



Progress of the HL-LHC CCT magnets in China

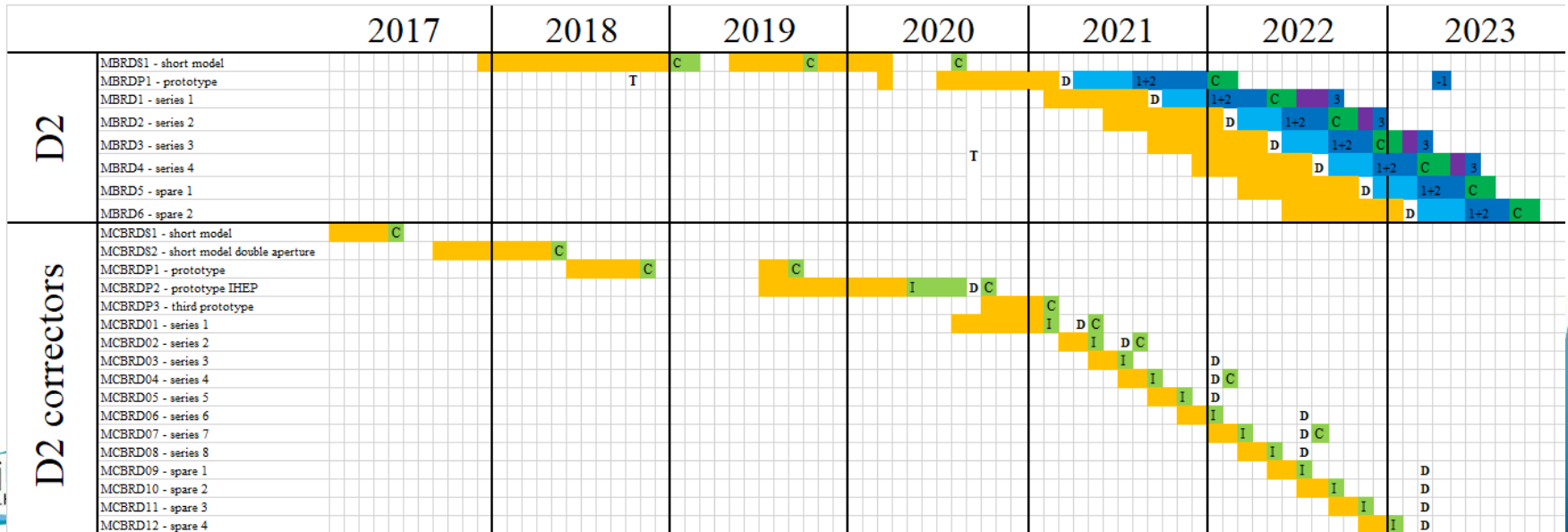
IHEP, IMP, BAMA



HL-LHC WP3 meeting – Dec 16 2020

Present Status

- The 1st practice coil from Bama with **New VPI procedure (wet winding plus 5bar VPI)** reached **530A stand-alone, after 27 times of quench, tested at 4K** at IMP. Comparing with the previous coils from WST (50~60 times of quench to reach the ultimate current), significantly improved the training performance, to be confirmed by more results in future.
- Fabrication of the **1st series magnet has been started**, to be completed by the **end of 2020 or beginning of 2021**, with **“dry winding” plus 5bar VPI**. Ready for delivery in February or March 2021



July 27, 2020
Received 50 km insulated NbTi wire



August 10, 2020
Test of insulation strength for ~14 km
NbTi wire completed



July 25, 2020
Received practice coil former



August 15, 2020
Copper wire for practice



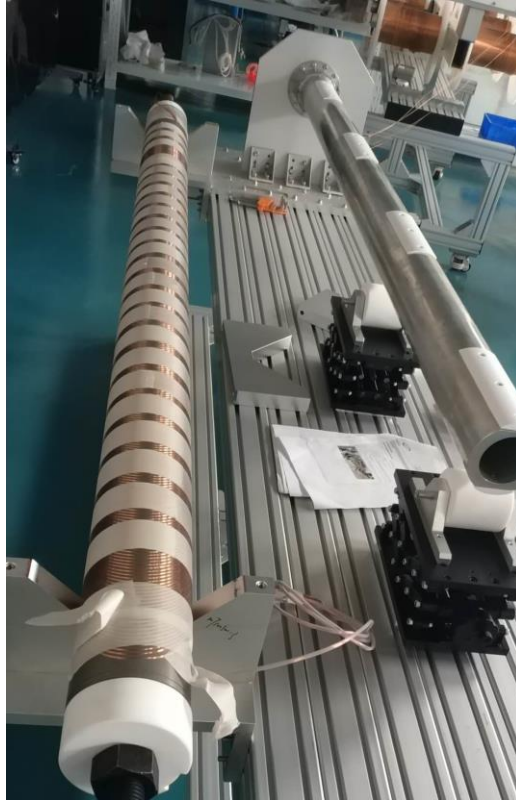
August 20, 2020
Winding machine preparation



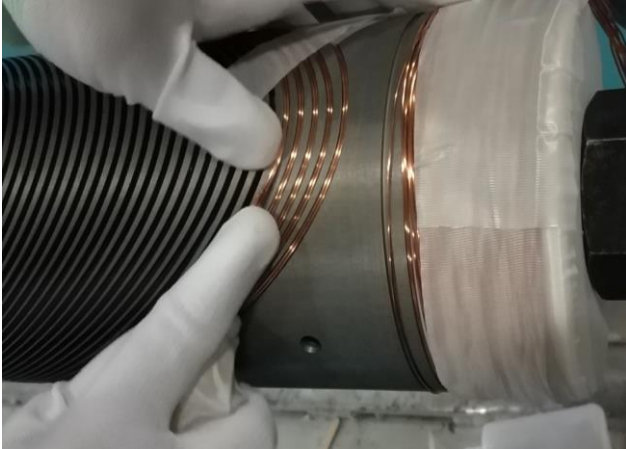
September 1, 2020
Winding tooling preparation



September 10, 2020
Winding of inner former completed



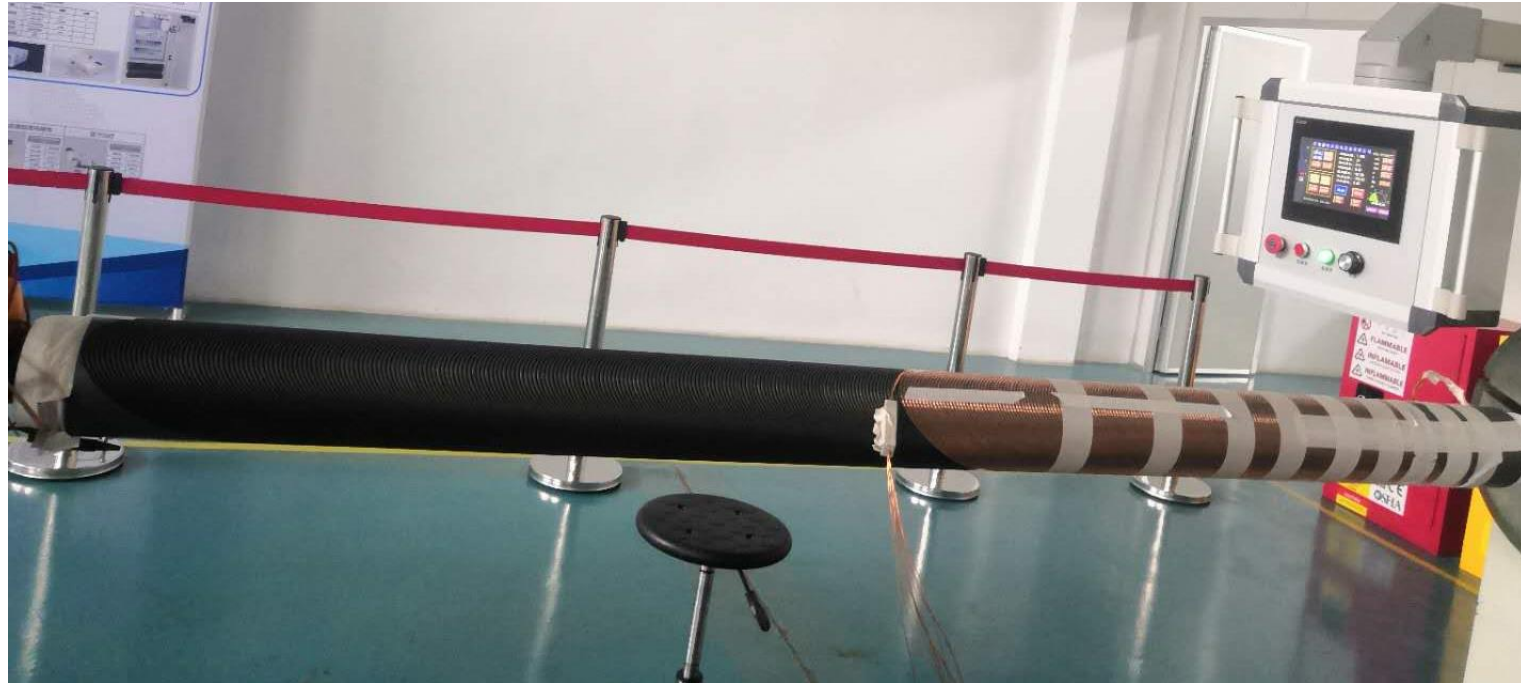
September 3, 2020
Practice coil winding with copper wire



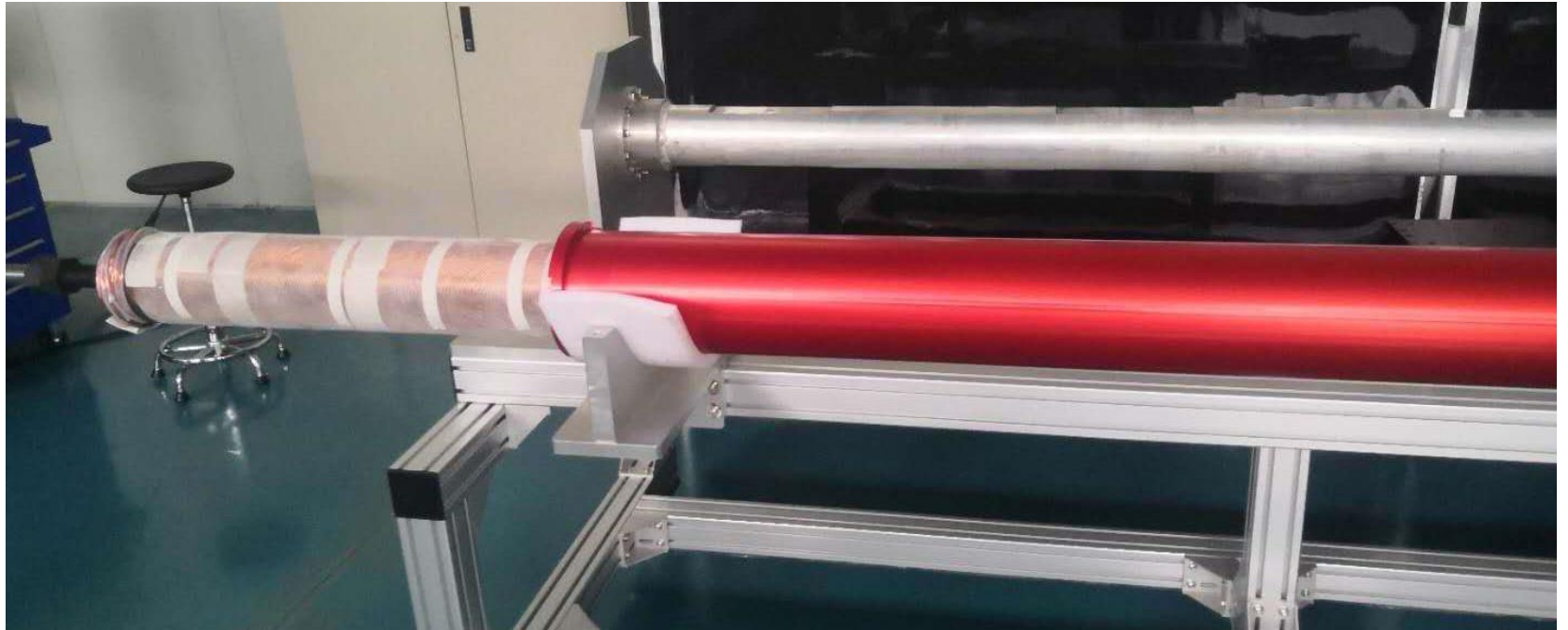
September 3-10, 2020
Solving problems related to winding tooling



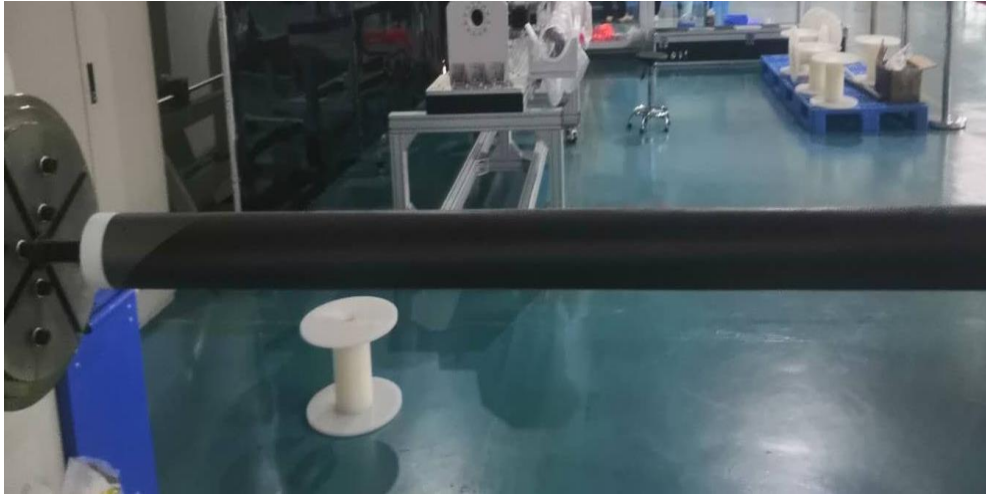
September 14, 2020
Winding outer former



September 15, 2020
Practice coil winding with Cu wire completed

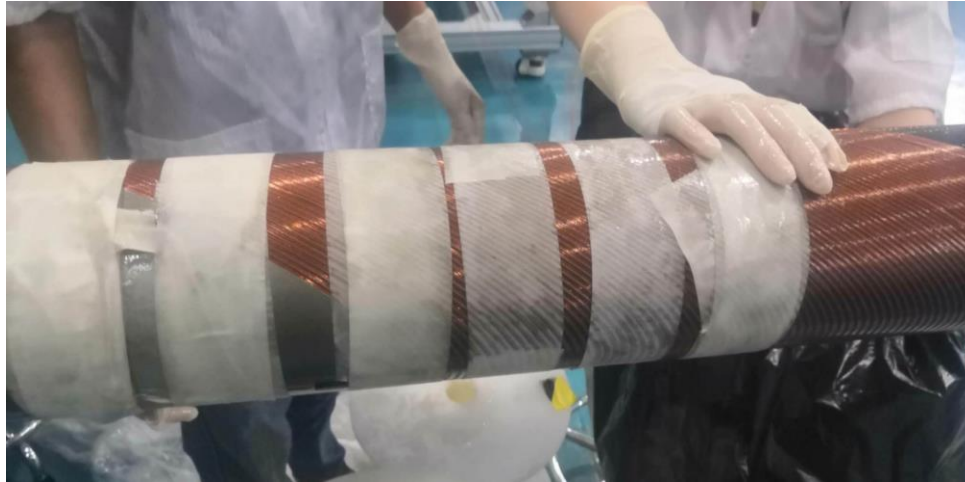


September 16, 2020
started to split the 14 km NbTi wires
and preparation of coil winding with NbTi wires



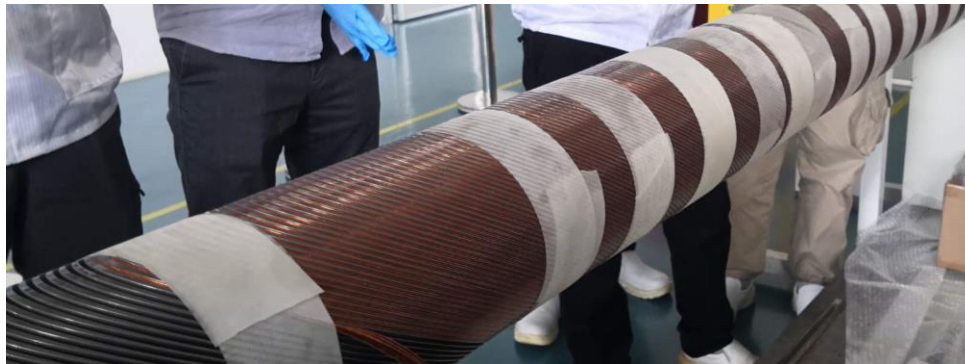
September 17, 2020
Ready for winding.





New VPI procedure for practice coil
Wet winding with CTD-101K,
pre-curing,
and 5-bar VPI

September 18, 2020
Inner coil winding 1/3



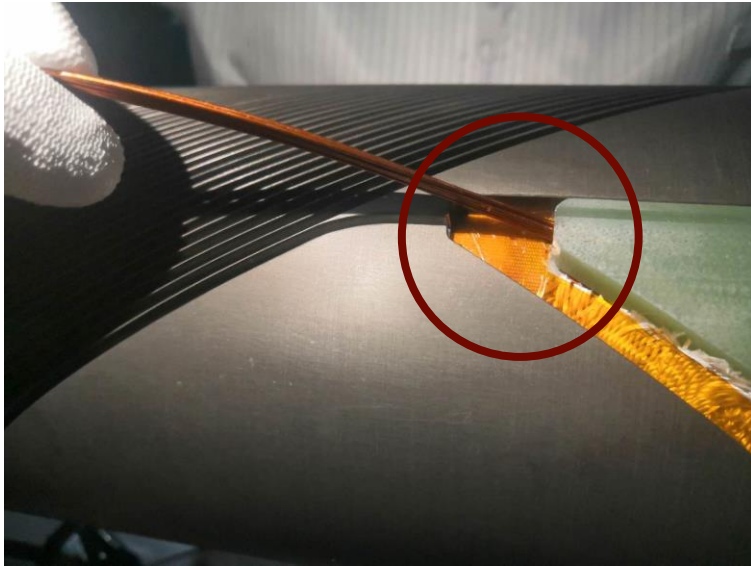
September 19, 2020
Inner coil winding 2/3

September 20, 2020

Inner coil winding completed and wrapped with glass fiber outside.



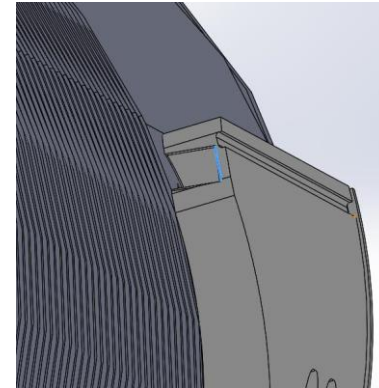
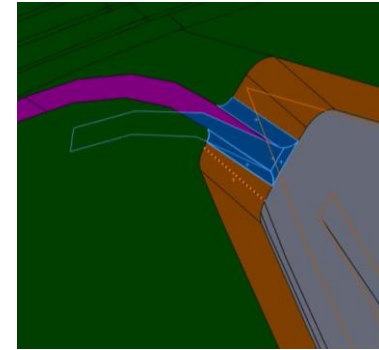
September 21, 2020
 Inner and outer former assembly completed.
 Insulation of wires damaged at some corner
 and repaired.



Repairing some sharp
 edges manually



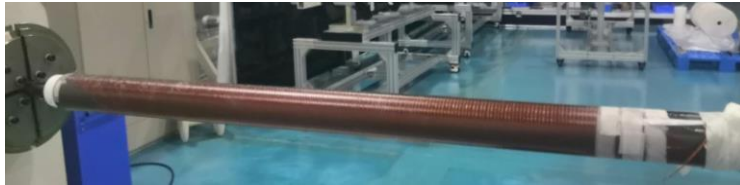
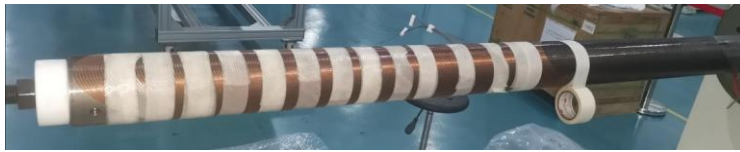
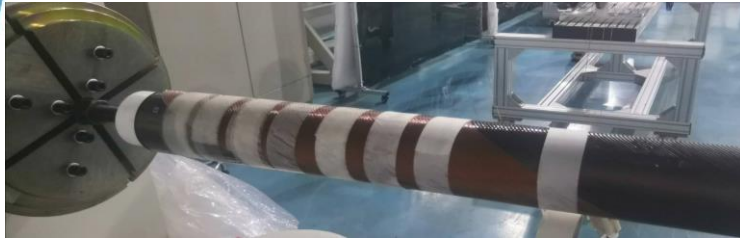
Proposed
 drawing modifications



September 22, 2020

Using 20*0.1 glass fiber to wrap around the inner coil and brush the resin.





September 23-25, 2020

The outer coil winding completed.

Wire of each spool is 476 meters long. The remaining wire after winding is about 40 meters.

The temperature sensors were installed.



The CCS Temperature Sensor number

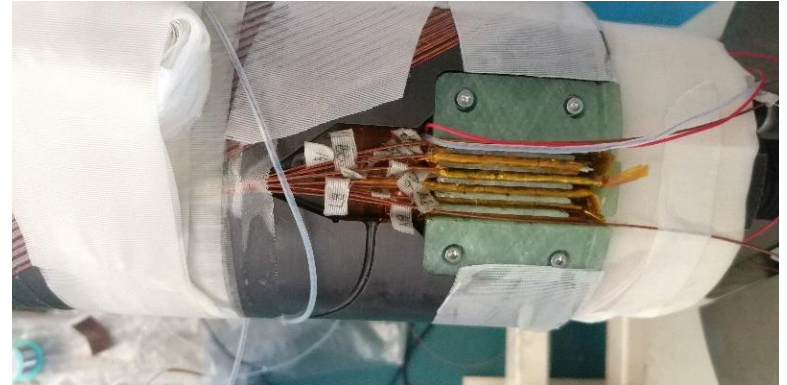
Similar joints that have been made by Bama



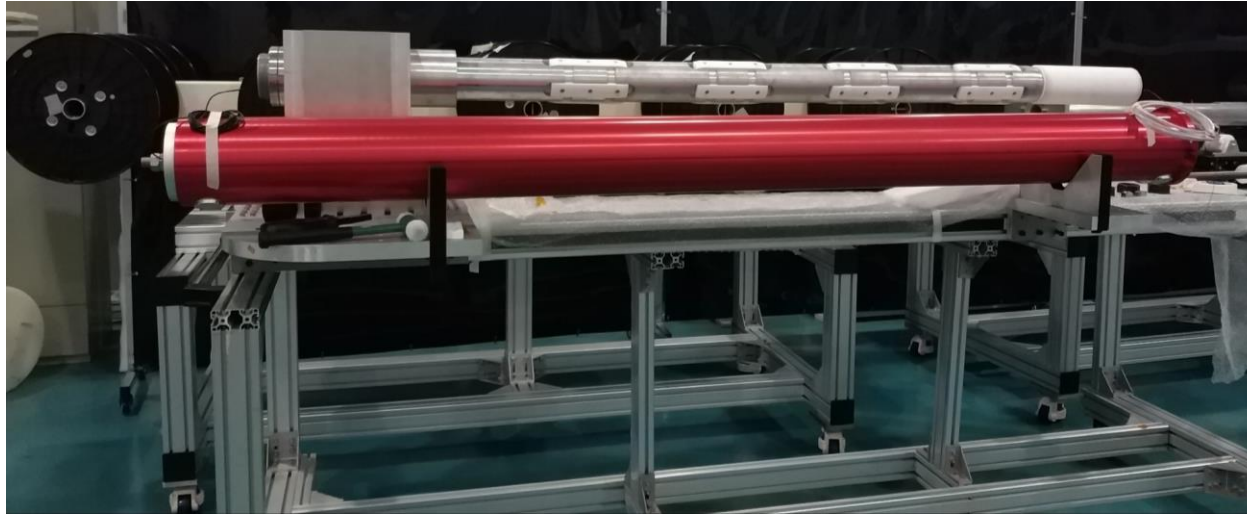
Practice joint welding



September 26, 2020
All joints completed



September 28, 2020
The outer support tube and VPI tooling installation completed



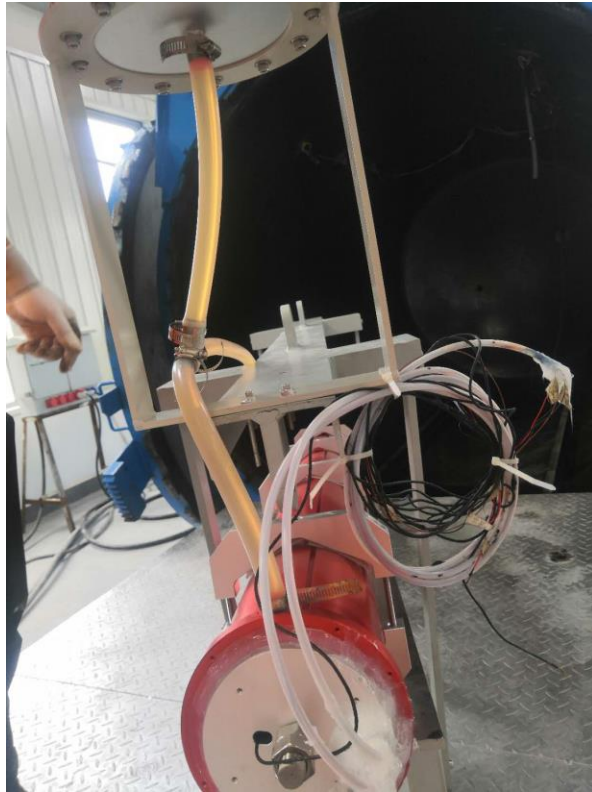


October 1, 2020
VPI tooling
assembly and pre-
curing completed.
Moved to VPI
furnace

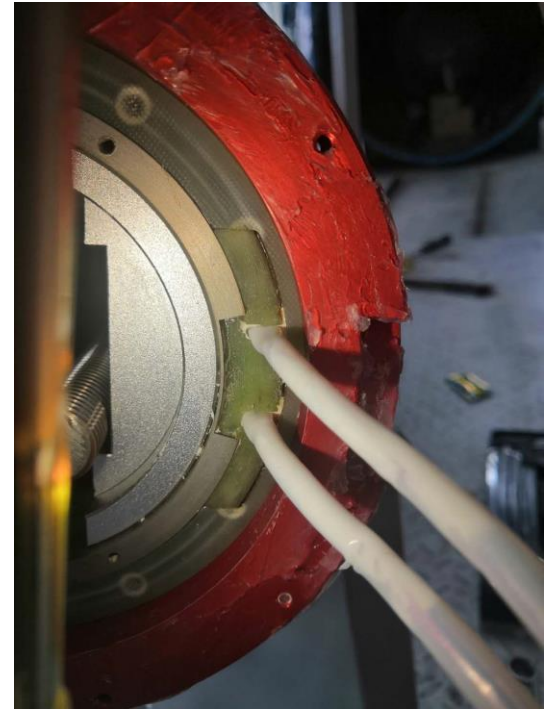
October 2-4, 2020
Vacuum baking at
100 °C



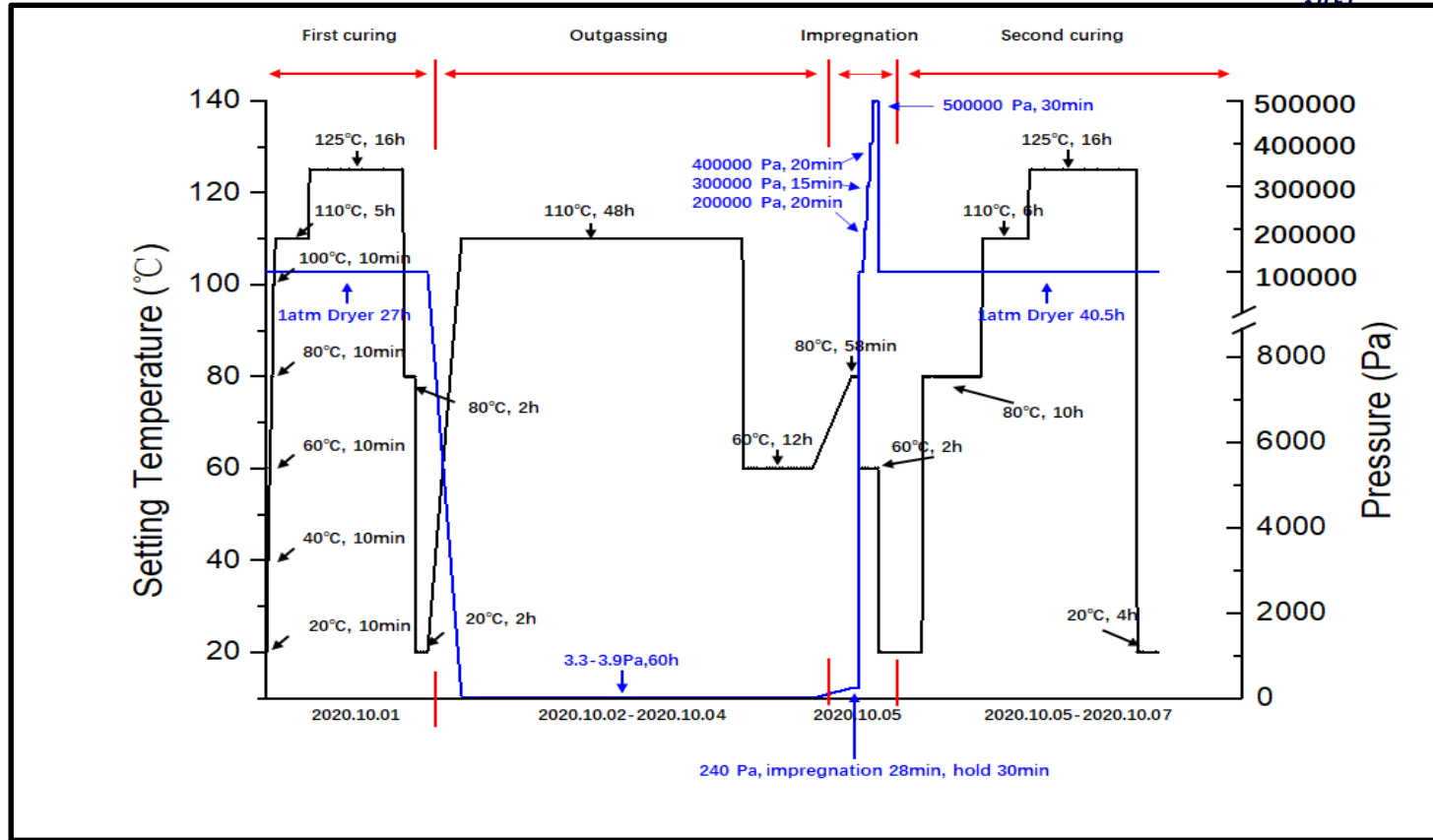
October 5-7, 2020
VPI with maximum 5bar



October 5-7, 2020
Moving from furnace to oven



October 7, 2020
VPI completed

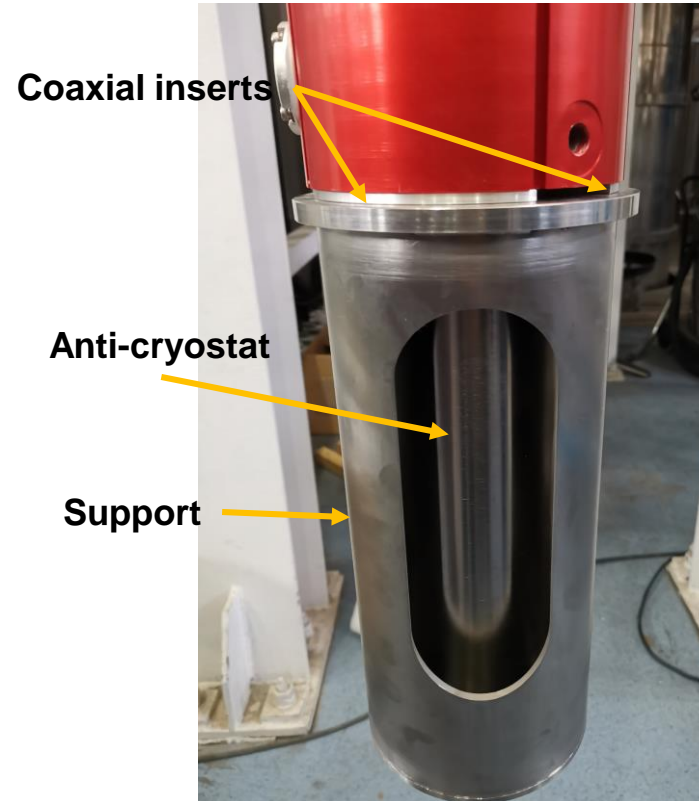




October 7, 2020
Transport to IMP Lanzhou
for the test at 4K

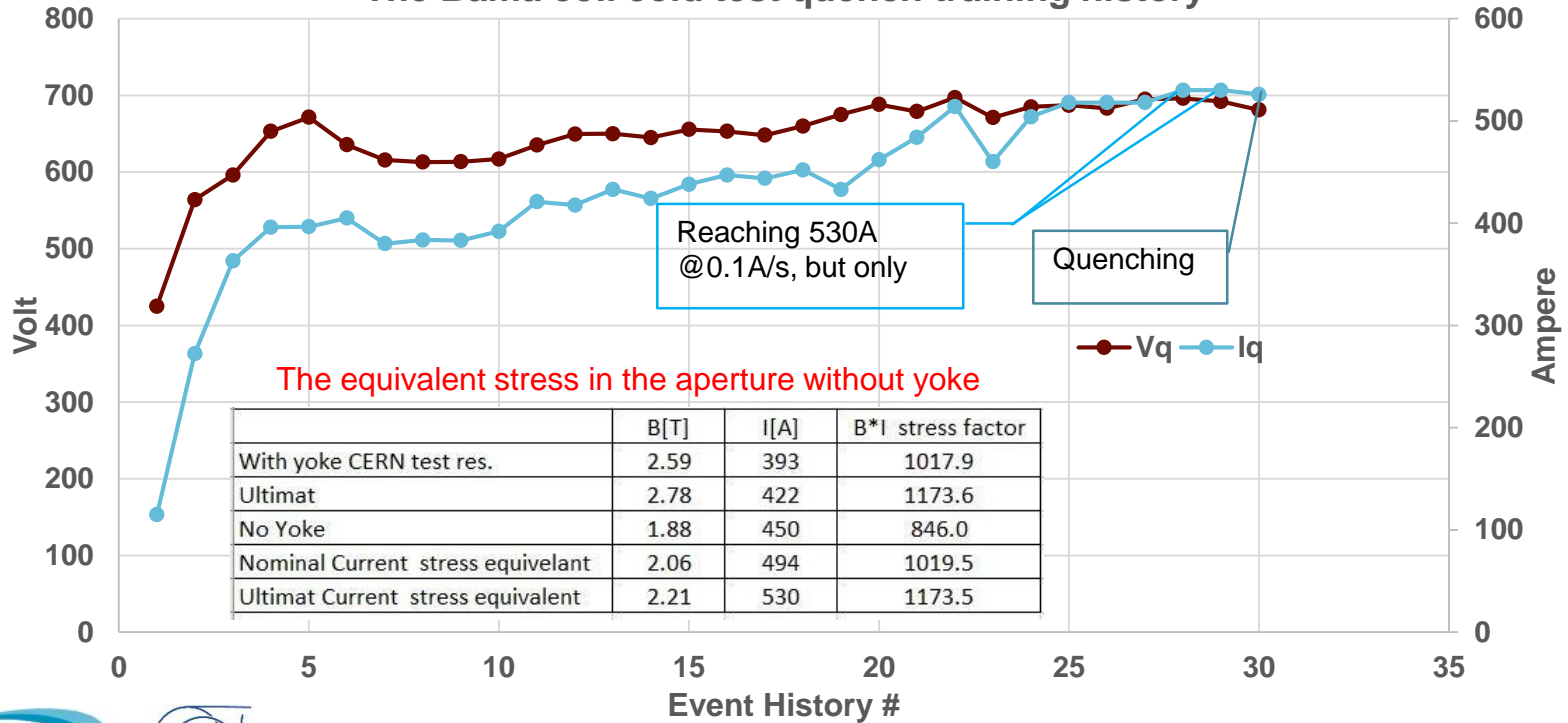


Coil installation for cold test



Reached 530A stand-alone, after 27 times of quench. significantly improved the training performance, comparing with MCBRDP2.

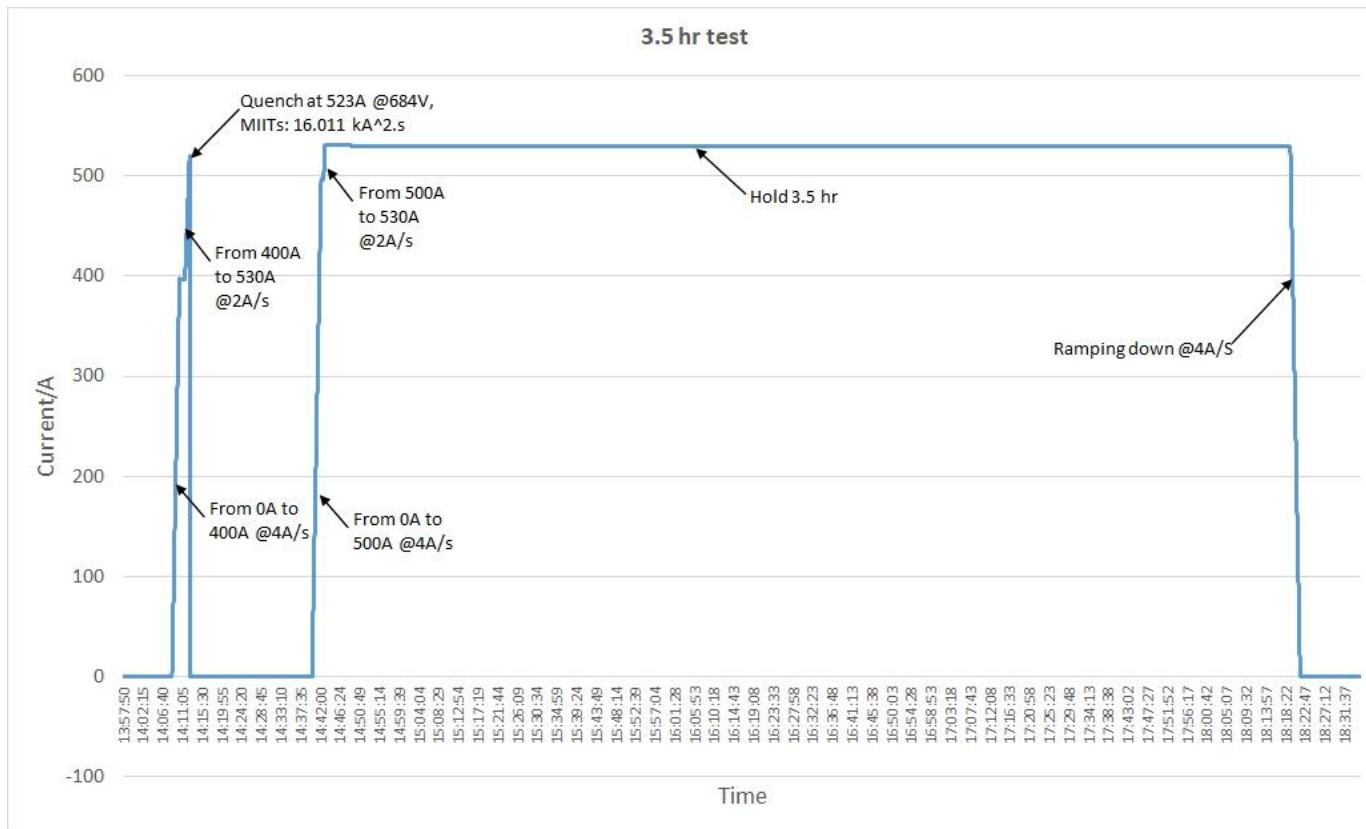
The Bama coil cold test quench training history



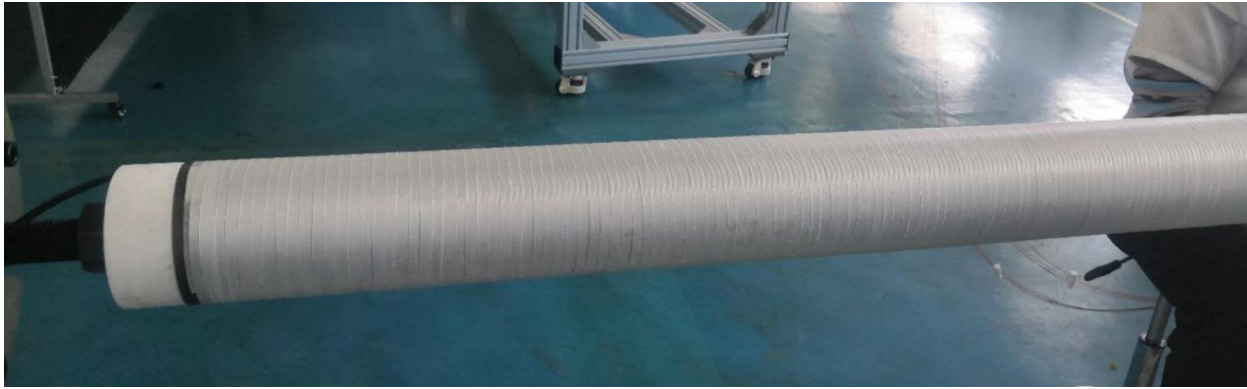
Holding test after thermal cycle



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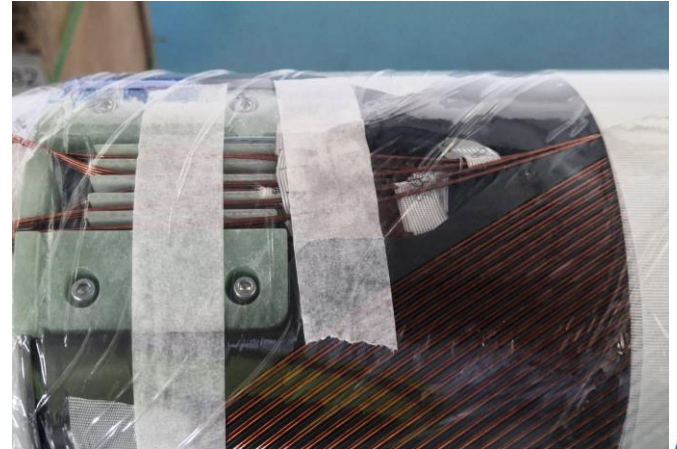
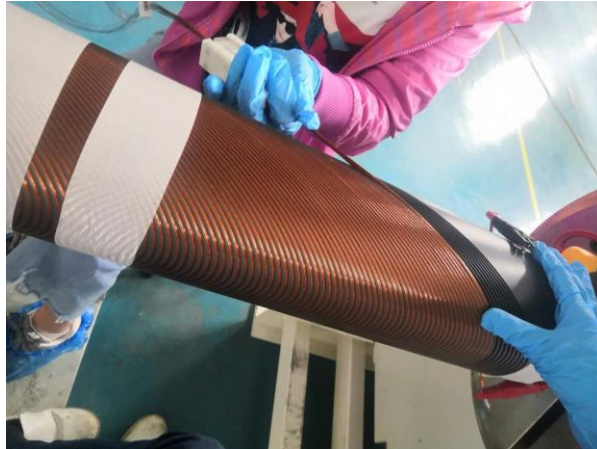
Fabrication of the 1st magnet



October 23, 2020
Inner coil winding of the
1st magnet V aperture
Completed
“dry winding”

Nov 2, 2020
outer coil winding of the
1st magnet V aperture
Completed

Preparing for making joints



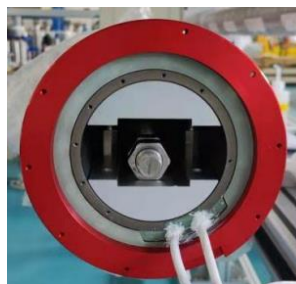
Nov 3-10, 2020

making joints, assembling outer cylinder. Ready for VPI.



Nov 3-10, 2020

making joints, assembling outer cylinder. Ready for VPI.

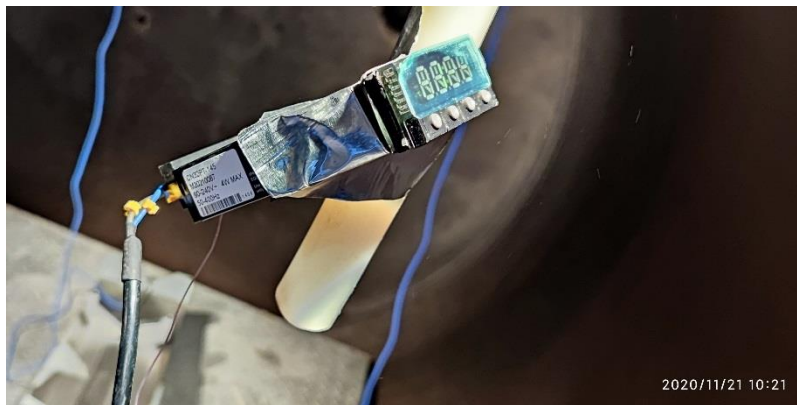
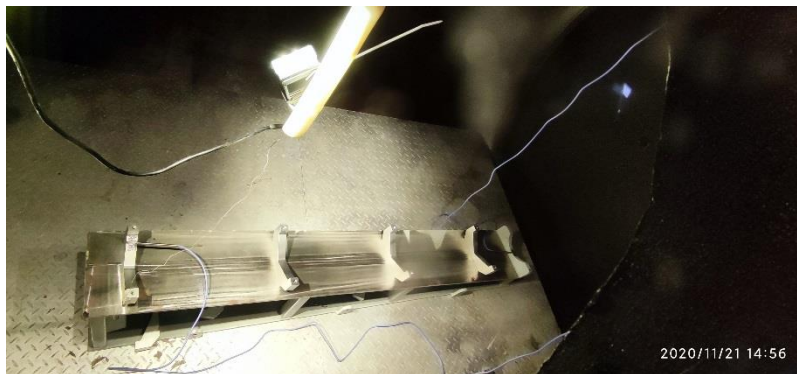


Nov 11-26, 2020

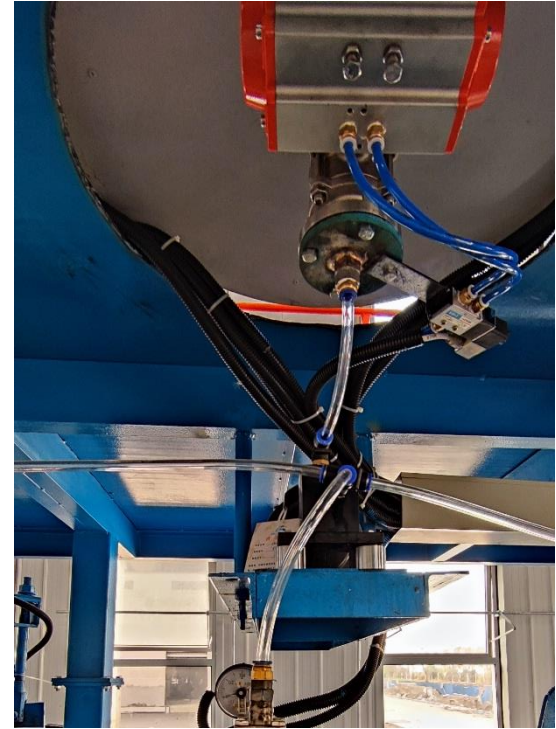
Thermometer calibration of the VPI furnace.



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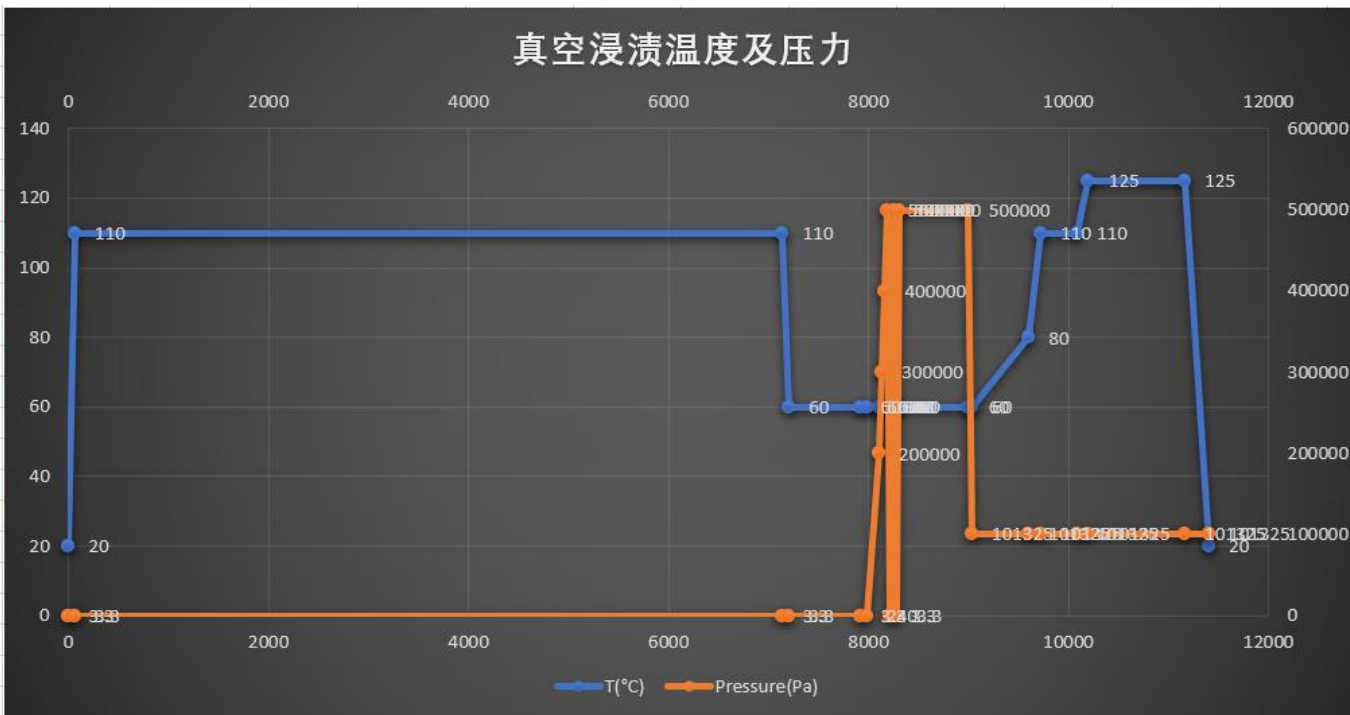
Nov 26-29, 2020
Preparation for VPI process



Nov 30-Dec 12, 2020

VPI process: 5-day degassing + 5bar VPI

Time(min)	T(°C)	Pressure(Pa)
0	20	3.3
60	110	3.3
7140	110	3.3
7200	60	3.3
7920	60	3.3
7980	60	240
8100	60	200000
8130	60	300000
8160	60	400000
8190	60	500000
8220	60	3.3
8250	60	500000
8280	60	3.3
8310	60	500000
9000	60	500000
9030	60	101325
9600	80	101325
9720	110	101325
10080	110	101325
10200	125	101325
11160	125	101325
11400	20	101325



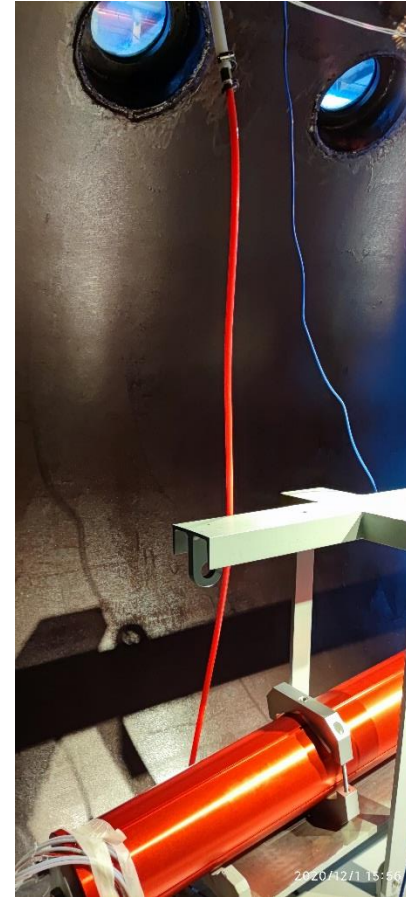
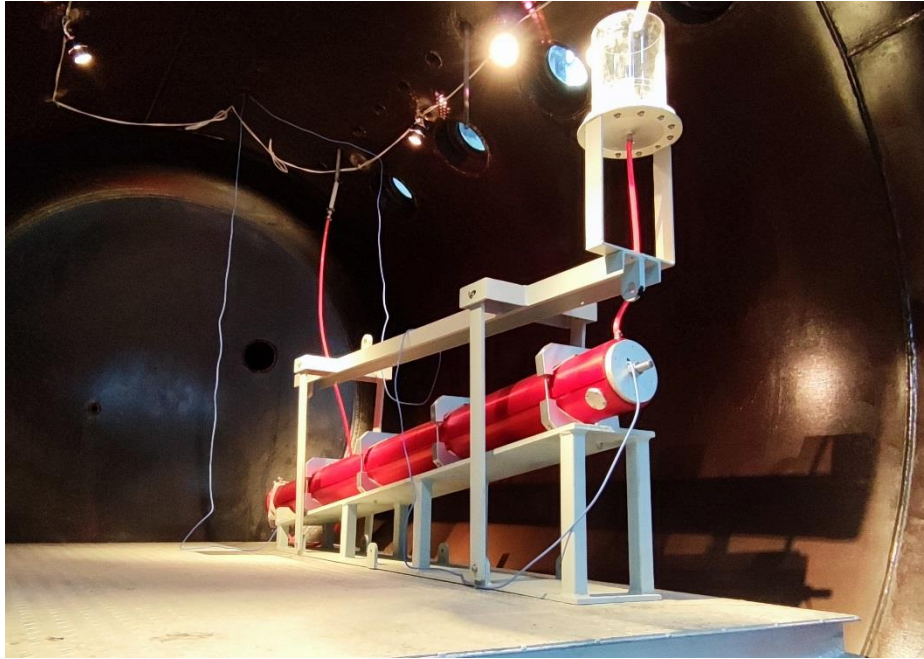
Nov 30-Dec 12, 2020

VPI process: 5-day degassing + 5bar VPI



Nov 30-Dec 12, 2020

VPI process: 5-day degassing + 5bar VPI

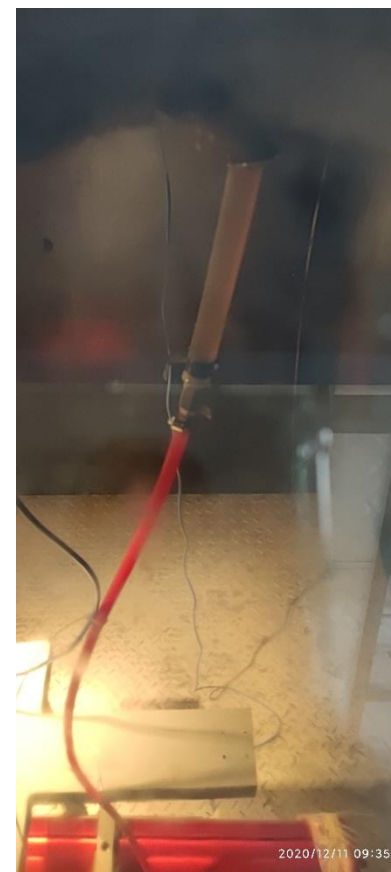


Nov 30-Dec 12, 2020

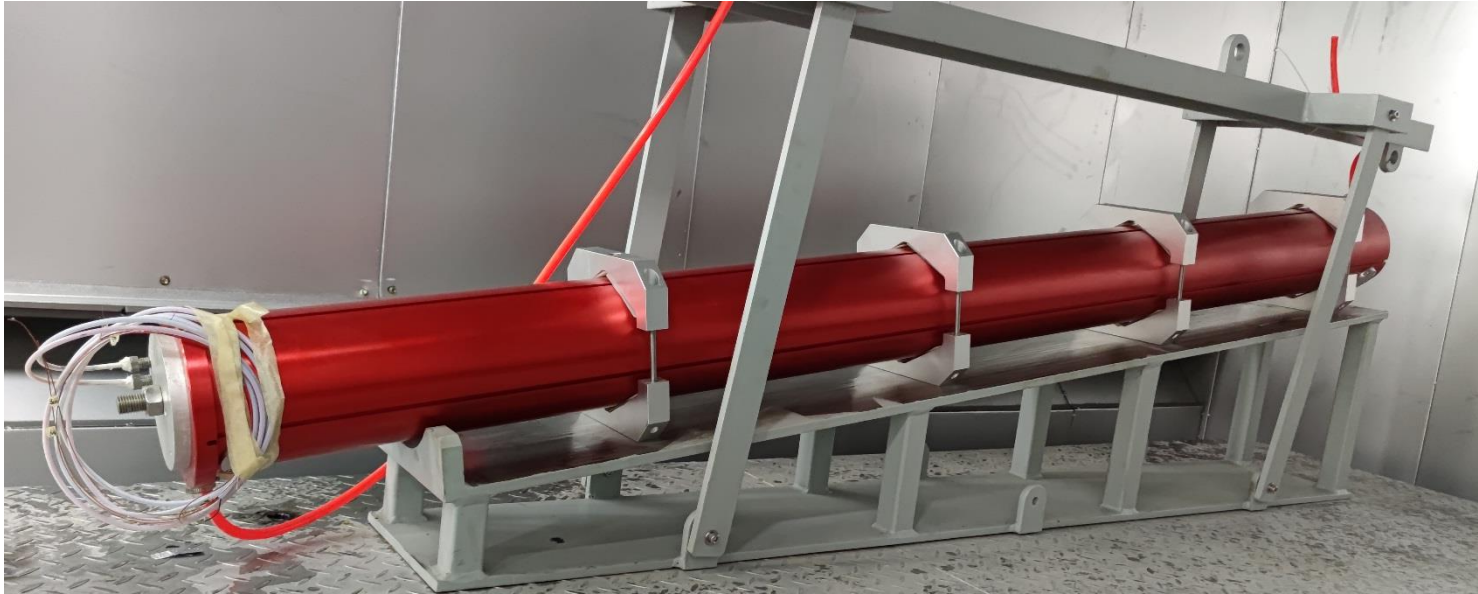
VPI process: 5-day degassing + 5bar VPI



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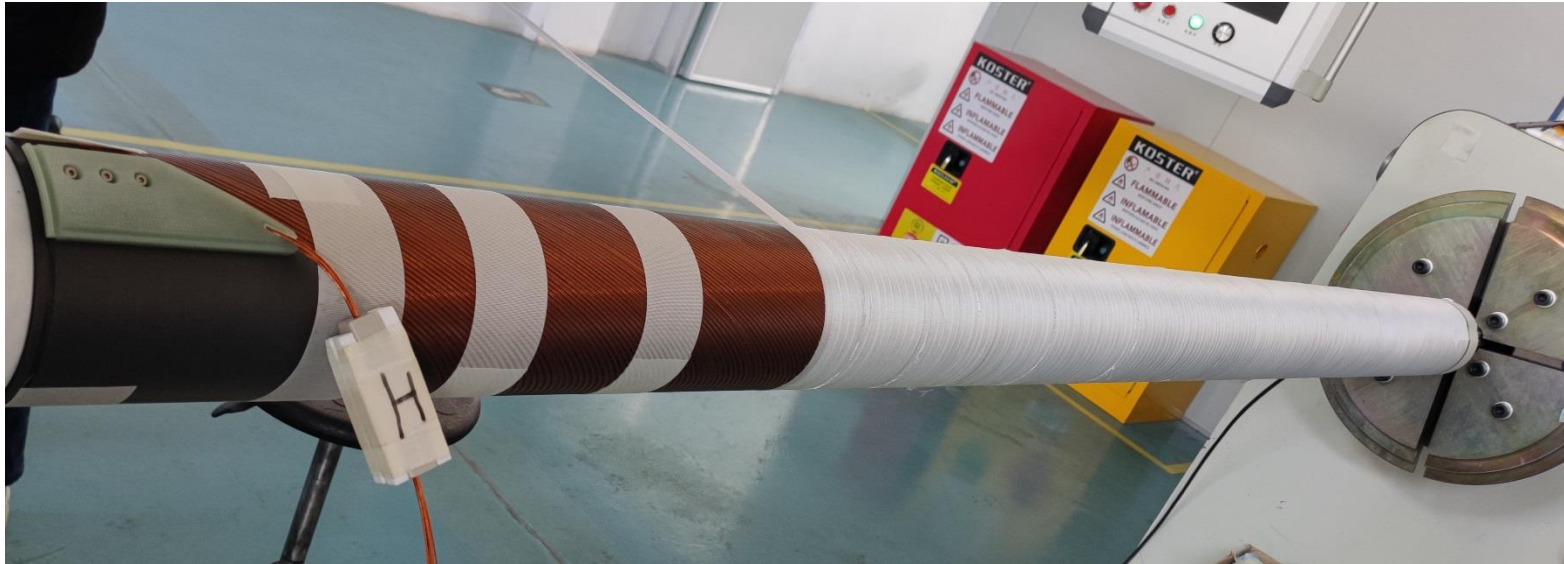


Dec 12, 2020 VPI completed



Dec 13, 2020
Transport to IMP for Stand-alone test

Dec 14-20, 2020
The 01-Aperture2 coil winding



VPI to be completed by the end of Dec 2020

Plan from now to Apr 2021

December 31, 2020	01-Aperture2 ready for stand-alone test.
Early January 2021	Start to assemble the 01 magnet
Early February 2021	The 01 magnet ready for test
Early March 2021	The 01 Magnet ready for delivery to CERN
End of April 2021	The 02 Magnet ready for delivery to CERN



Thanks for your attention