

Summary

1. Many thanks for the latest model, SOTON and CERN now agree on the deployment of x4 (12 mm rods), their locations, and simplified fixation by bolts and nuts
2. Friction contacts between the stainless rib and invar rods through fastening of invar nuts on invar thread eliminate the thermal stress in all cases (A1-A9) seen previously in bonded contacts
3. The access port in the side wall of the vacuum elbow section has been removed
4. The final assembly sequence for the rods remains an open point
 - SOTON understand the reasoning behind the CERN proposal to pre-install the four rods to the vacuum flange and then to simultaneously aligned with the four locations in the ribs as the vacuum flange is moved forwards and closed. However, aligning four “dangling” rods **simultaneously** during installation seems challenging and quite impractical
 - SOTON present in the following slides (Slides 2-12) an alternative to install the Invar rods **one-by-one** from “behind” through the large flange for vacuum pumps on the opposite side of the elbow section
 - The main obstacle for the proposal is the limited space for tightening the rods to the warm vacuum flange even with the corresponding vacuum section displaced – See Slide 7
 - SOTON propose to adapt the warm vacuum flange section to make install of the rods easier and at the same time create smaller, lighter sub-sections to handle during assembly
 - i. Introduce an intermediate O-ring in the vacuum section to provide the access required – See Slide 13
 - ii. Introduce a floating flange arrangement to enable this section to slide for full access – See Slide 14

2-D overview of design

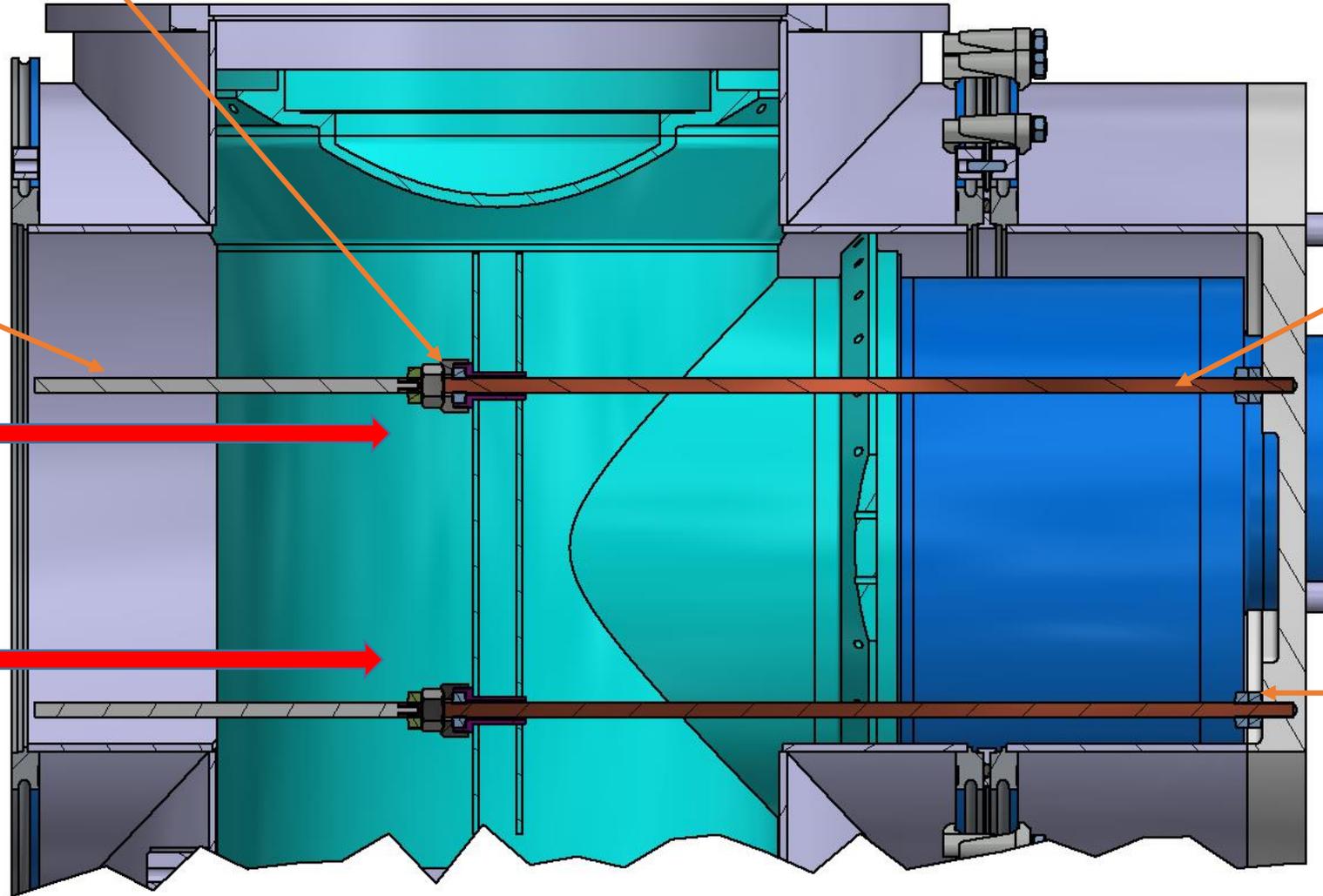
SOTON option
for fixing to
vertical rib

12mm extender rod
to aid insertion and
assembly at the
warm flange end

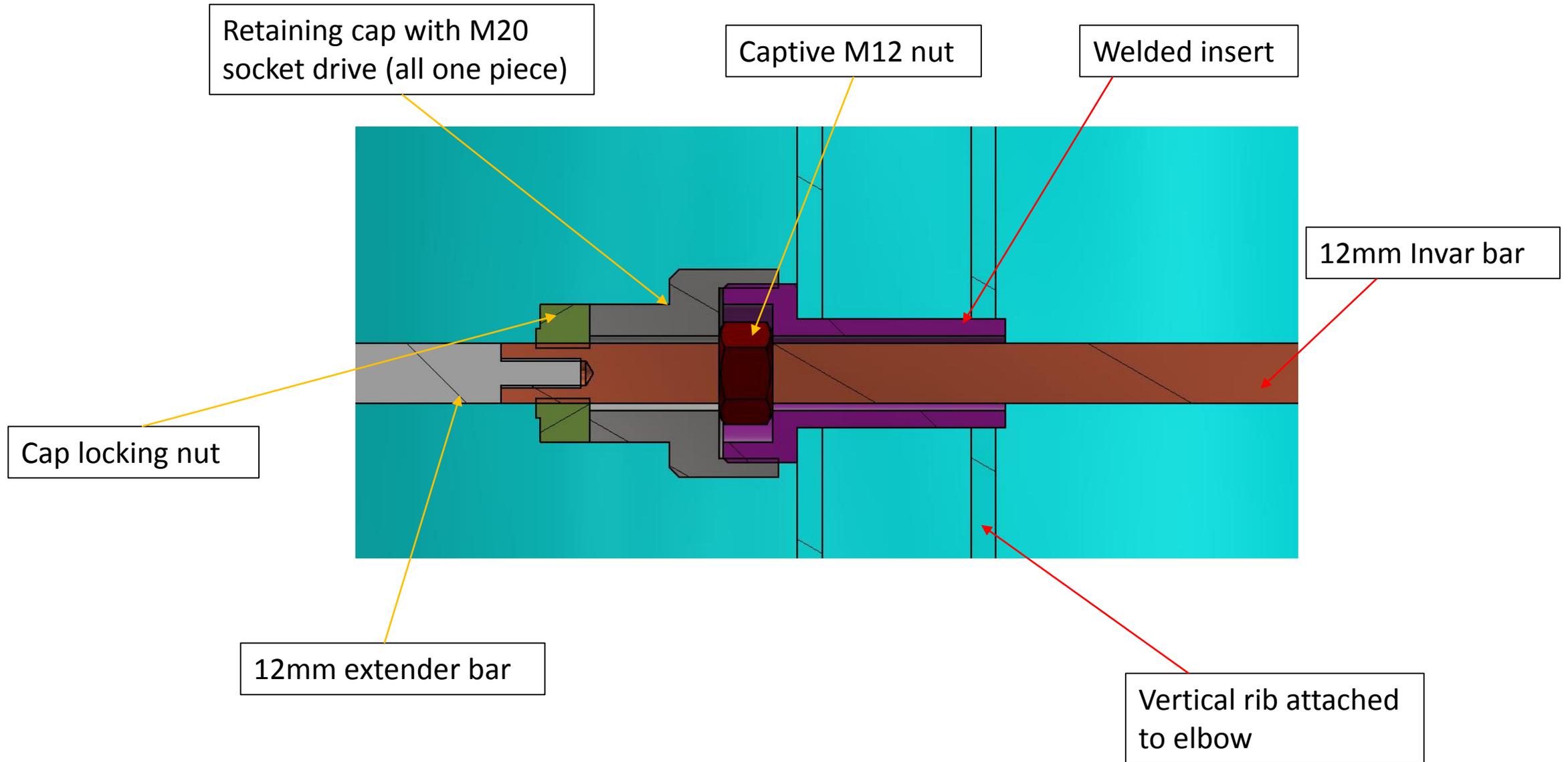
Red arrows show the
direction of insertion
of the Invar rods

12mm Invar rod
(final length)

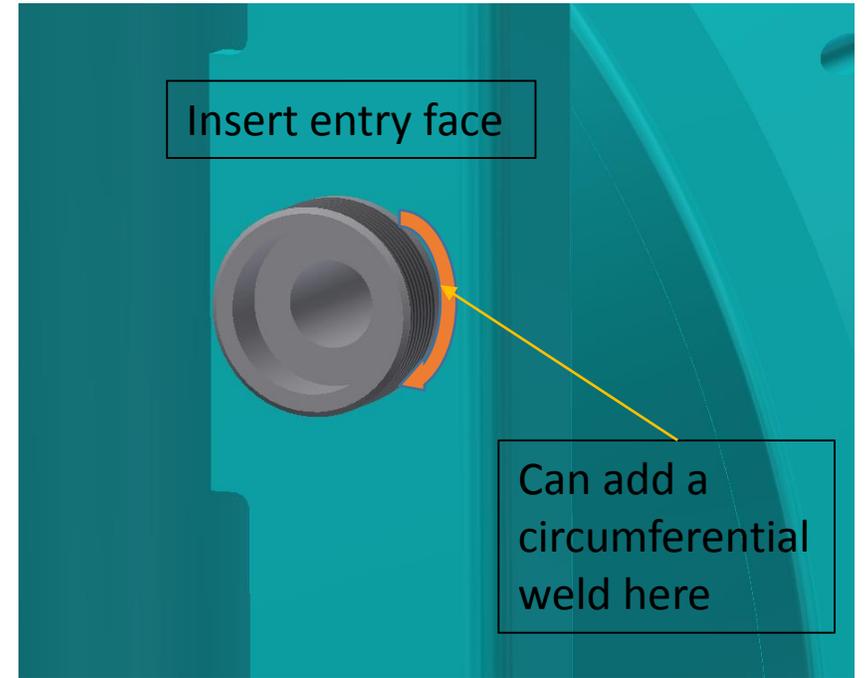
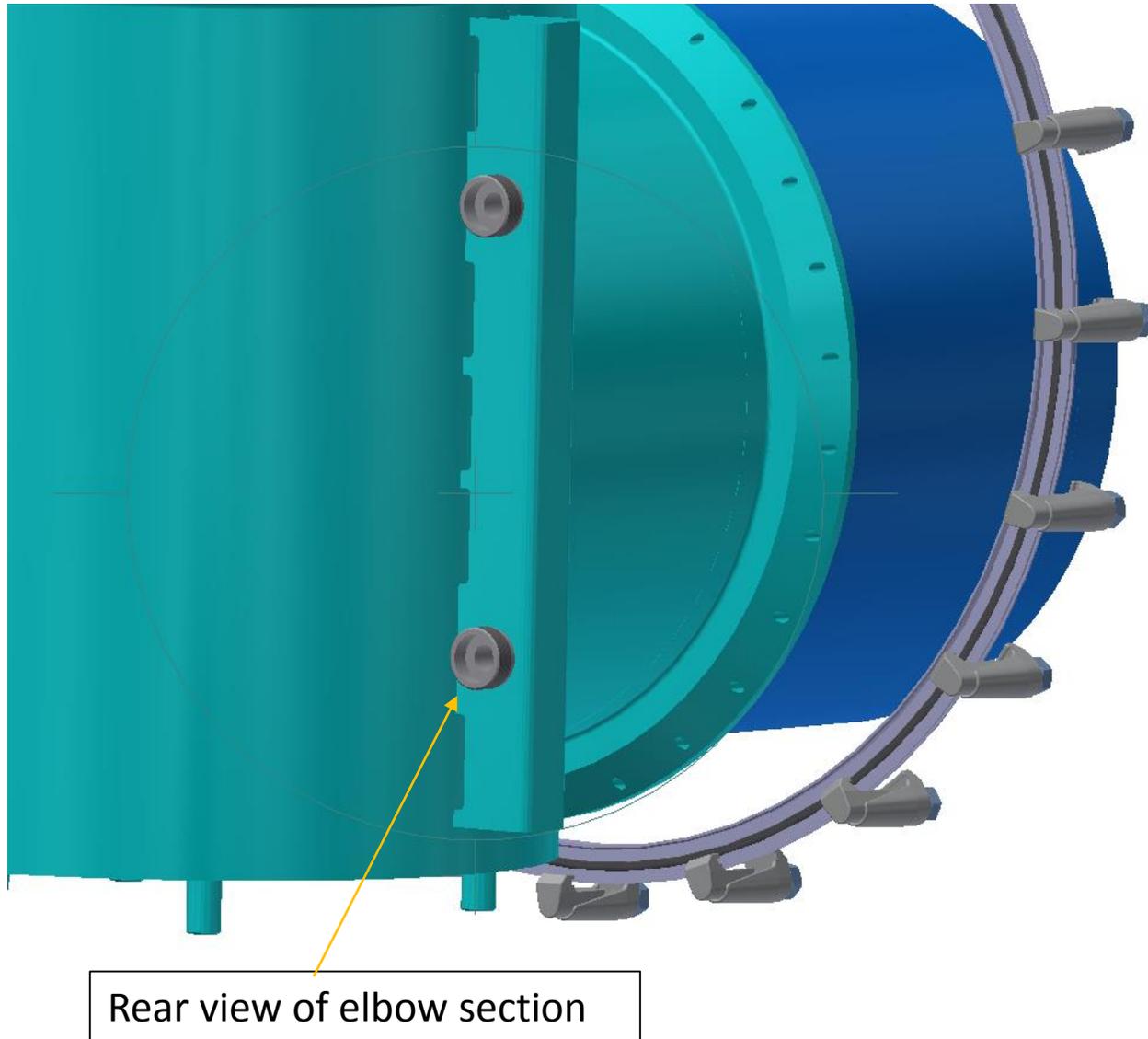
Threaded
connection to
vacuum flange
with double
nut locking as
proposed by
CERN team



2-D zoomed in view of SOTON option for fixing to vertical rib



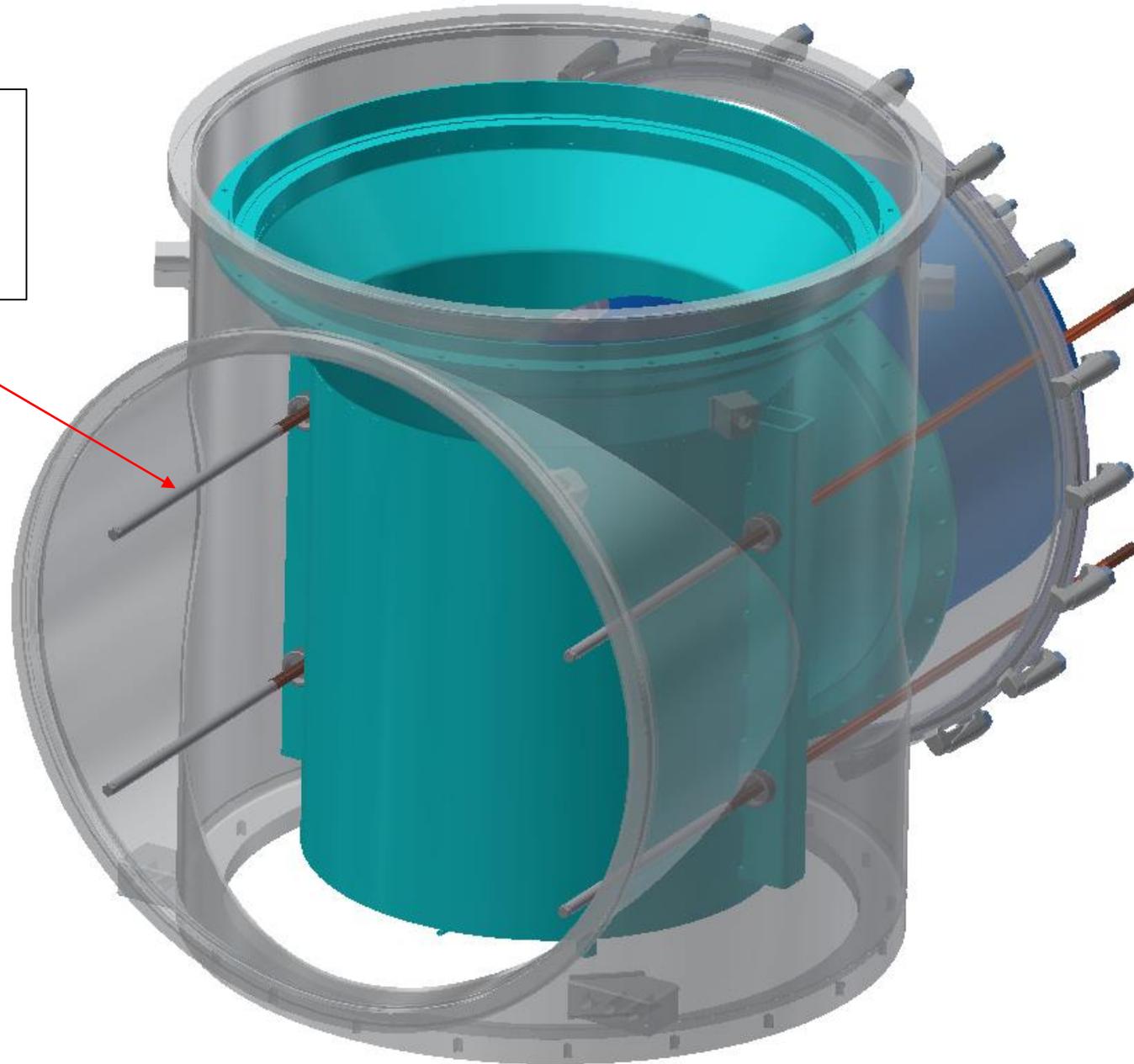
3-D view show insert welded in ribs



Assembly sequence

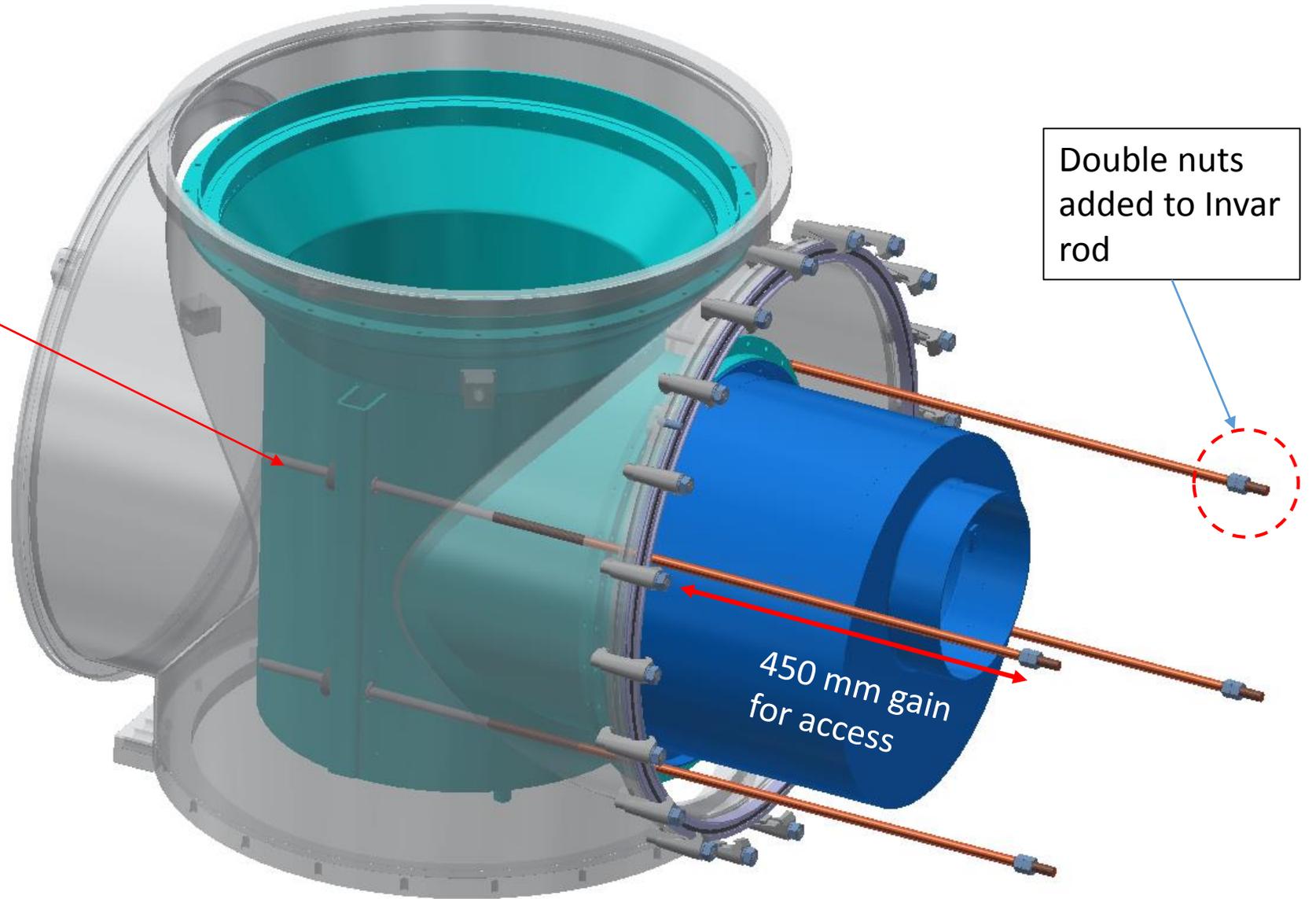
STEP 1:

Attached the extended rods to the Invar rods and insert into socket



STEP 2:

Long rods are pushed through socket fitting but still remain supported

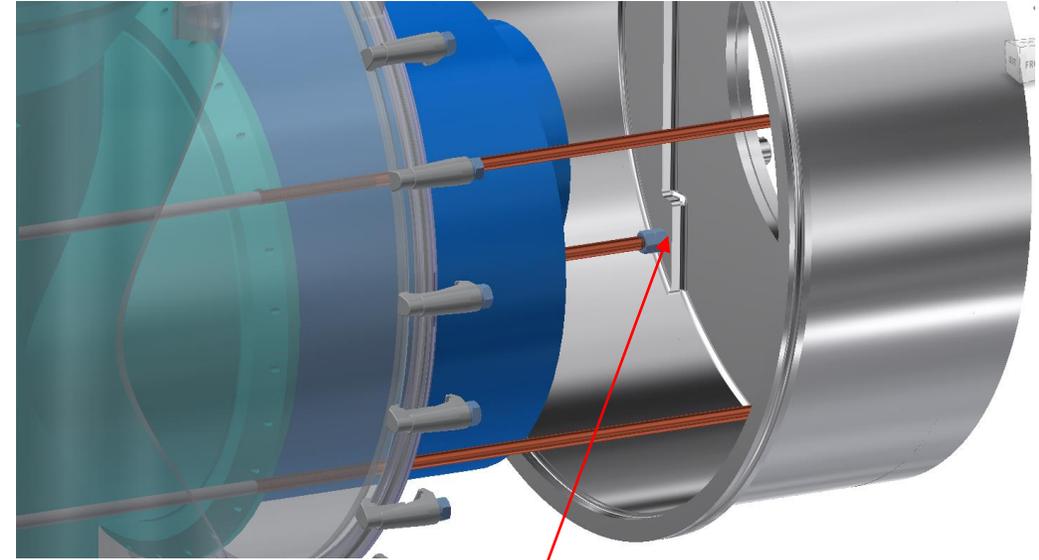
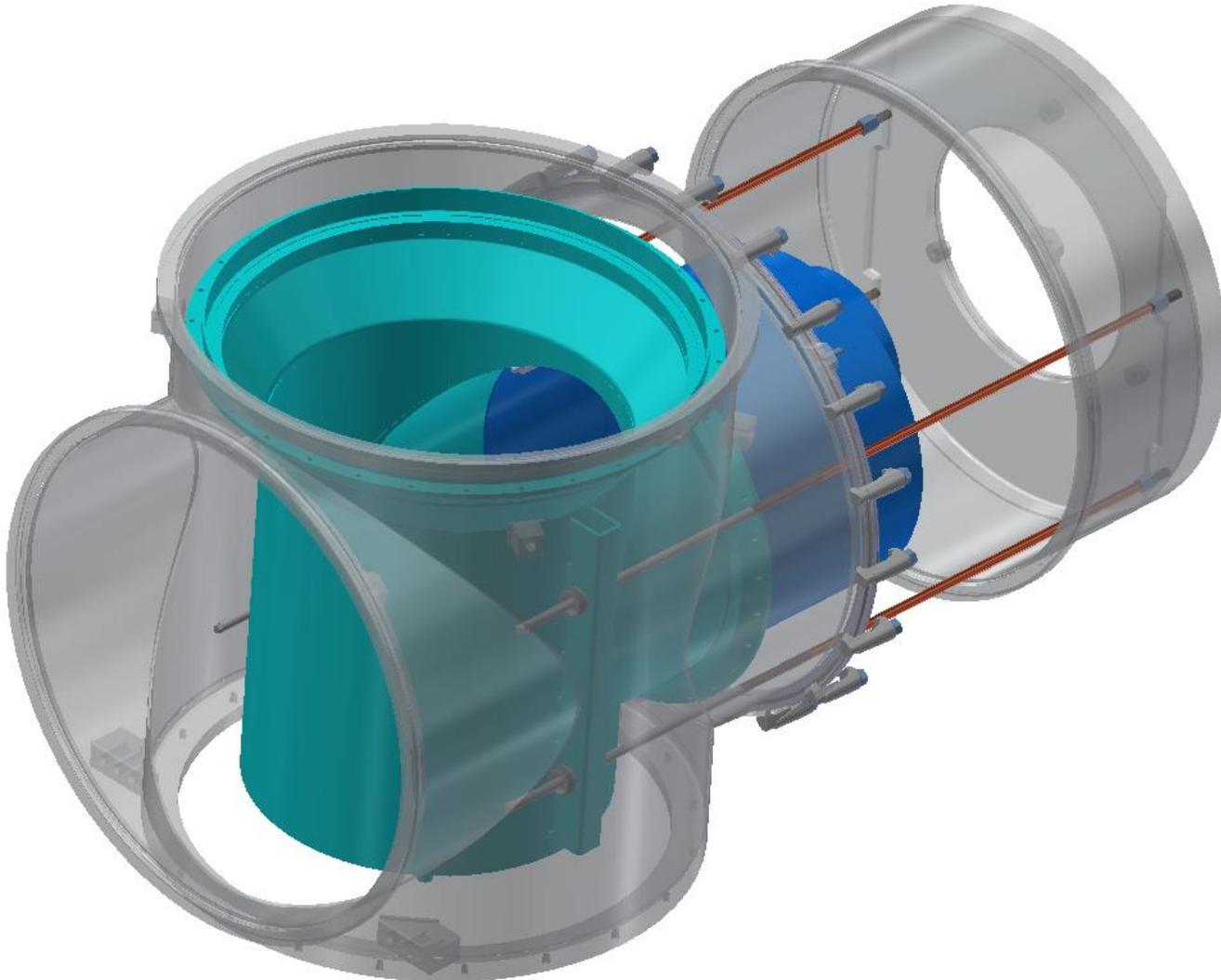


Double nuts added to Invar rod

450 mm gain for access

STEP 3:

Prepare vacuum flange by aligning and support in front of main assembly. Leave sufficient space for access to see and tightened each bar independently with tooling

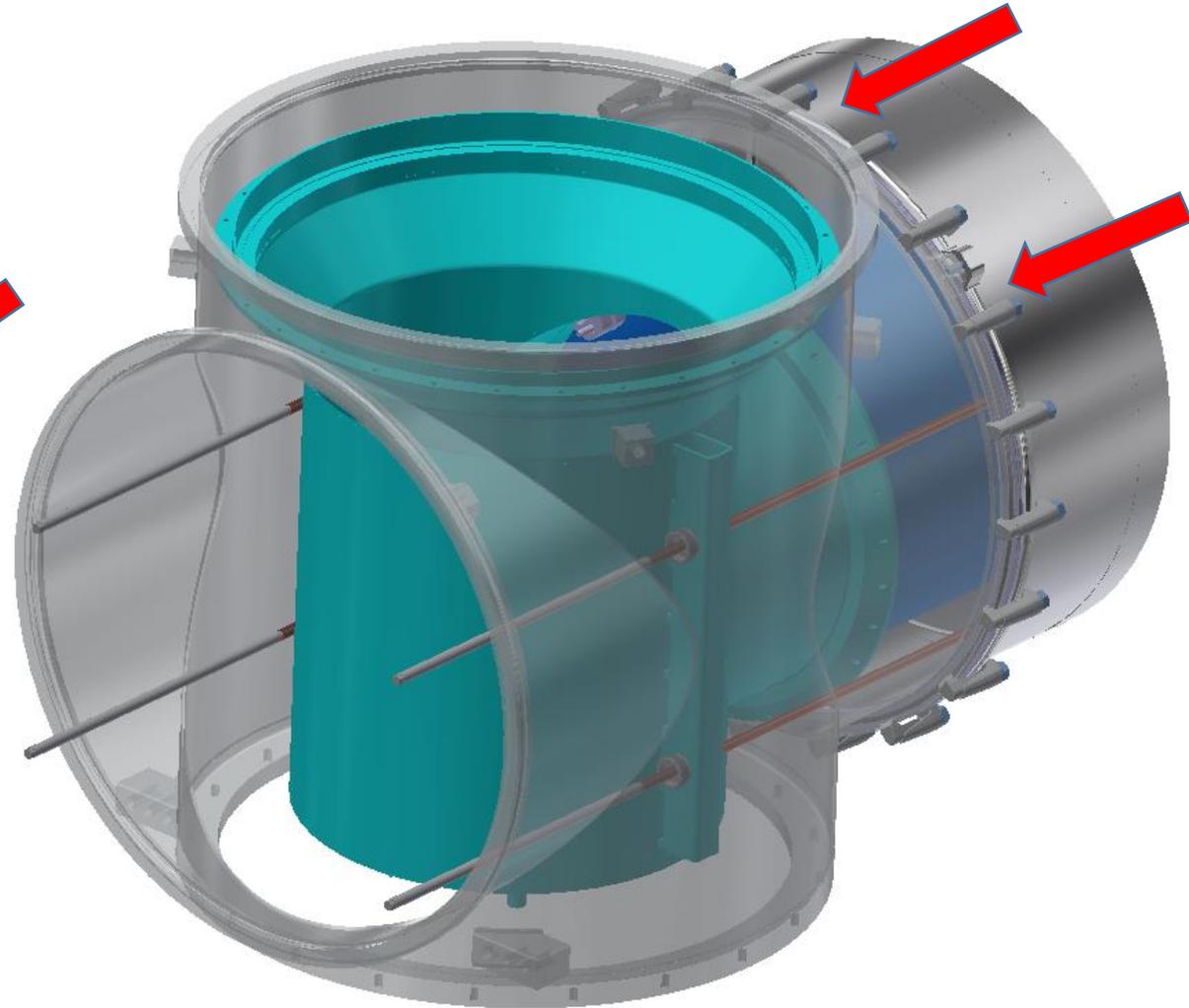
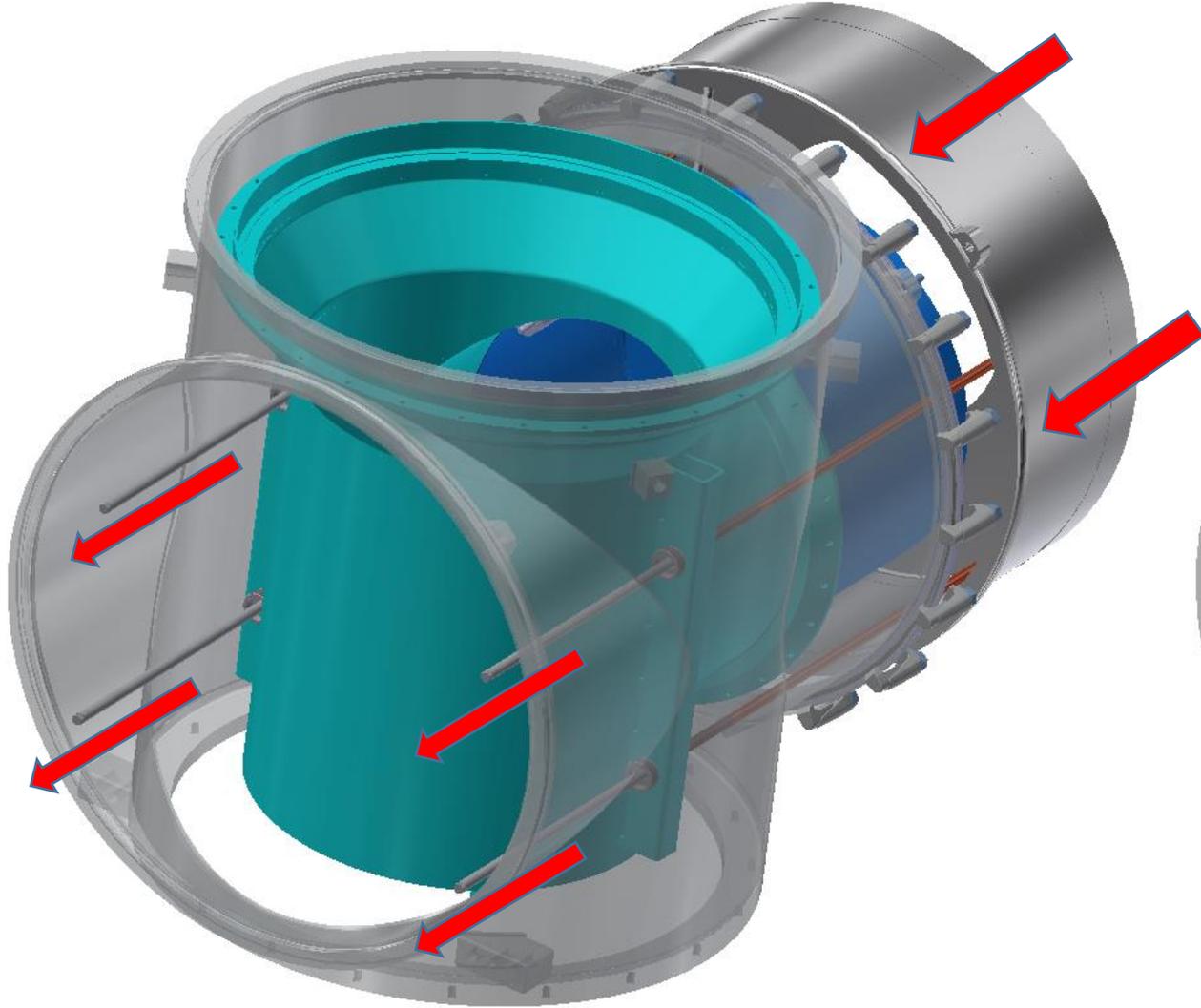


Due to the reduction on the helium vessel in this section, there appears to space to tighten Invar rods against the flange and tighten nuts

There is the option to put a set of flats in the invar rods at the mid point to help drive the rods home.

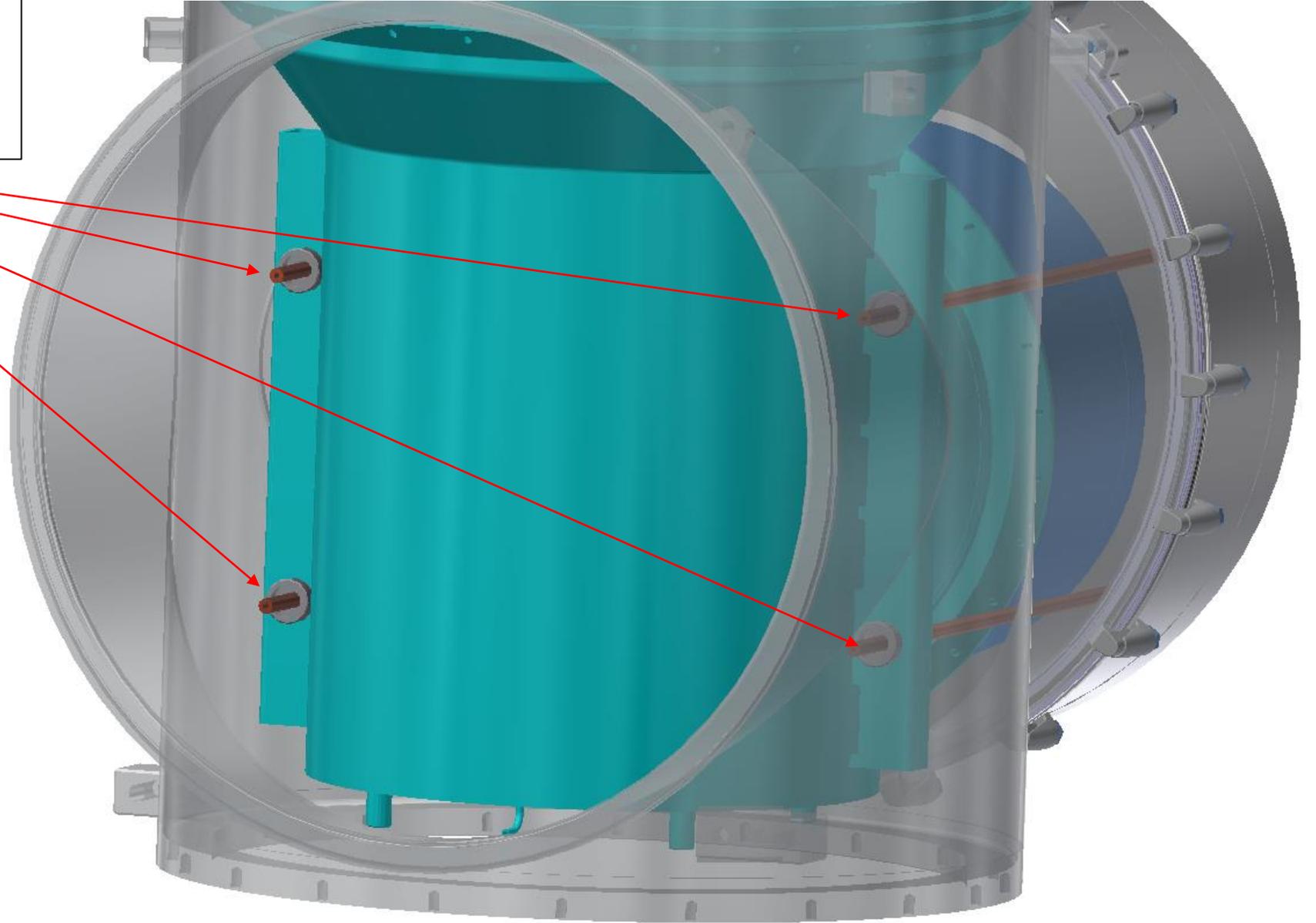
STEP 4:

Begin closing the vacuum vessel once the bars are fixed. The bars should have sufficient clearance at the vertical rib end to avoid snagging as the extended rod retreats.



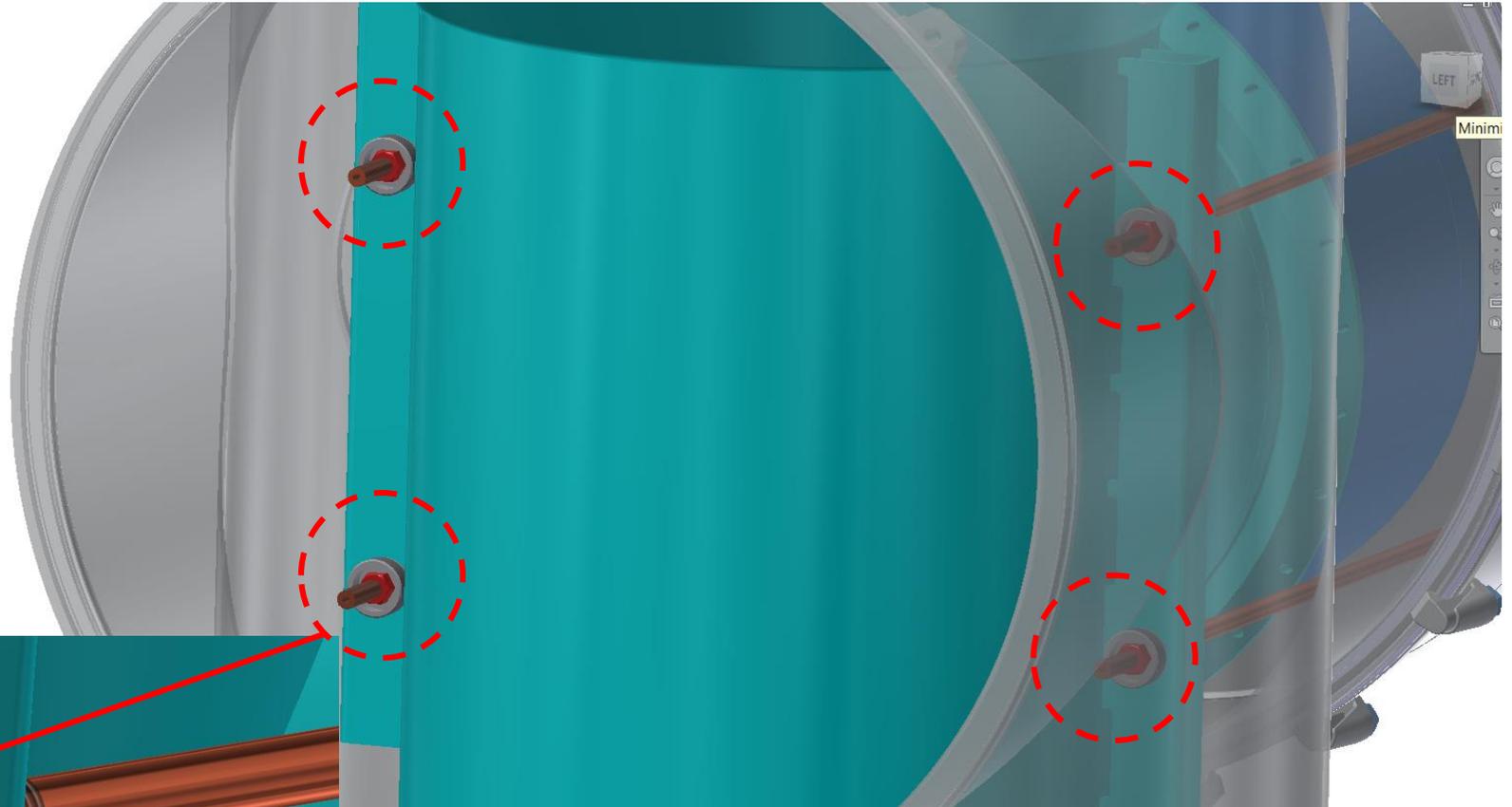
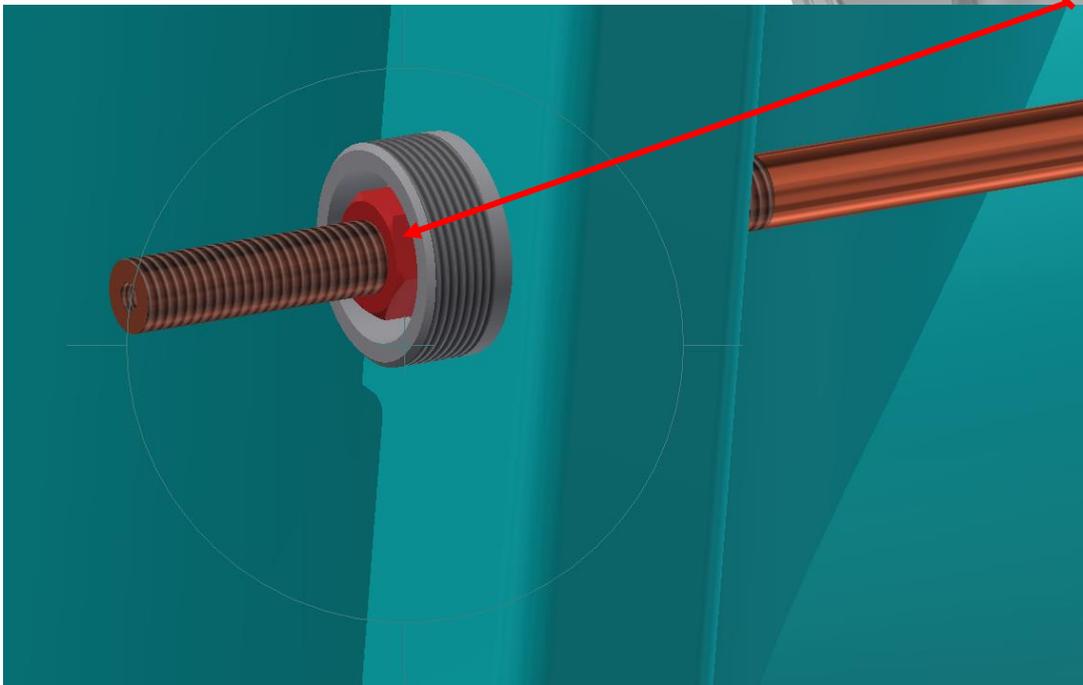
STEP 5:

Once the vacuum flange is clamped. Remove the extender rods



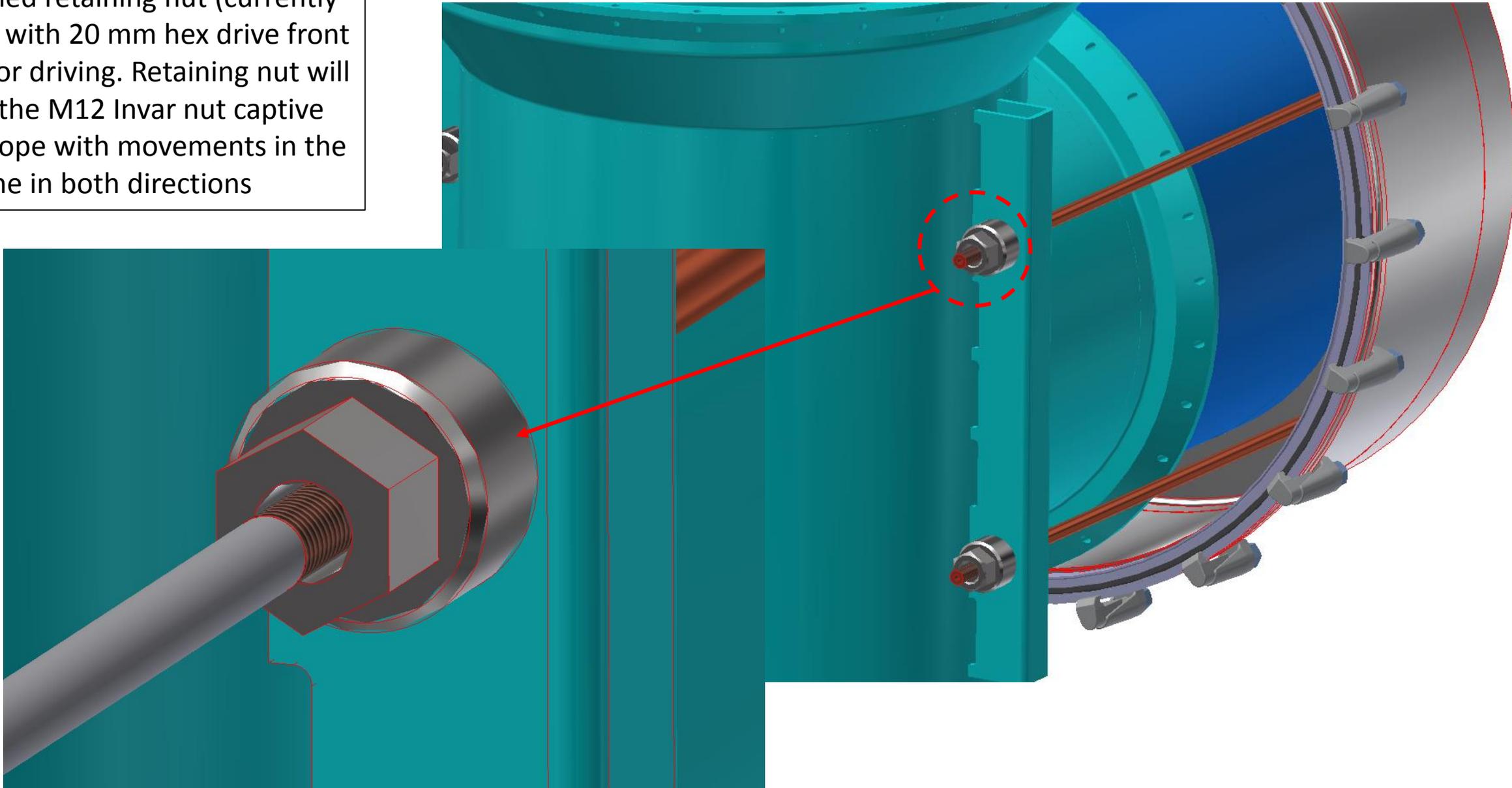
STEP 6:

Installed M12 Invar nut (red) and use a socket set drive with extension to tighten nut inside weld insert

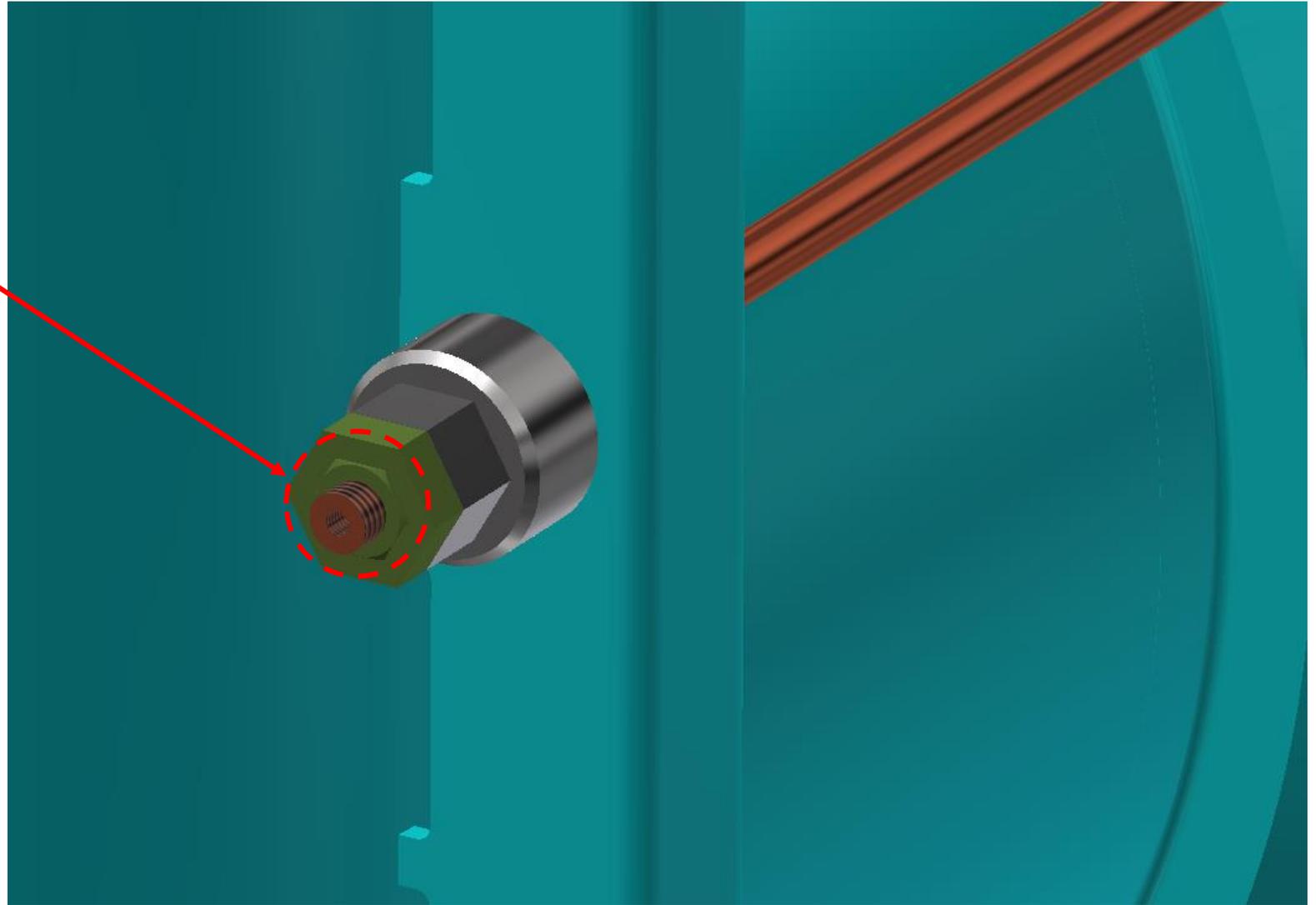


STEP 7:

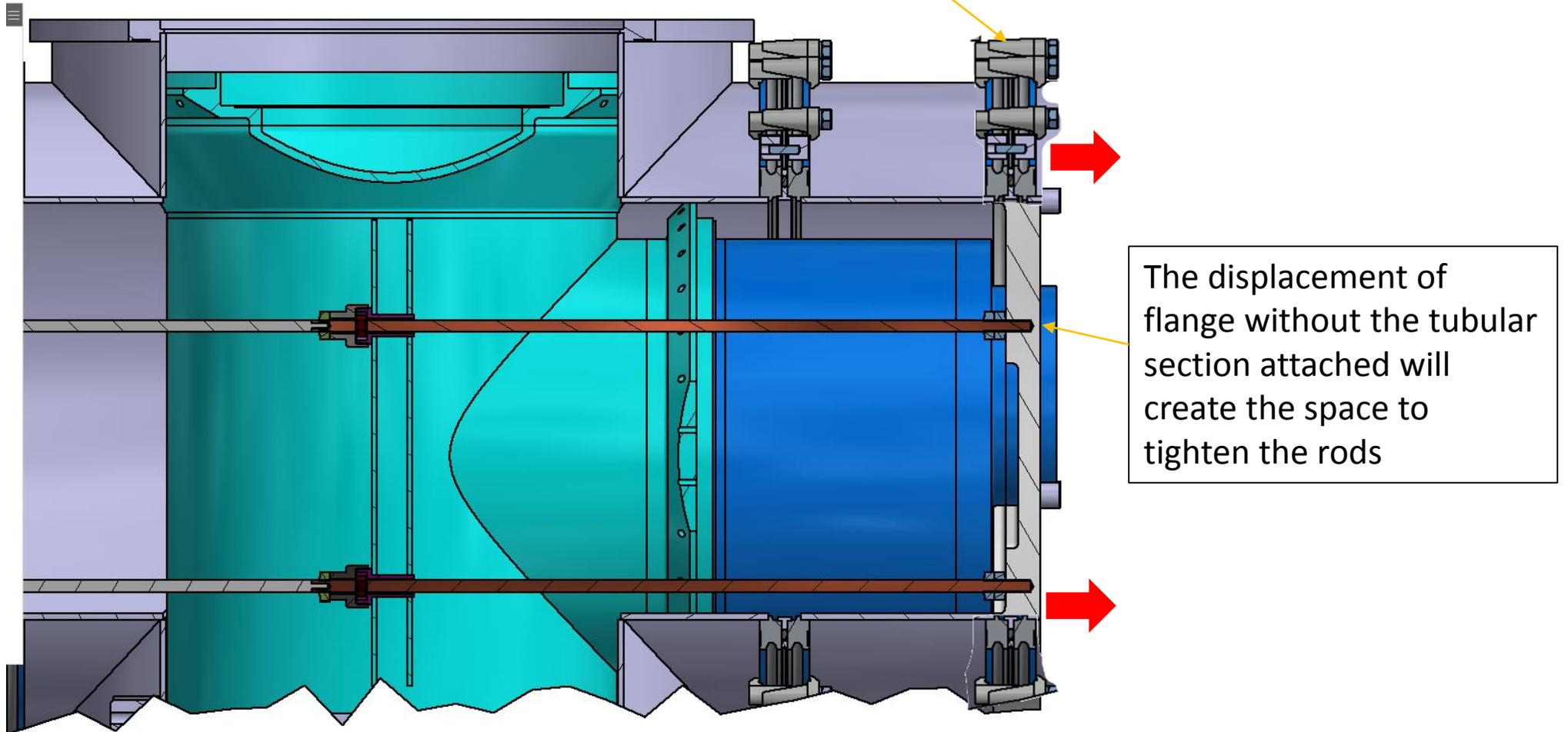
Installed retaining nut (currently M36) with 20 mm hex drive front end for driving. Retaining nut will keep the M12 Invar nut captive and cope with movements in the z-plane in both directions



STEP 8:
Installed the cap locking nut to
avoid the cap loosening



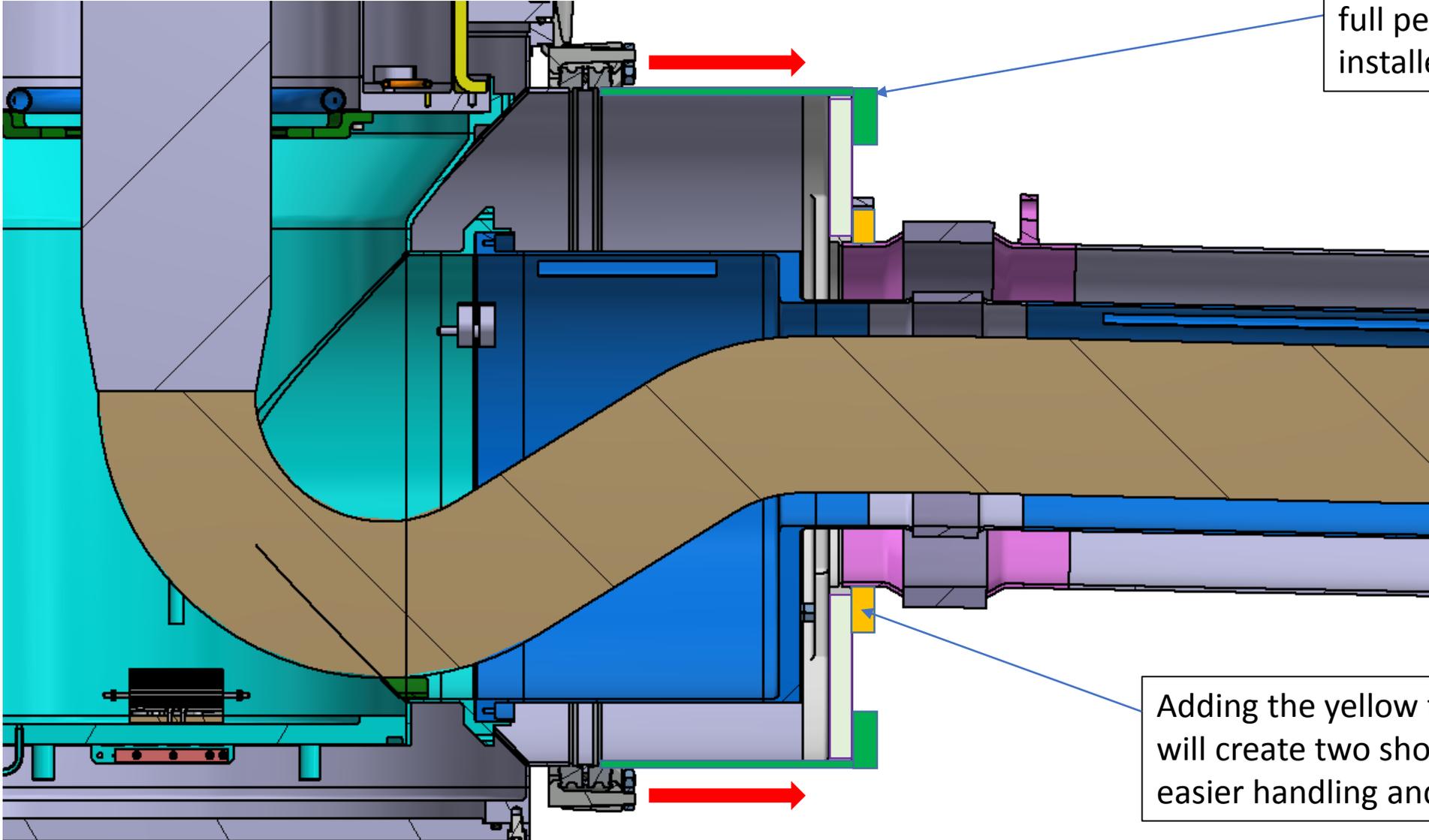
Option:
i) Install an additional O-ring joint to break the vacuum section into two



The displacement of flange without the tubular section attached will create the space to tighten the rods

Option:
ii) Introduce a floating flange arrangement

The sliding section creates full peripheral access to installed the rods



Adding the yellow flange to the bellows will create two shorter sub-section for easier handling and installation