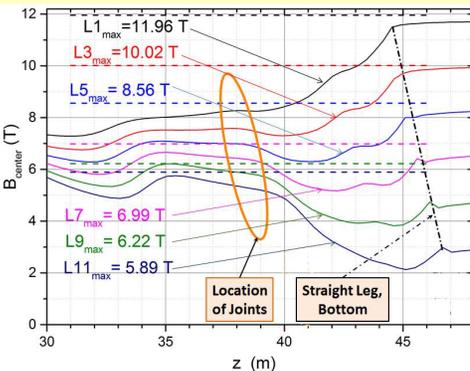


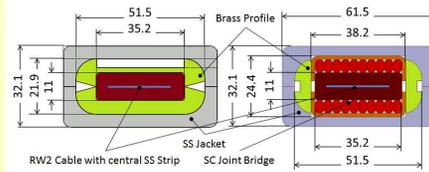


## Operating Condition

DEMO RW2 High-Grade Conductor: 63 kA, 12.2 T, Tcs >6.5 K



## Design of Inter-Layer Joint



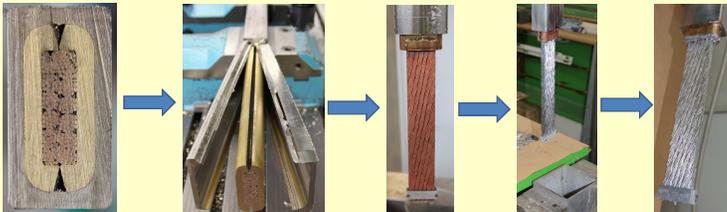
	RW2 Conductor	Joint and Bridging Conductors
Operating Current, kA	63	63
Operating Field, T	12.2	8.2
Width x height, mm x mm	61.5 x 32.1	61.5 x 32.1
Strand Diameter, mm	1.2	1.5
J <sub>c</sub> , A/mm <sup>2</sup> (12T/4.2K)	1078	1007
Cabling Layout	(1Cu+6sc+12sc)x13	7sc, 20 sections
Cable final pitch, mm	380	45
Central strip in flat cable	Steel, 25mm x 0.2mm	Steel, 25mm x 0.2mm

- Butt-joined conductors, 380 mm twist pitch
- Superconducting bridges, 380 mm overlap

TF Inter-Layer Joint, RW2 High-Grade Conductor: 63 kA, 8.2 T

## Manufacturing of Inter-Layer Joint Parts

The RW2 Conductor, earlier tested in SULTAN Test Facility is used for the joint manufacturing



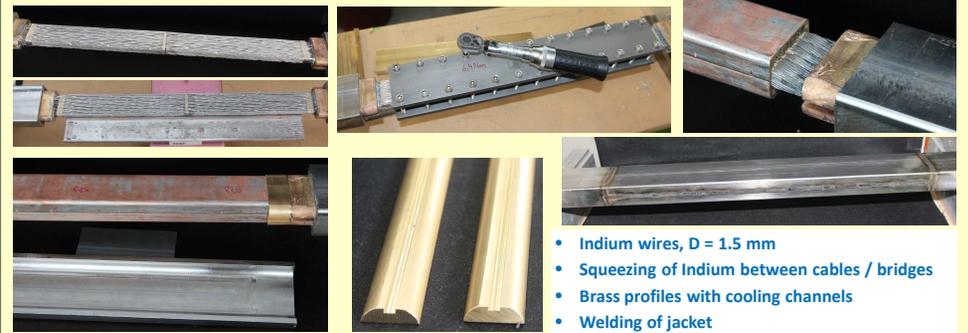
- Cutting of RW2 conductor
- Opening of cable
- Cr removal
- Dipping into the Sn95Ag5

## Superconducting Bridges



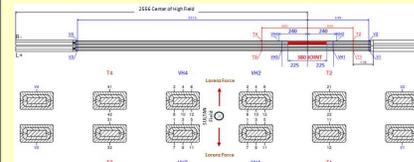
- Heat treatment
- Removal of oxide and cleaning
- Dipping into the Sn95Ag5
- Smoothing of surface

## Assembly of Inter-Layer Joint



- Indium wires, D = 1.5 mm
- Squeezing of Indium between cables / bridges
- Brass profiles with cooling channels
- Welding of jacket

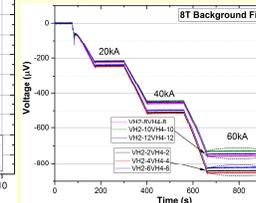
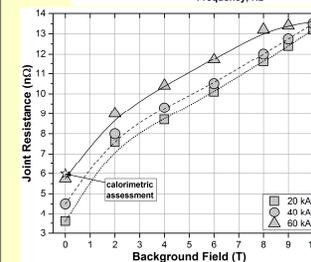
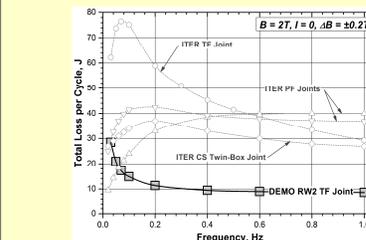
## SULTAN Sample and Instrumentation



## Discussion

- In order to investigate the bad resistance of joint, the jacket of joint was cut away, and the joint was disassembled. A visible reason for bad joint resistance has not been observed. The indium wires are well squeezed; cover about 90% of surface and well sticking to the surfaces of conductor and bridges. This observed fact could imply that the resistance of contacts between the cable and bridges is good enough, and the contact resistance should be low.
- The big voltage build-up beyond the joint implies that there is very big inhomogeneity of current inside the joint, leading to the current re-distribution and saturation of current in the strands. The inhomogeneity of current in the joint may cause a significant increase of resistance in the joint.
- Probably the overlapping of cables by bridge is not long enough to provide a good homogeneity of current inside the joint, the length of overlapping should be at least two times longer, the full twist pitch of cable at each end of joined cables should be overlapped by the bridges, i.e. the length of bridges should be as much as twice longer. Probably a solder filling process should be improved for the conductor cables and for the bridges also.

## Test Results



## Acknowledgement

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

## Conclusion

- A first sample of inter-layer joint had been manufactured and tested at SPC for DEMO TF coil with available and earlier tested RW2 conductor.
- The resistance of tested joint is about ten times bigger than expected, probably due to the poor current distribution inside the joint.
- The AC loss of the joint is low enough in spite of parallel conductor inside the overlapping bridges. The AC loss at low frequency is at level of ITER conductors and reflects the configuration of high-current conductor.