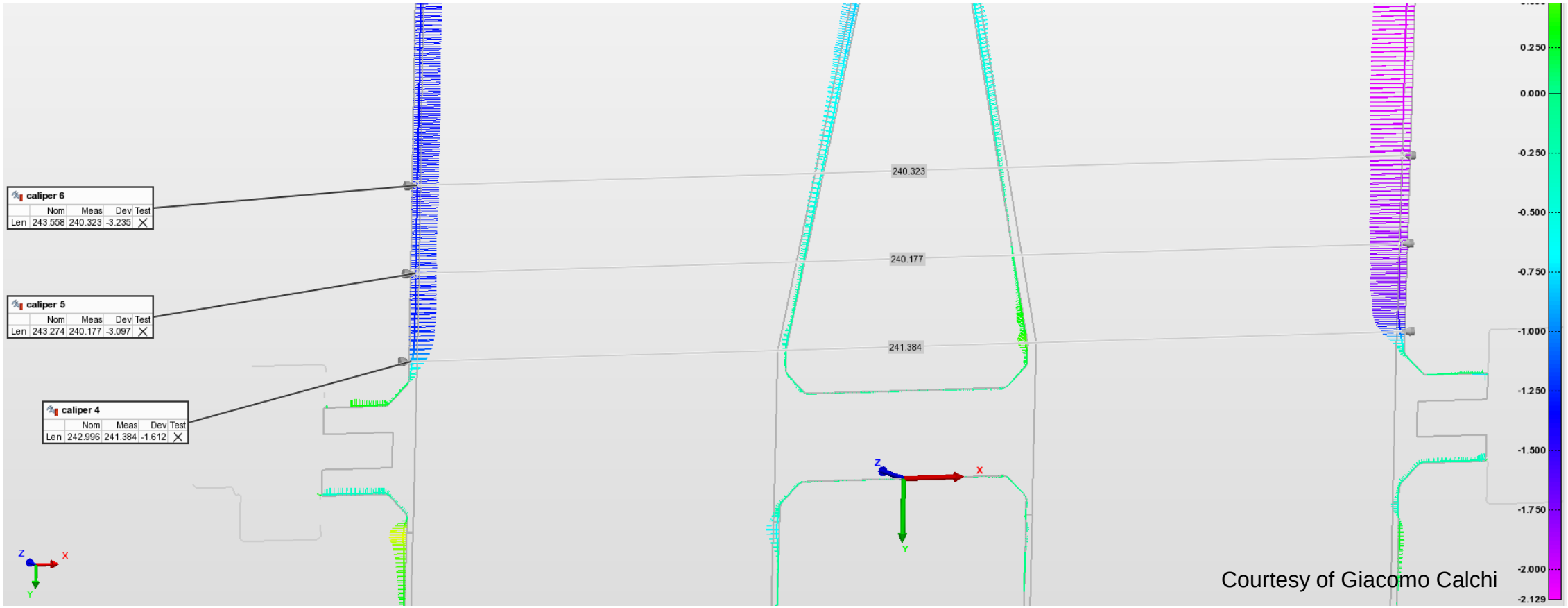
Status of the subcomponents

- **Other components**
  - **Flanges & recombination reference plate machined.**
  - **Transporting/storage beam + special beam for NEG coating ready.**

All the subcomponents for the 5 chambers have been manufactured

Status of the TAXN chamber

metrology NC

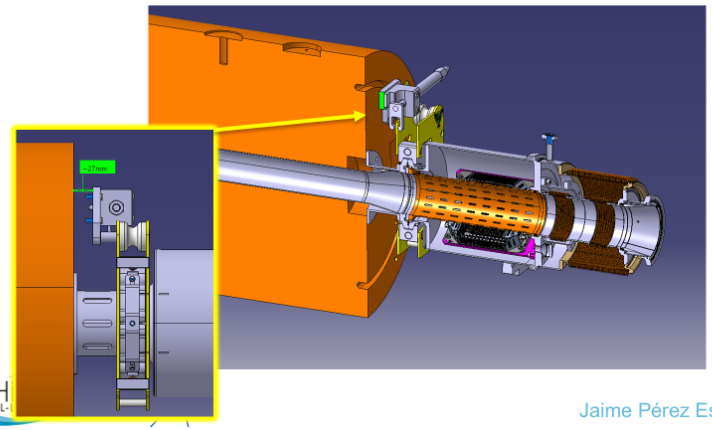


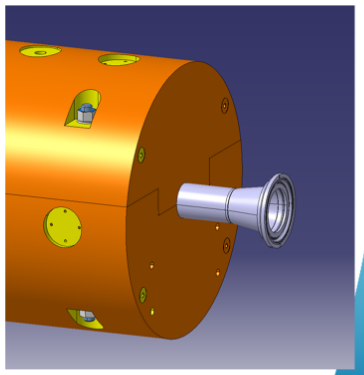
Manual calliper measurements at 10 mm, 30 mm, 50 mm from the flange were taken with Mike Dequidt confirming the MetraScan data.

Slides from TAXS chamber contribution on 15/05/24

Interfaces and open points

- Interfaces:
  - Chamber to TAXS (radial): WP8 to propose an ID and tolerance chain for TAXS that copes with above chamber dimensional tolerances, chamber geometrical tolerances (TBC by main workshop), the requirement to establish a good contact between both (any spec?) and the requirement to avoid sag of the chamber, which could affect the effective aperture
  - Chamber to TAXS (longitudinal): TE-VSC proposes a spacer formed by two half parts of unique length attached directly to TAXS or to shim supplied by WP8 → final length depending on the interface to TAXS (by WP8)
  - Chain connection collar (Q1-TAXS module side) to TAXS: chain connection collar connecting TAXS chamber to Q1-TAXS module is attached to TAXS through shim supplied by WP8
- Other open points to be clarified for the final design
  - Installation procedure of TAXS chamber inside TAXS
  - Alignment procedure (on surface and in tunnel) of TAXS chamber wrt nominal beam line and validation of aperture by optical team





Next steps

- Meeting foreseen with main workshop for (chamber) manufacturability, cost estimation and production planning (t0 to start from drawing approval)
- Meeting foreseen with TE-VSC-SCC for surface treatments and tooling definition
- Production of final drawings… once all open points and interfaces are defined and validated

INDICO #1410699