Progress On The Design And Manufacture Of The New Stator

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Quick Background

Why are we developing a new Stator?
When it was agreed to put a Mice target into ISIS one of the stipulations was that a second target was built and run 'offline' so that any potential threats to ISIS would be found before problems arose. As it happened the target in ISIS performed very well whilst the offline target had problems with wear to its bearings. The target was stripped down and inspected and it was discovered that the DLC was badly worn. The problem was tackled in 2 ways:
One was to improve the materials used in the bearings and to rebuild using new materials
The other was to try and discover what factors if any were adding to the wear in the bearings.

The bearing material was changed to DLC on Vespel and after an ongoing development the bearings perform well.

Quick Background cont.

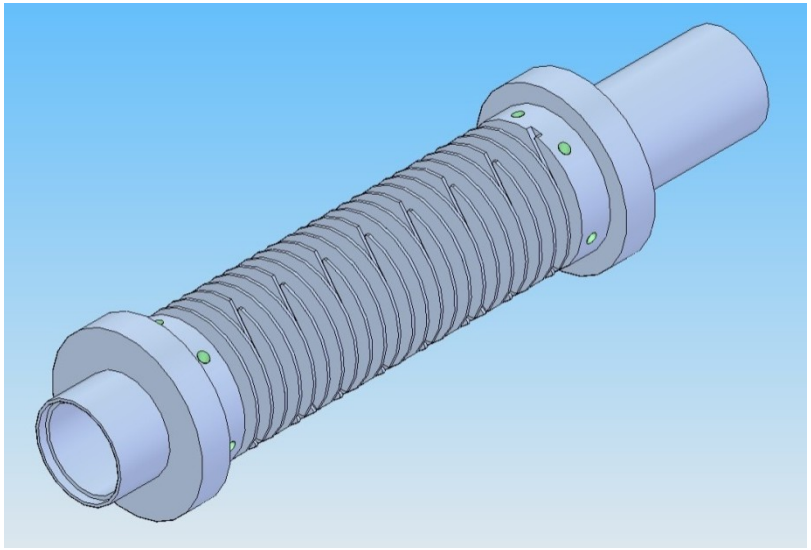
One of the spare units was then put through 'inspection'. It was decided to Map the magnetic field of the stator coils. Initially this was carried out in the first instance by Emily Longhi of Diamond. She found that the Mechanical (bearing) axis and the Magnetic axis were not aligned. Unfortunately this was not quantified and due to the pressure of work from Diamond Emily was unable to continue with the work.

Enter Ben Shepherd from Daresbury, Ben quantified the magnetic offset and it also turned out that it was not linear.

To improve the performance of future targets a redesign of the coils was undertaken, the idea was to incorporate improvements to the magnetic axis alignment, cooling and overall performance.

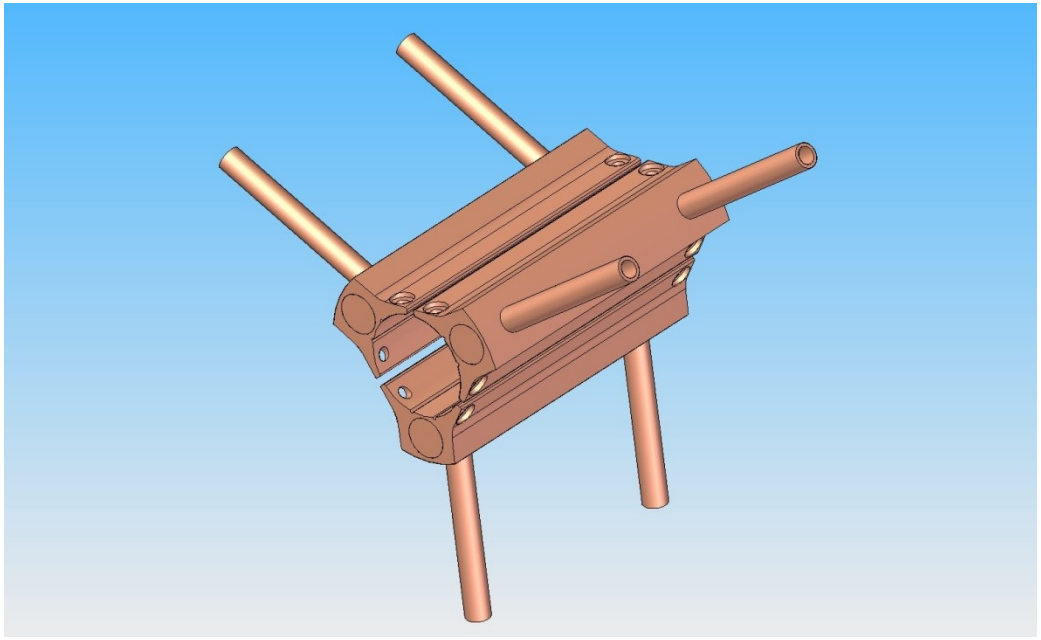
The following is where we are.....

Bobbin with Wire Slits



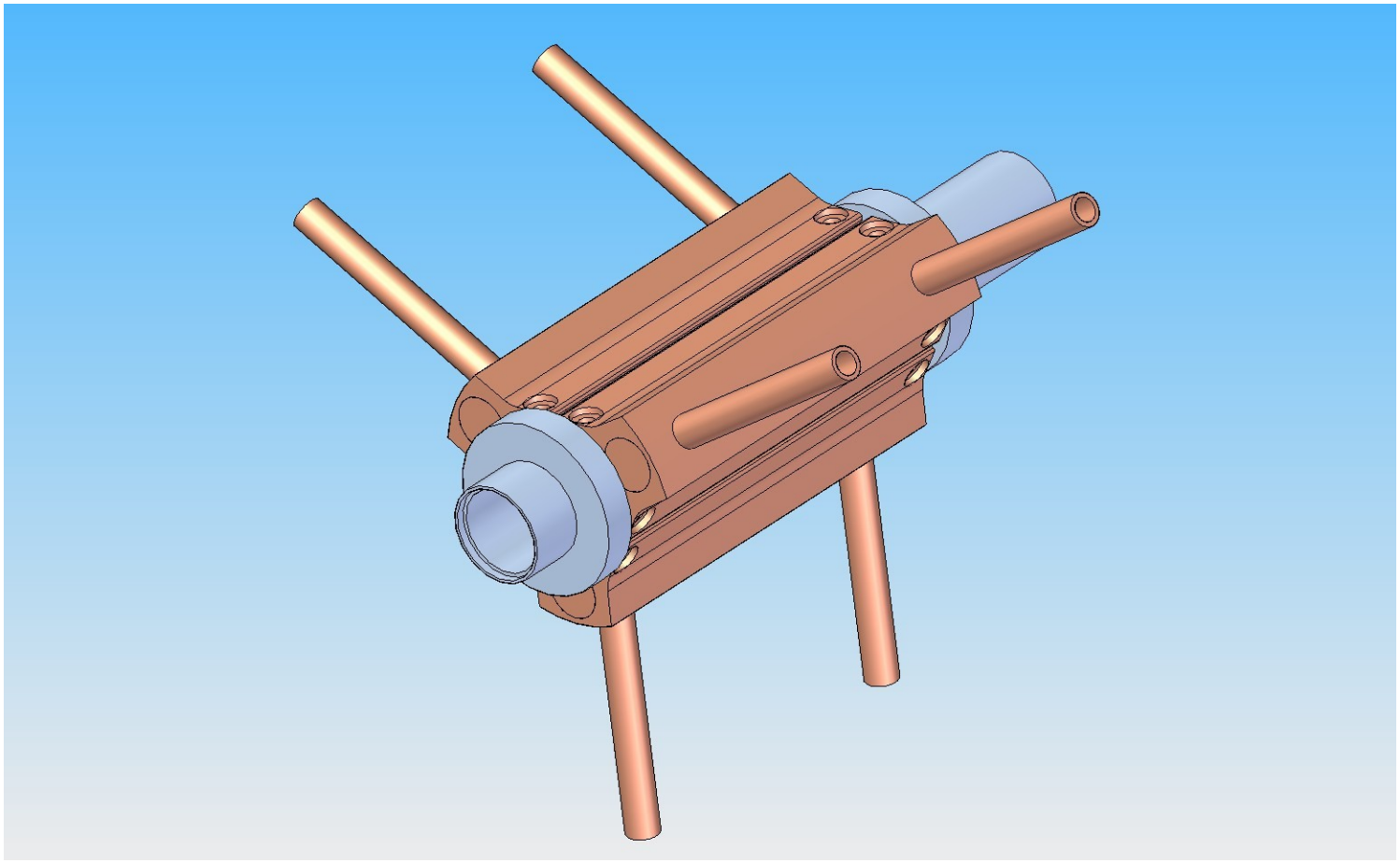
The design has the 24 coils wound onto a common 'bobbin' and this will hopefully address the misalignment problem. The design fits into the original body and flange (with 2 additional slots for cooling pipes). To help improve the performance the bore was reduced to decrease the gap between the inner bore of the coils and the permanent magnet. The number of turns on the coils has also been increased. This has been modelled by Ben to ensure we were not adding turns 'beyond a useful radius'. It is now complete and out to manufacture. (AC Precision and Oxford Physics workshop)

Cooling Segment

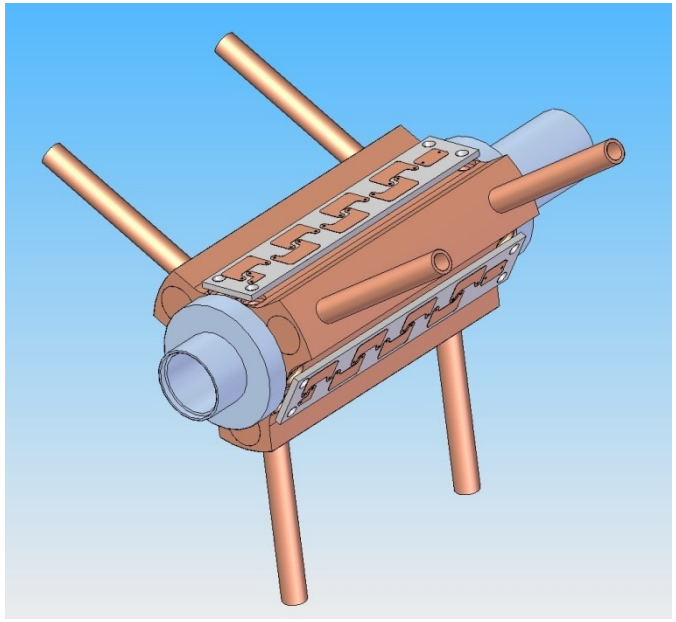


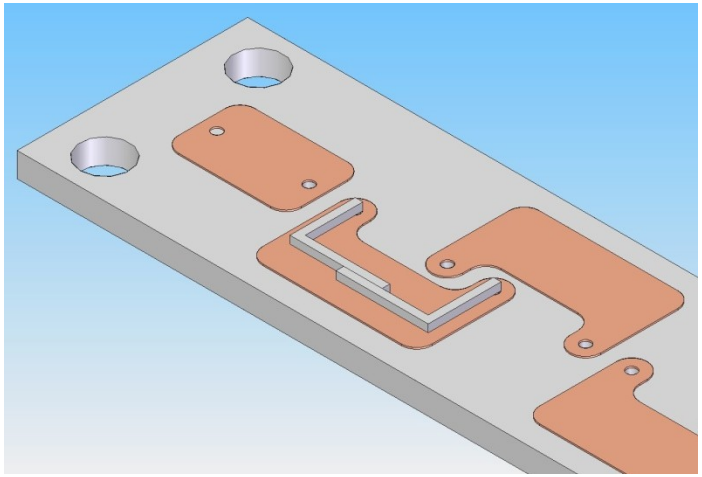
The cooling was revisited and a new cooling jacket designed. This will hopefully make contact with the top outer radius of the coils. The flow of coolant has also been greatly increased. It is hoped that this will aid performance improvement as the cooler the coils run the less resistance and so more power can be fed in. The cooling jacket segments are being manufactured at Imperial College and will be vacuum brazed the tested.

Bobbin with Cooling Jacket Fitted



Power Distribution





The Power distribution to the 3 phases now takes place internally and is done using bus bars. These were to consist of heavy duty printed circuit boards fixed over the gap between the cooling jacket segments, however if the tails are left longer and soldered to each other as well as the track this will negate the need for a 'high weight' board. The tails from every third coil is soldered as shown above. The strange layout of the copper on the board is to reverse the polarity of each coil in a given phase.

QA

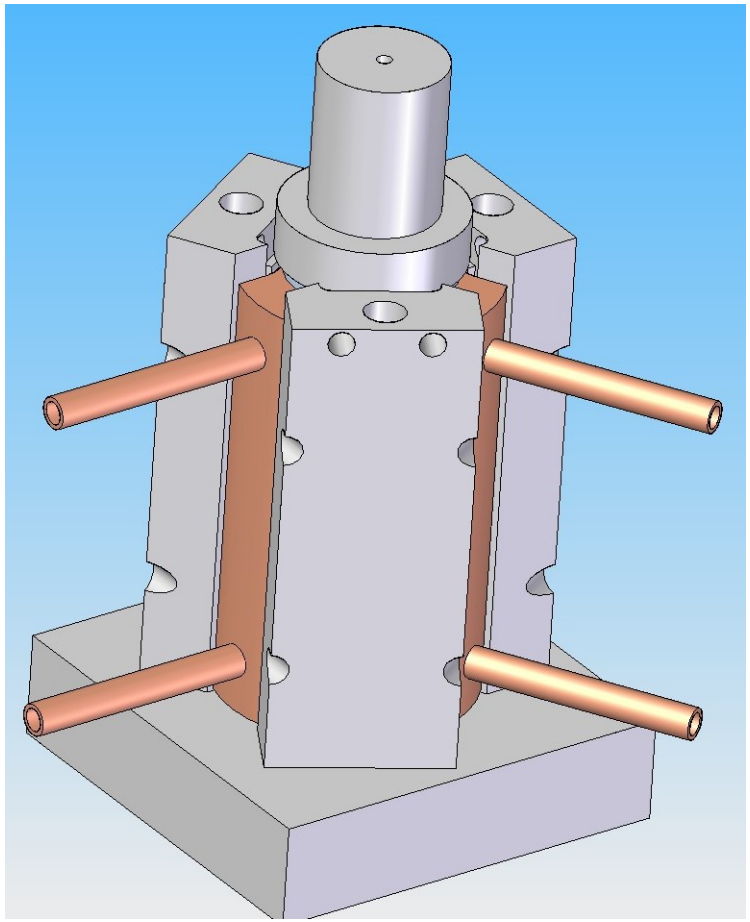
As the Bobbin-Cooling Jacket-Power distribution assembly are to be potted (more later) it is essential that there is a rigorous QA in place.

This has not been fully developed yet but must include:-

- Testing for shorts between the winding and the bobbin body, this will need to be done at each coil to avoid risk to subsequently wound coils
- Testing for shorts in a coil i.e. winding to winding, a technique will need to be developed for this possibly using precise resistance measurement in the wire. Again this needs to be done at each coil.
- Good solder joints on the bus bars
- Test for shorts between coils and the cooling jacket when fitted

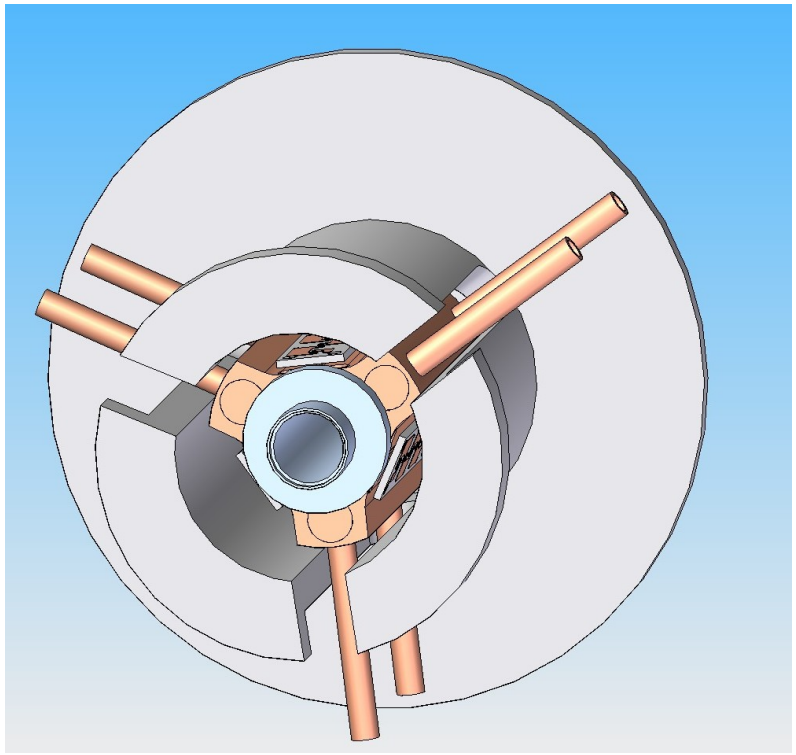
There will be many more before the potting can be confidently undertaken and any suggestions will be welcome.

Assembly Fitted Into Potting Jig



Once the assembly has passed all the QA requirements it is to be potted. A potting jig has been designed and manufactured from PTFE

Stator Assembly (shown Minus Flange)



Once the assembly is potted and passed further QA it is to be installed into a modified version of the original body, this has 2 extra slots to accommodate the cooling pipes and welded into position.

The completed assembly is then taken to Daresbury to be field mapped by Ben as the final QA.

Future Plans

The Bobbin bodies that we have had manufactured have stress relieved during the machining process and this has 'dished' the flanges. We have further ideas for reducing this effect that we would like to pursue.

We can still use these bodies to investigate the production methods further. It is planned to wind a number if coils onto one of the bobbins and then to field map the unit. This could be either every 3rd position (8 coils) or every other position (12 coils). This will give us valuable data as to the uniformity we can expect in the magnetic axis position from this production method. It will also act as a test piece for the assembly processes that will need to be carried out.