# FABRICATION TESTS FOR IMP 162.5 MHz RFQ*

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*Abstract*

The RFQ for one of front ends of C-ADS is designed. The frequency of the RFQ is 162.5 MHz and the energy is 2.1 MeV. The beam intensity is 15 mA and it works at CW mode. Because of low frequency, the four-wing structure is big size. It makes fabrication will take more risks. Therefore, four fabrication tests were planned and done to minimize the technic risks. The description about fabrication and testing results are presented .

## STRUCTURE DESIGN

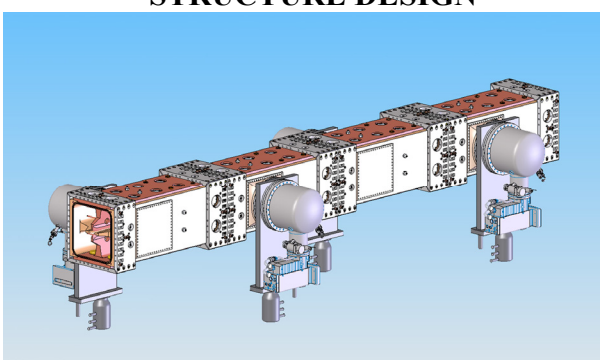

Figure 1: Structure of the ADS-Linac RFQ

Four 1.05 m long cavity modules were bolted together with a total length of 4.20 m, approximately 1000 kg for each complete module. All OFHC copper body were machined from solid billets, 4-vane cavity structure be choose with fly cut modulated vane tips. In this structure it includes 32 Pi-mode rods for mode stabilization, 20 fixed slug tuners/module 12 field sensing loops were designed per module. RF power feed through two loop couplers. 20 cooling channels per module will take the heat of RF power.

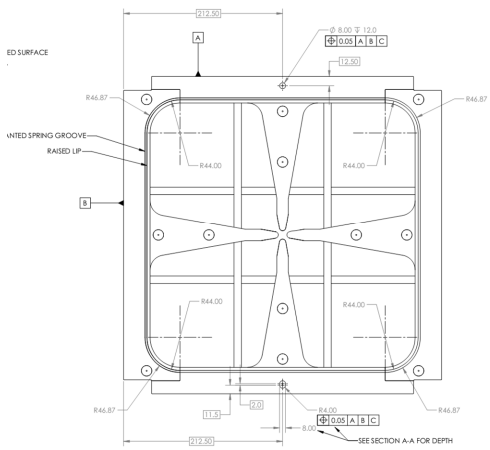

Figure 2: Section of RFQ

## FABRICATION TESTS

Since the RFQ work in a low frequency, the four-wing structure is big size (425mm×425mm at section), four fabrication tests were planned and done to ensure fabricated process and minimize technic risks. It include fly cutting test, full length vane test, braze and clamp test and half-length test module. Two of them had finished the last one were rough machining now, as for hydrogen braze test, more tests were necessary before the last braze to take.

### *Flying cutting test*

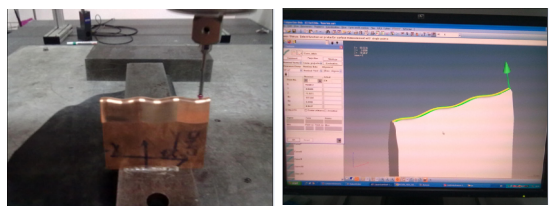

Figure 2: measurement vane

Flying cutting method were choice for RFQ modulation machined instead of ball drill. Two short pieces were cut and measurement with CMM. the result of measurement shows some point were out of tolerance ,some improvement with cutting tool will be take and the pieces will be measurement again in new CMM device.

Table 1: result of modulation measurement

| | Max (mm) | Min(mm) |
|---|---|---|
| Profile tolerance | +0.0067 | -0.0070 |
| Section 1 | +0.0056 | -0.0097 |
| Section 5 | +0.0103 | -0.0185 |
| Section9 | +0.0431 | -0.0856 |
| Radius of tip | 8.5685 | 8.5315 |
| Angle | 19.9332 | 19.5164 |

### *Full length vane fabricated test*

Full length of a single vane is about 1050mm, include all mechanic structure of RFQ, such as braze groove, cooling water deep hole, modulation of vane, vacuum seal groove etc. Main task were focused on the Gun-drill for deep hole, EBW for water plunger and the tolerance for vane pale. So far, it had been finished and all ports, holes and outside surface geometry tolerance will be checked by CMM this month.




ISBN 978-3-95450-122-9

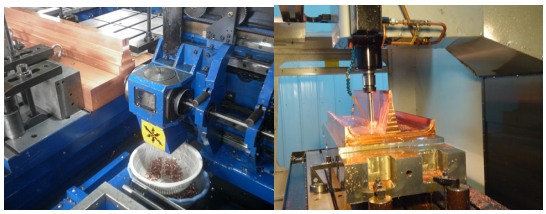

Figure 3: process of fabrication

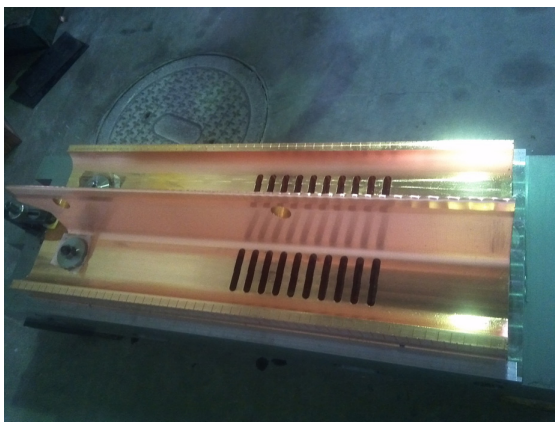

Figure 4: Single vane in full length

### *Braze and clamp test*

Braze alloy is Ag-Cu28, and braze temperature is 790°C. Two braze test were carried out separately in hydrogen furnace and vacuum oven. The result shows braze in hydrogen has advantage attemperature uniformity. After checking with CMM the deformation of short braze pieces , nearly 0.8mm deformationwere be found. 3D ANSYS calculated were taken and it shows the same deformation trend. The reason is that OFC will get very soft at high temperature while braze clamp (SS) still keep intensity. Improved braze clamp had been redesign, and next test will be carry out later.


Figure 5: Short part were brazed in furnace

### *Half-length test module*

The half-length module were rough machining now, however, fine machining will wait until braze test be finished.

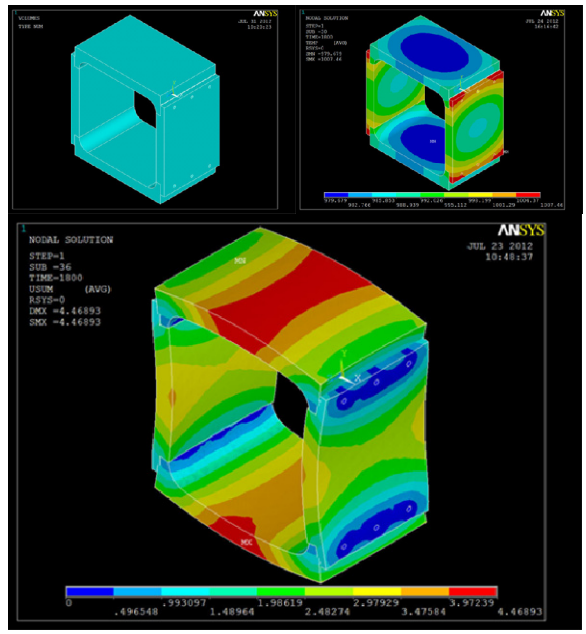


Figure 6 Deformation during brazing

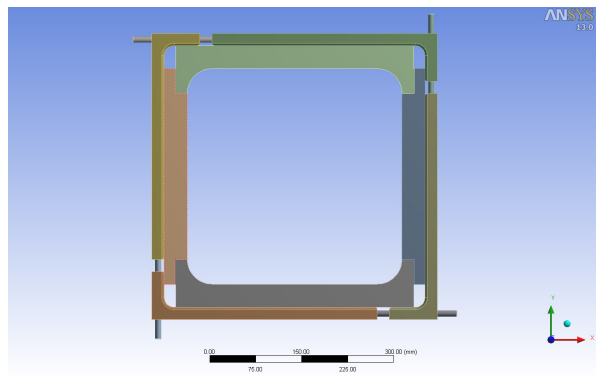

Figure 7 New structure of braze clamp

## CONCLUSION

There are benefits in starting fabrication tests in parallel to the planned short module.

Gun drill (in addition to vane cutting test)

EB welding for the cooling channel

Inter-module assembly technique

Development of brazing for large copper components is critical.

Tooling and assembly procedures need to be discussed.

## AKNOWLEDGEMENTS

We would like thank Xiaoqi Zhang and Guoping Sun (KTTJ)for their fruitful collaboration on the mechanic design and machining.

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