Results of 300 mm impregnation trial and

Modification of impregnation mold for coil #110

OUTLINE

300 mm Trials

- Initial idea
- Tooling
- Coil dummies
- Results

2m Fixture Modification

- Mechanical
- Coating
- Assembly

Disclaimer

All the work reported here has been carried out and is to the sole efforts of CERN TE-MSC-MDT :

A. Benfkih, S. Clement , R. Gauthier, R. Gavaggio, L. Lambert, G. Maury, J. Mazet, S. Tavares

(927, PolymerLab)

This presentation is on their behalf.

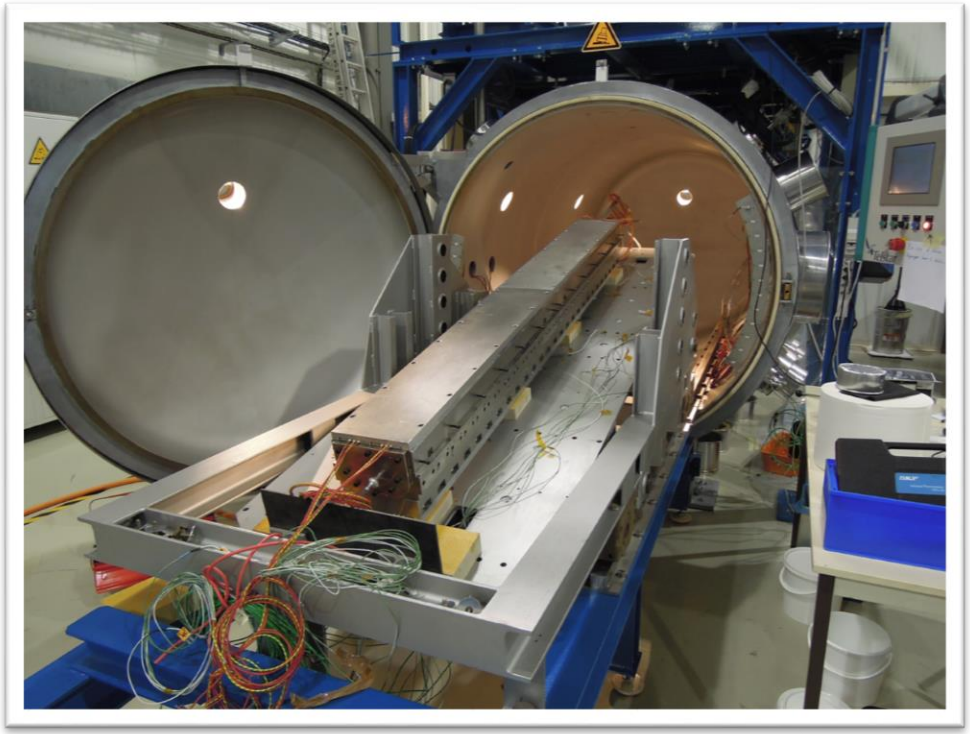
Impregnation-method

Current Standard:

- Impregnation from Injection Point A to Exit point B.
- Tested at CERN and US many times (Up to 4m length).

The 6m case:

- Is the potting life too short?
- What, if there is a blockade?
- …



Decision to look into an alternative tool designs, which lead to multipoint-injection

Experimental planning

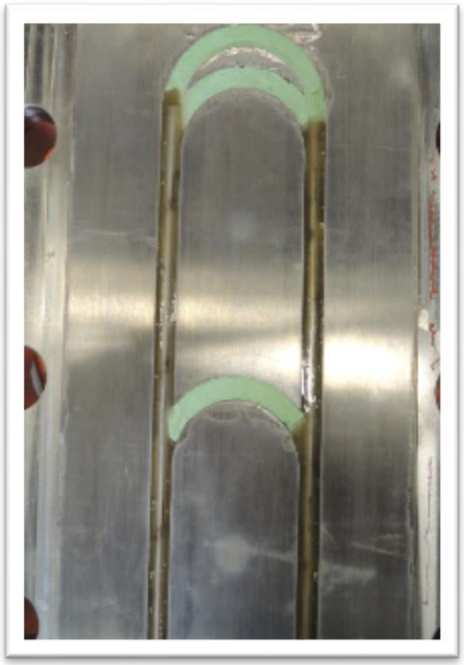
First trials on 300 mm mock-up:

- Test different injection schemes
- Test demoulding
- Look for major impregnation defaults
- Investigation of cross section

Impregnation of 2m dummy coil from broken cable:

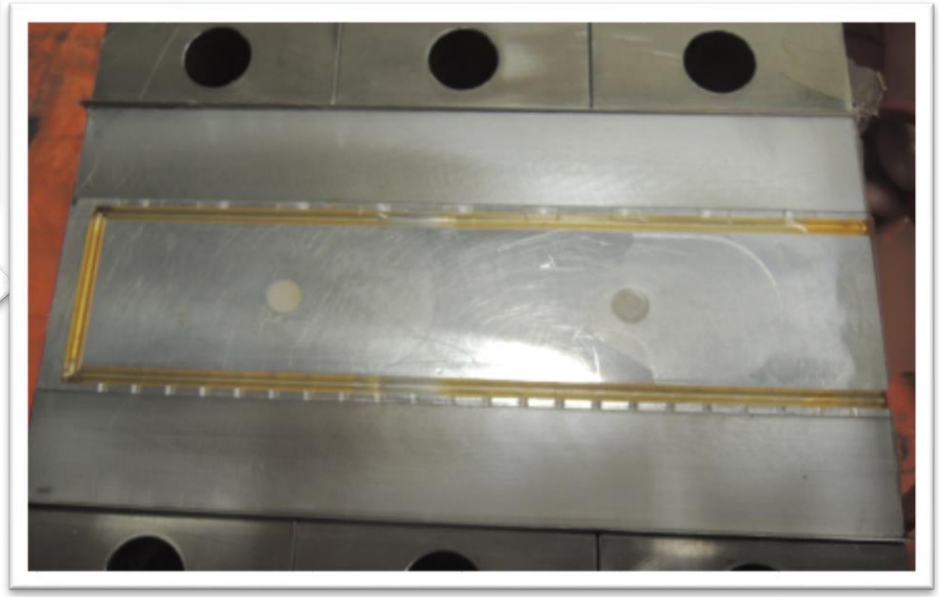
- Scalability
- Monitor process and feasibility of demoulding
- Electrical testing
- Optical investigation of cross sections

300 mm Trials
Two basic concepts for injection

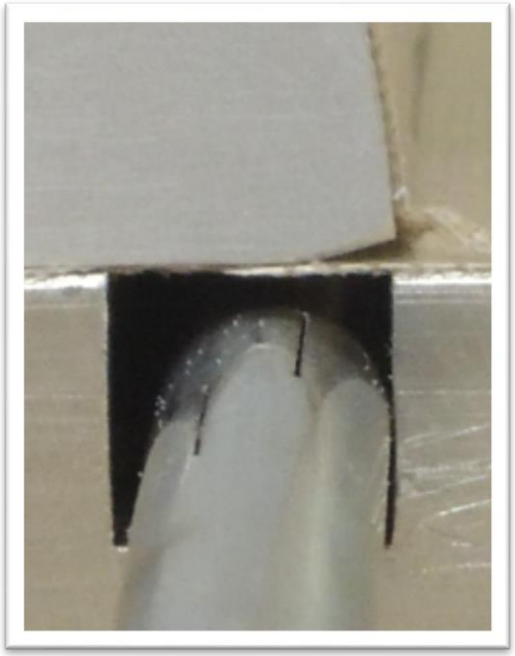


Baseplate modification

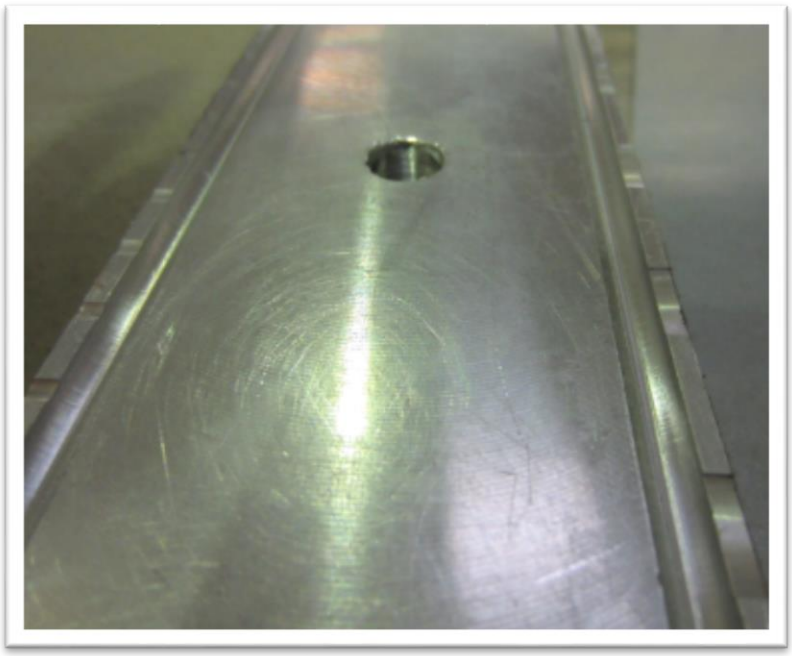
Mandrel modification



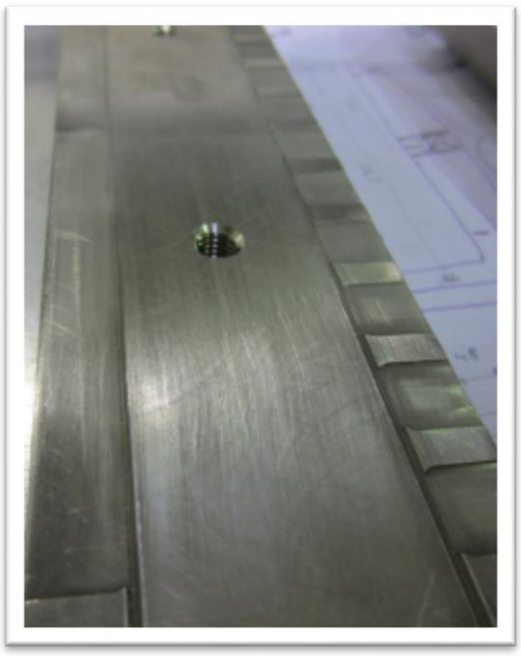
300 mm Trials
Variation of injection schemes



MIP1: Chamfer, continous
(BNG)



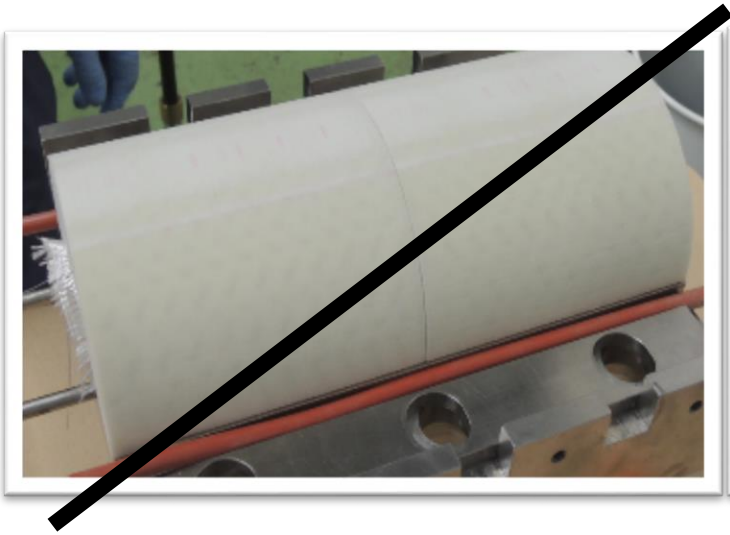
MIP2: Grooves, short, long
(Gauthier, Lambert, Mazet)

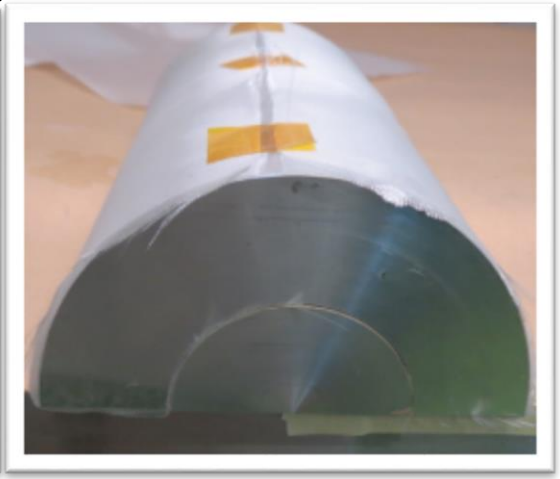


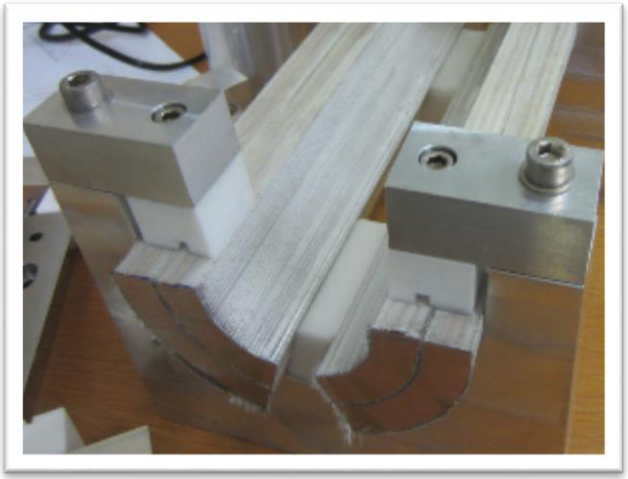
MIP3: Grooves, long, cont.
(Gauthier, Lambert, Mazet)
Depth: max. 0.1 mm !

300 mm Trials
Impregnation coil dummies

A first test has been carried out with a **3d-printing material**. After the material has proven to be not suited, an **aluminium dummy** has been machined for the first test. Another trial is to be carried out on a **coil-like structure.**

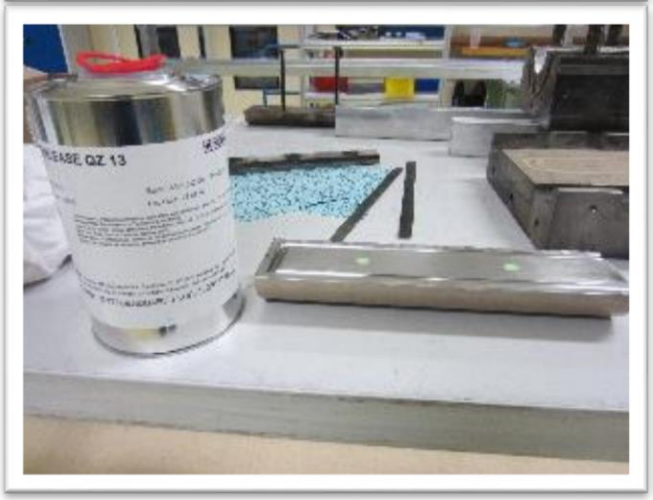


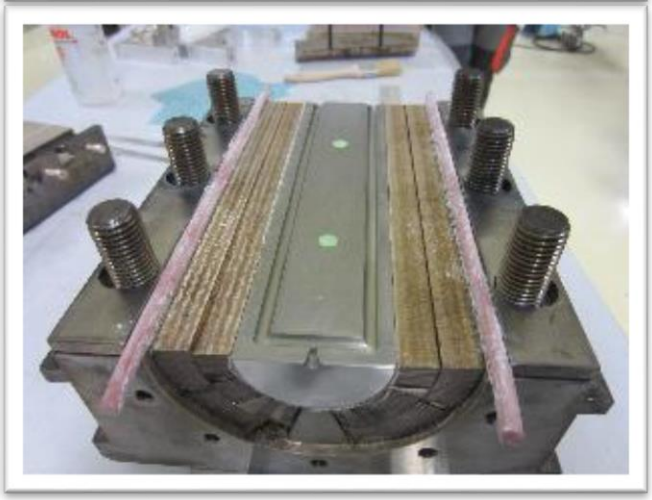




(Due to oversize 2 layers mid-plane layers removed)

300 mm Trials
Impregnation coil #103 section



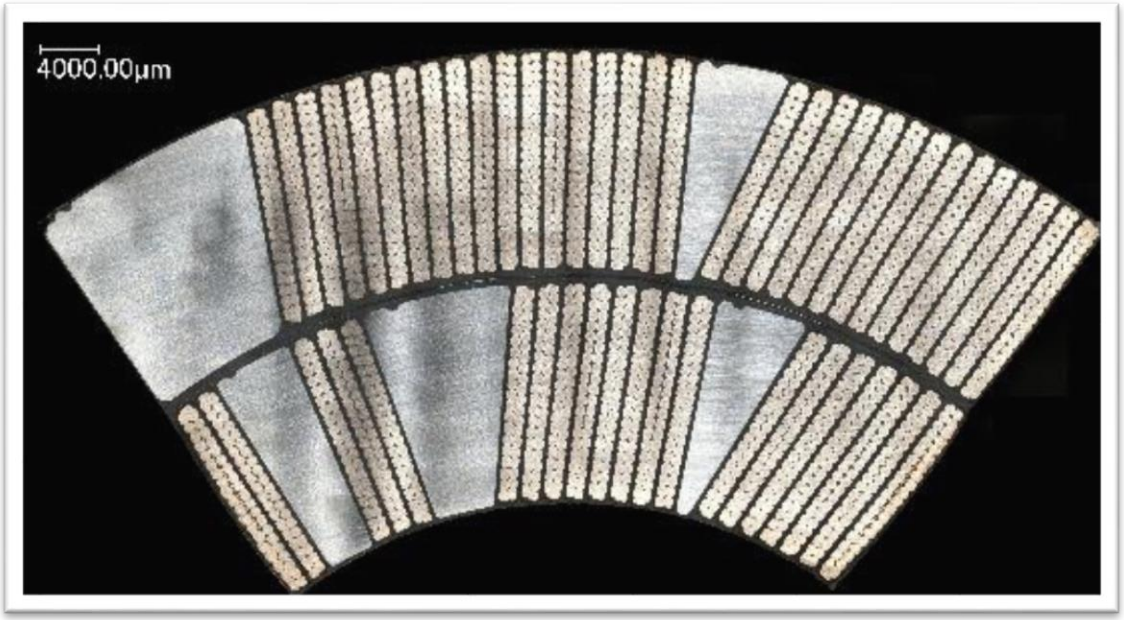


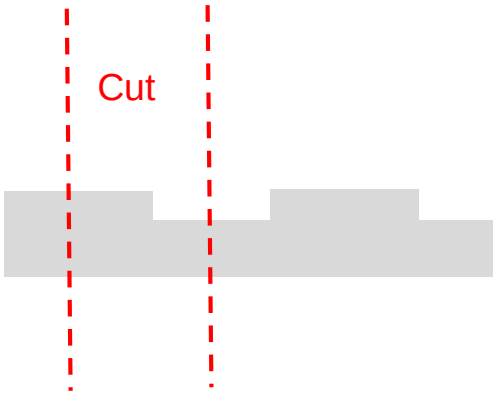
Impregnation conducted in the Polymer Lab, respecting inclination angle.

300 mm Trials
Impregnation coil #103 section – CUT RESULTS

Analysis:

- Coil has been cut in several positions: Plot and Cote each at Injection and Exit





S. Langeslag (MME-MM)

No obvious defects at 50-fold magnification

300 mm Trials
Impregnation coil #103 section – CUT RESULTS

Higher resolution investigation currently in progress at MME-MM

S. Langeslag (MME-MM)

300 mm Trials
Conclusion

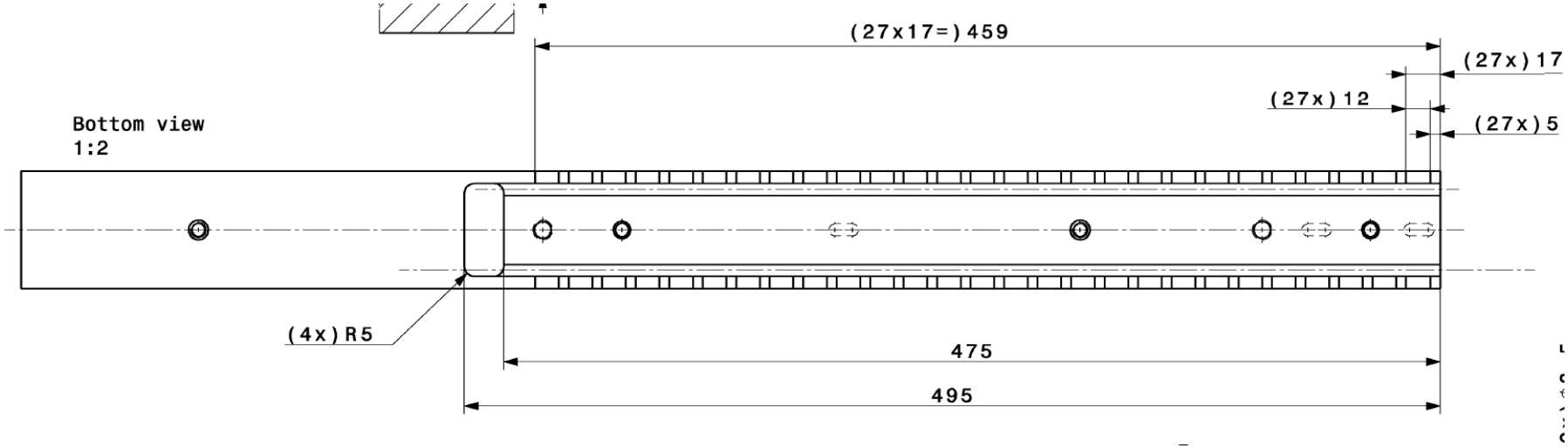
Injection:	Both variants are working; GM preferred, for easier baseplate demoulding.
Patterns	Hollow grooves of 0.1 to 0.2 mm preferred; so far no difference of Muliple points to continous injection
Bubbles	So far no bubbles could be found
Demoulding	Good for multiple point grooves as described above (Auxiliary skrews by J. Mazet)
Quality Coil	Ongoing

Modification of 2m tooling
Mechanical

Based on the experience gained with 300 mm tooling:

- Implementation of Mazet-channels like in the last MIP4
- Additional threads for removal (pressing against pole)
- Pocket at arch in order to trap potential bubbles (J. Mazet)

LHCMBHST0598, LHCMBHST0599, LHCMBHST0600



Modification of 2m tooling
Mechanical

Modification of 2m tooling
Surface coating

The removal adhesive has been replaced with Teflon-coating:

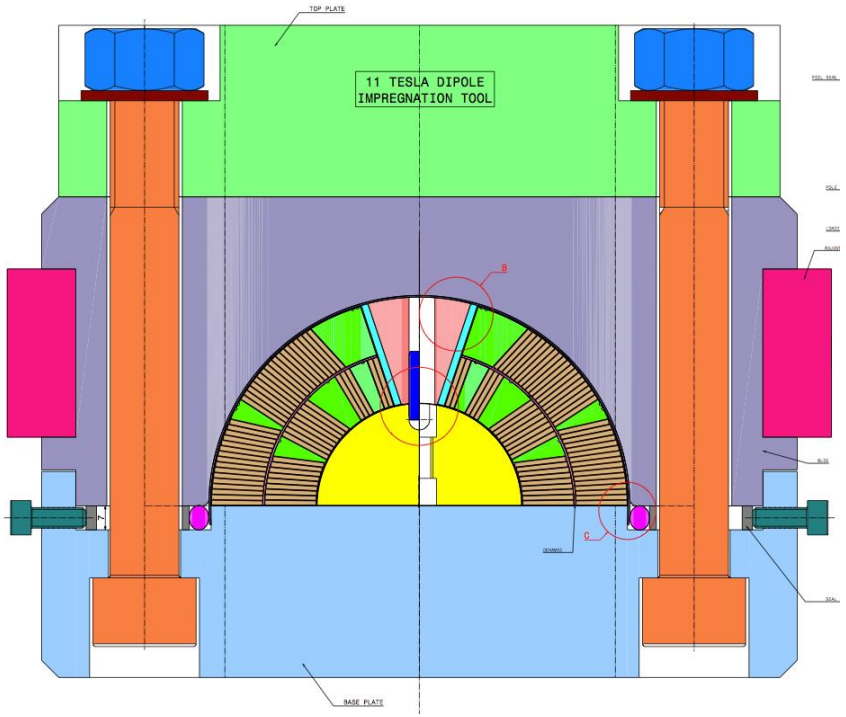
- All mandrels on the outer surface, not midplane
- Inner surface of the seal foil

	Supplier	TYPE	Thickness mm	Tolerance mm
Teflon Adhesive	Aerovac / UMECO	FF03-PTFE	0.114	(applied by hand)
Teflon coating	TTM S.A.	PFA	2 x 0.04	2x (±0.01)

Modification of 2m tooling
Surface coating

Modification of 2m tooling
Impact on cavity size

The parameters of the coil and the tooling decide for the quality of the impregnation



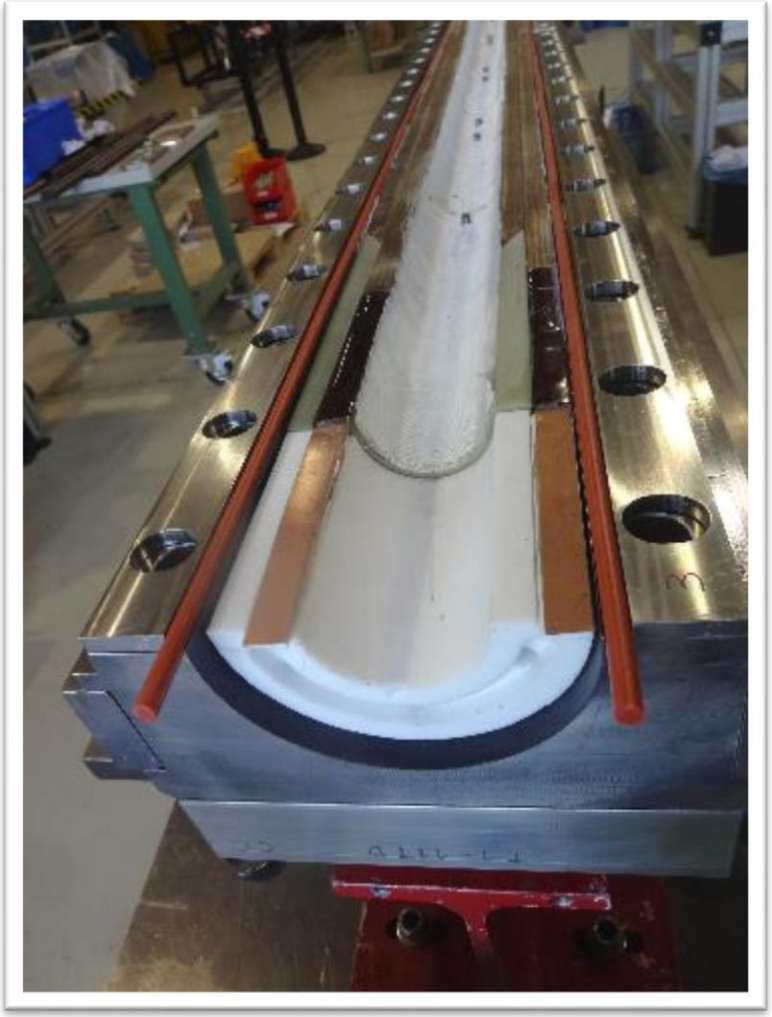
D. Smekens

Coil R60.8

Block R61.425

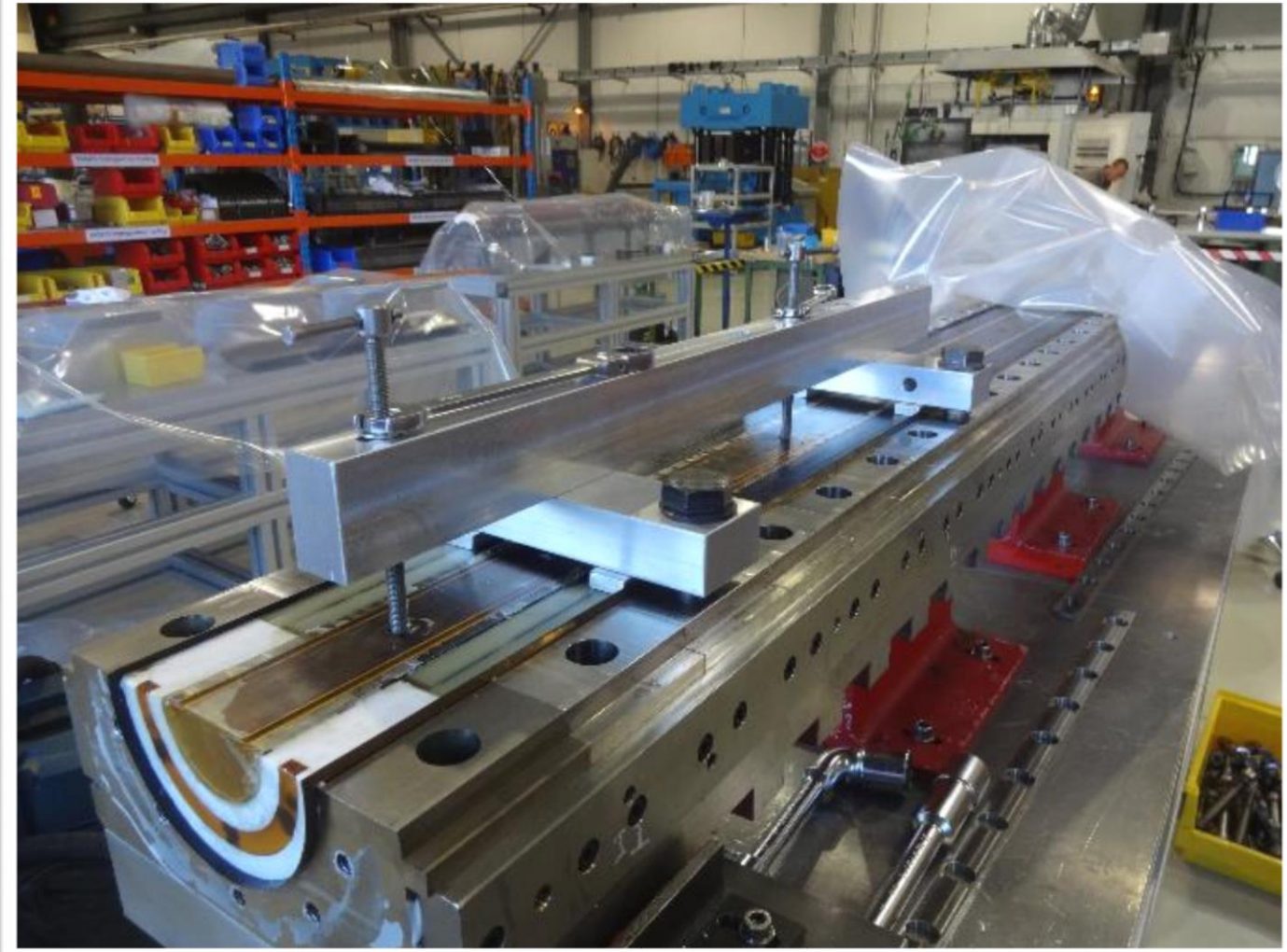
Gap	0.625	
shell	- 0.5	- 0.3
film	-0.11	- 0.11
Assy gap	**0.015**	**0.215**

Modification of 2m tooling
Fixture assembly

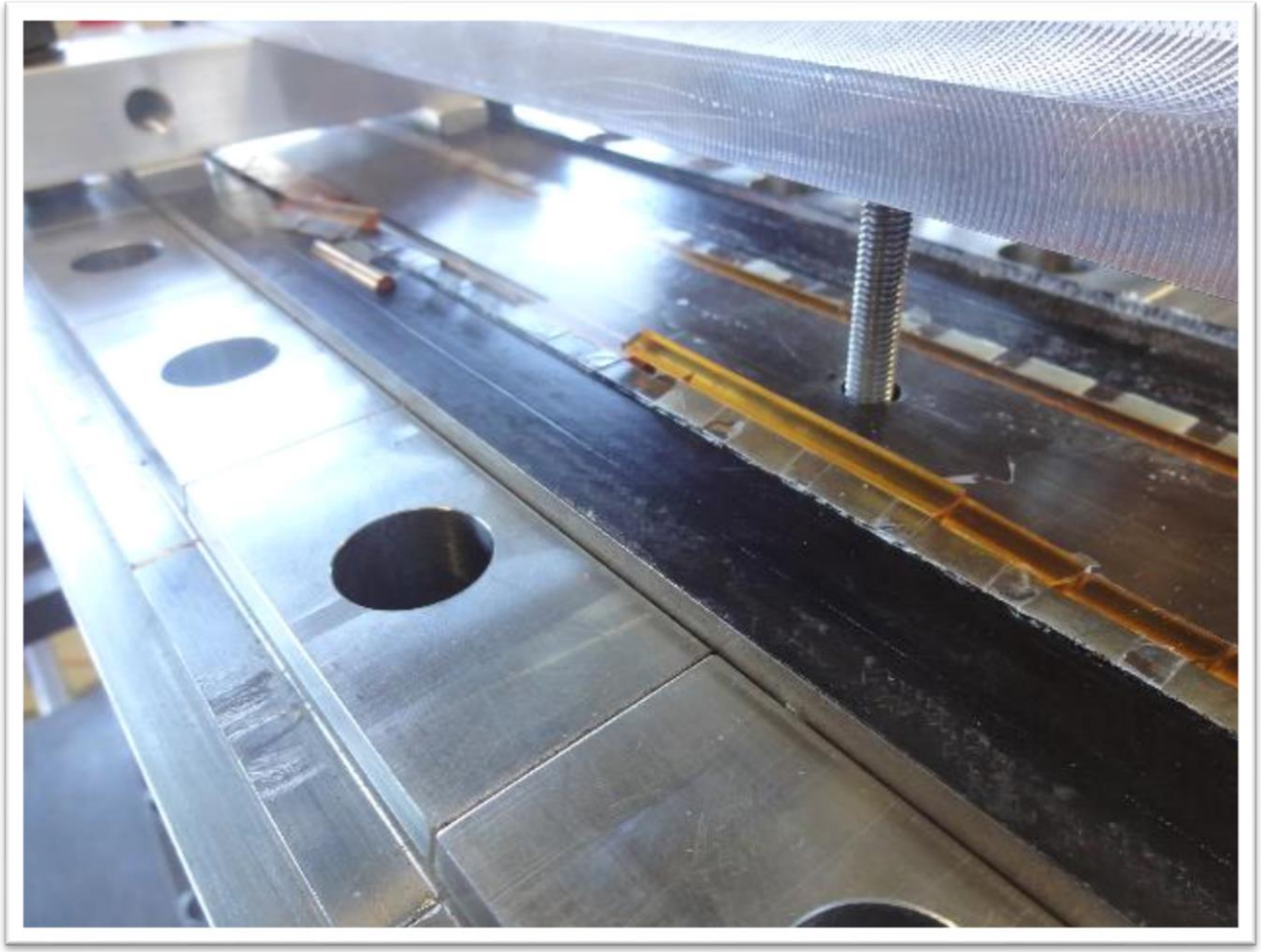


Modification of 2m tooling
Fixture assembly

Modification of 2m tooling
Fixture disassembly



Modification of 2m tooling
Fixture disassembly



Conclusions

The 300 mm trials showed:

- the tools work in small scale
- the impregnated section looks promising

The modification of the 2m tooling was successful

The Quality of the impregnated coil: See the next talks:

Modification of 2m tooling
Fixture disassembly

Thank you!