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Status report on SALAF technical activity during the second half of 2008

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As known the activity of the SALAF Group is presently dedicated to the construction of 3 cells structures, 11.424 GHz, to be sent to SLAC for power tests.

The construction is essentially based on two different processes: BRAZING and ELECTROFORMING.

Here some experimental tests will be presented, performed during these months, both on Brazing and on Electroforming.

BRAZING.

As already said a brazed 3 cells Cu structure , completed with the vacuum system fig.1 , has been sent to SLAC , where it has been tested with good results .The eutectic Ag/Cu 72/28 is an alloy largely used for vacuum brazed joints because it is simple to use and not particularly expensive.
Unfortunately not all the metals or alloys are wetted by it. This is the case, for example, for Stainless Steel and Molybdenum.
A simple way to overcome this difficulty is to create a thin layer of Copper or Nickel, electrolytically deposited, where it is necessary. Then the Ag/Cu can be used without any difficulty because it wets very well both Cu and Ni.
At this point the adhesion between the layers of these two metals and the base metal is the only parameter to be tested.
In our laboratory a galvanoplastic process was adopted in order to obtain thin layers of Cu or Ni. These metals are deposited just on the areas where their presence is necessary. For this reason the galvanoplastic process is based on the use of a graphite anode, wrapped up with a cotton pad which is soaked in a special electrolytic bath that contains the ions of Cu or Ni. (brush plating). This method is simple and quick to use and makes easy to treat only the area involved.
The thickness is a few microns.
The Cu layer gives the best results if it is fixed, both on S.S. and Mo, through a vacuum thermal treatment at, roughly, 800 °C, before brazing. For Ni this is not necessary.
Some enamels have been prepared in order to check the adhesion strength between two S.S. parts brazed with this procedure. This means that the enamels are made in the following way: S.S./Cu/AgCu/Cu/S.S.
In fig 2 the tensile strength machine is shown. In fig 3 the AgCu alloy between the two S.S. parts can be seen. In fig. 4 the graph giving the breaking load is shown.

A control of the rupture surface shows that just the AgCu alloy has broken down, not the contact surface between Cu and S.S.
Considering that the AgCu Tensile is about 35 Kgr/mm^2 , the fig 4 confirms what has just said, because the enamels brake down just at roughly that value.
A 3 cell structure (fig 5) completely in Molybdenum (with the exception of Conflat Flanges obviously) has been built and vacuum brazed following the above procedure.
Finally the use of Palladium/Silver/Copper alloy, PALCUSIL, has been accurately tested because its large solidus-liquidus temperature interval makes its use not so easy. This alloy is used when a melting point higher than that one of the Cusil is necessary, for example when a structure requires more than one brazed joint at for the same piece.
Another example of brazed joints obtained with the above procedures are the Wave Guides for the SPARC Frascati accelerator (fig 6).

ELECTROFORMING.

The present activity in the Electroforming field is dedicated to explore the possibility to use an electrolytic deposit (generally Copper) for “sealing” or “encapsulating” a multicell structure.
The whole procedure would consist in
machining the single cells, the end parts and the flanges
putting and strengthening them together
covering all the structure with a thick layer of Copper.
The last item is obtained following the Electroforming procedure already described in other reports.
The result is a flange to flange, vacuum tight piece which contains inside the RF cells.
The advantages of this technique are:
the single cells can be made in every material,
materials that can not be brazed at high temperature (as Cu/Zr) can be easily used,
possible deformations or surface changes due to the high thermal stress during brazing are avoided.

To test this procedure a 3 cells structure has been prepared, following the drawing (fig 7). It is composed by 3 single cells plus two end S.S. parts to be connected to the flanges.
The structure is similar to that one prepared for the brazing but the contact between the cells has a different shape in order to facilitate the Cu deposition.
At the end of the machining all the components are pressed together with a central screw, so obtaining a structure ready for Electroforming.
In fig 8 the final result can be seen. The single Cu cells cannot absolutely be distinguished from the layer of Cu electroformed up.

Presently two 3 cells structures, ready for RF power tests, are under construction. The machining is complete, as well as the high quality inner finishing (Ra = 0,05 micron). They have just to be sent to our Company for the Electroforming. One structure is made in OFHC Cu and the other one in Cu/Zr alloy. (fig 9).
Finally a second version of a Coupler, a little different from that one presented during 2007, has been prepared using Electroforming. It is ready to be cut in order to test the quality of the inner geometry and surface.

Figure captions:

Fig 1 Brazed 3 cells Cu structure with the vacuum system.

Fig 2 The tensile strength machine.

Fig 3 The AgCu alloy between the two stainless steel parts.

Fig 4 The graph giving the breaking load is shown**.**

Fig 5 A 3 cell structure completely in Molybdenum.

Fig 6 Example of brazed joints for the Wave Guides of the SPARC Frascati accelerator.

Fig 7 Design of an electroforming 3 cells structure.

Fig 8 Electroformed 3 cells structure.

Fig 9 The inner surface of an electroformed 3 cells structure**.**

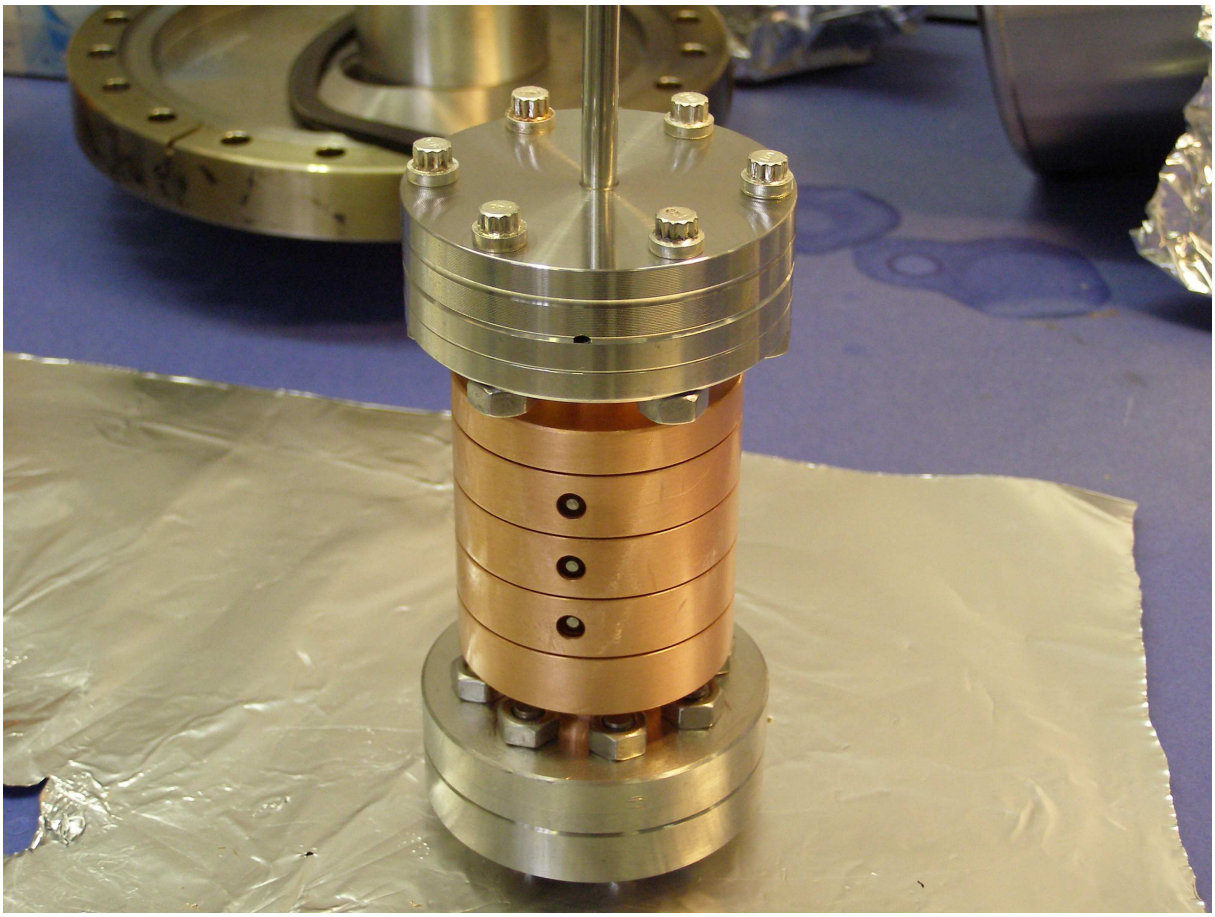

Fig 1: Brazed 3 cells Cu structure with the vacuum system.

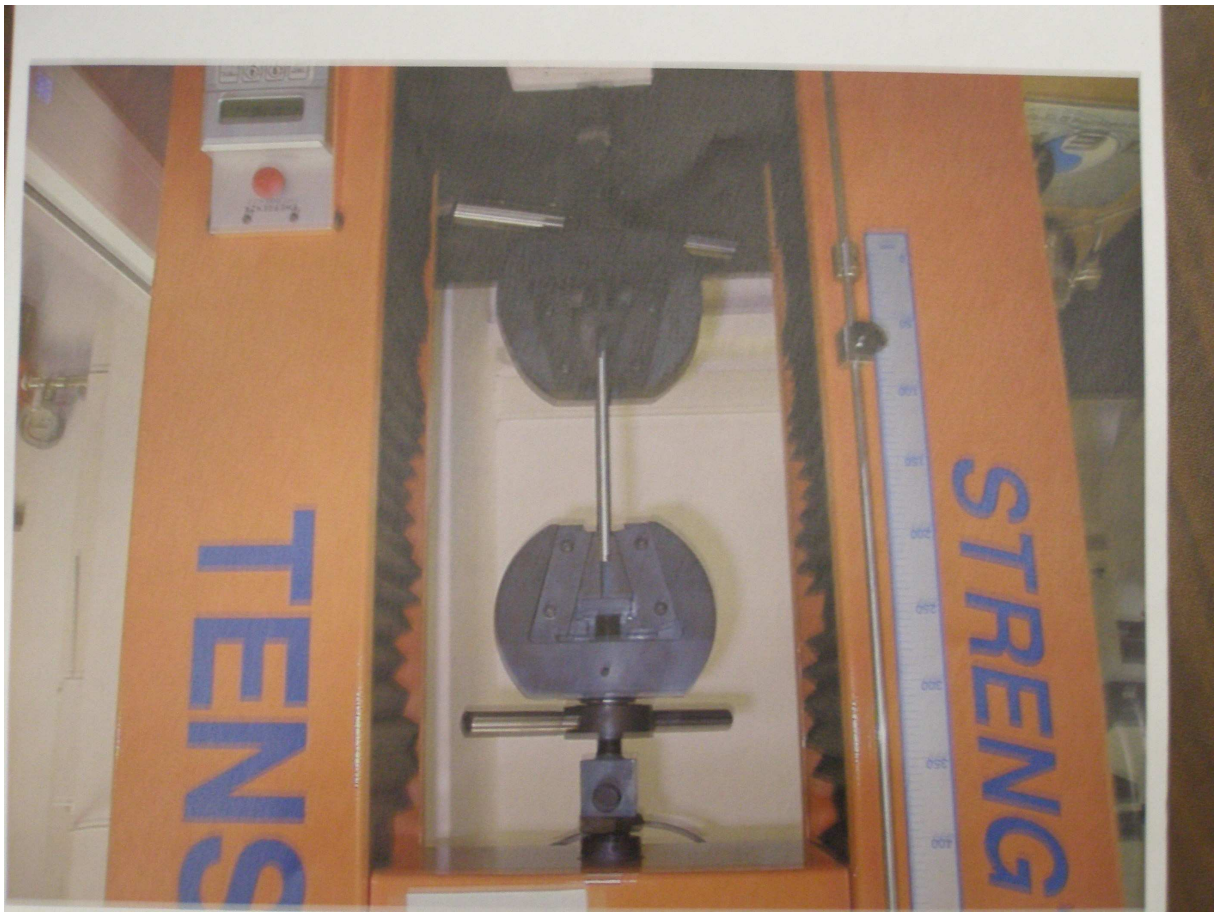

Fig 2 : The tensile strength machine.

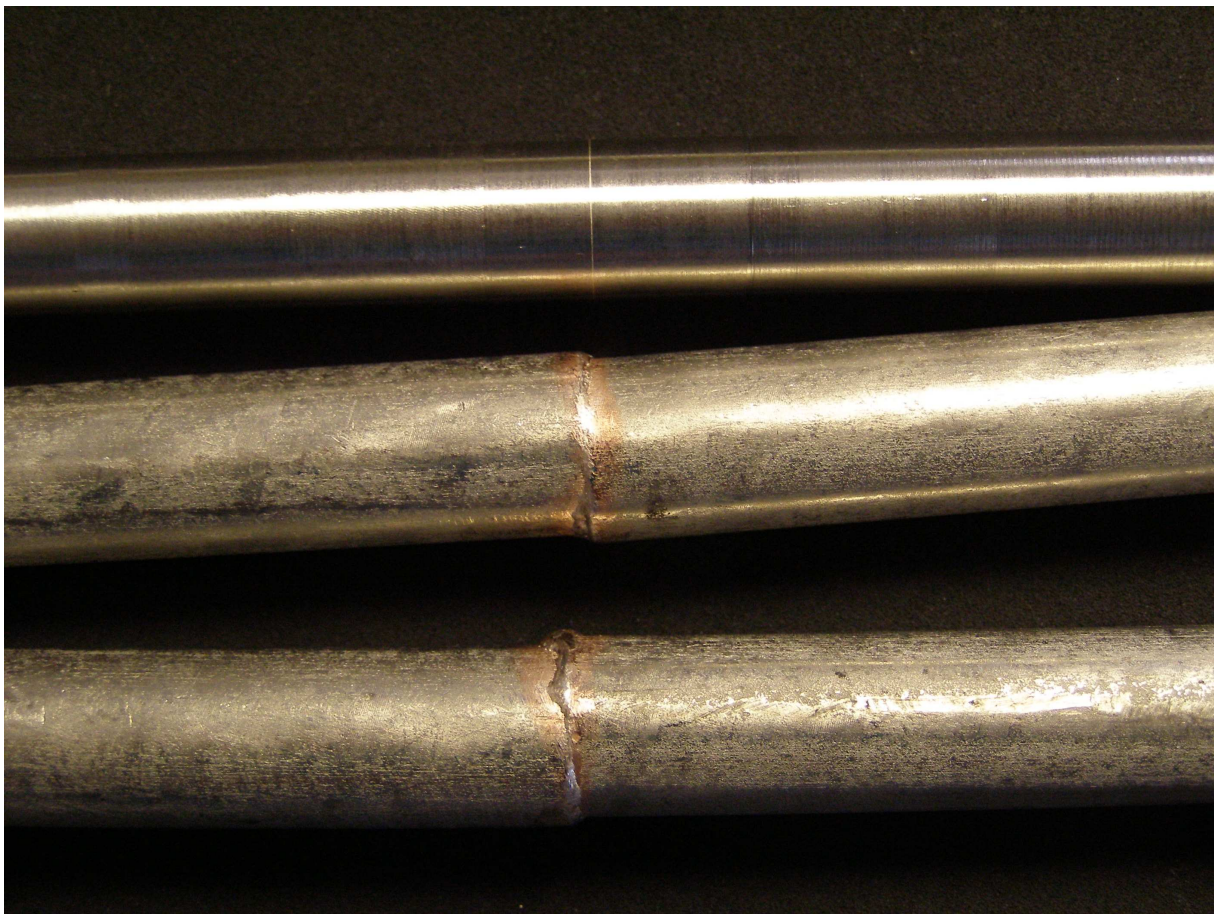

Fig 3 : The AgCu alloy between the two stainless steel parts.

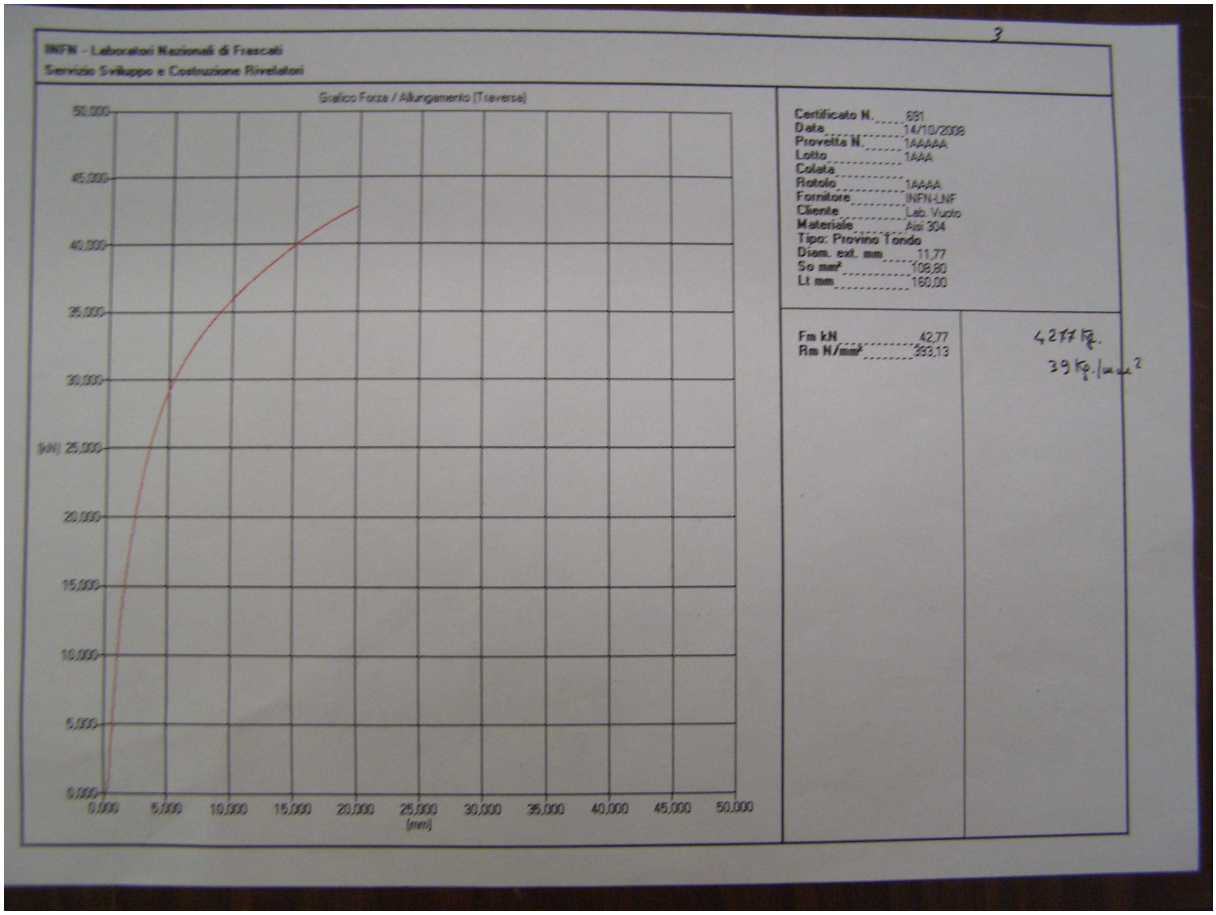

Fig 4 : The graph giving the breaking load is shown.

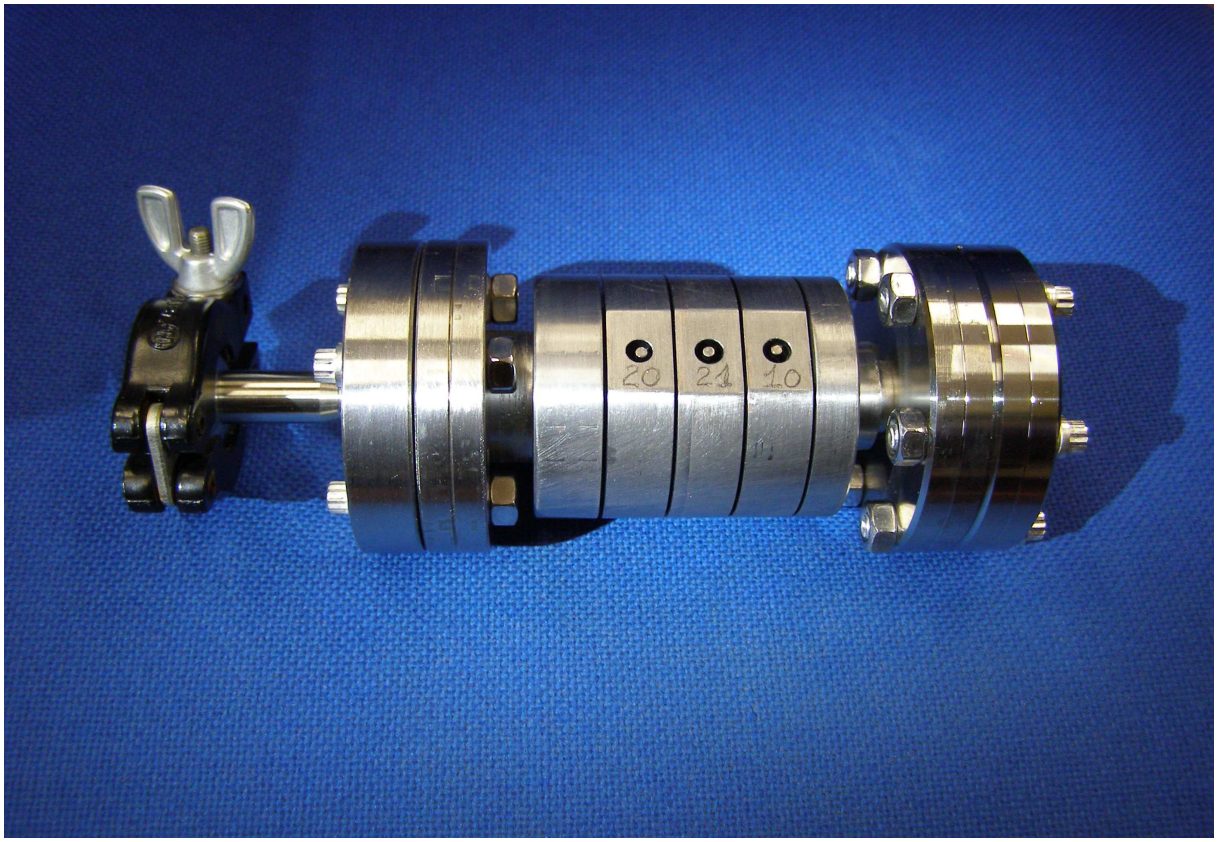

Fig 5 : A 3 cell structure completely in Molybdenum.

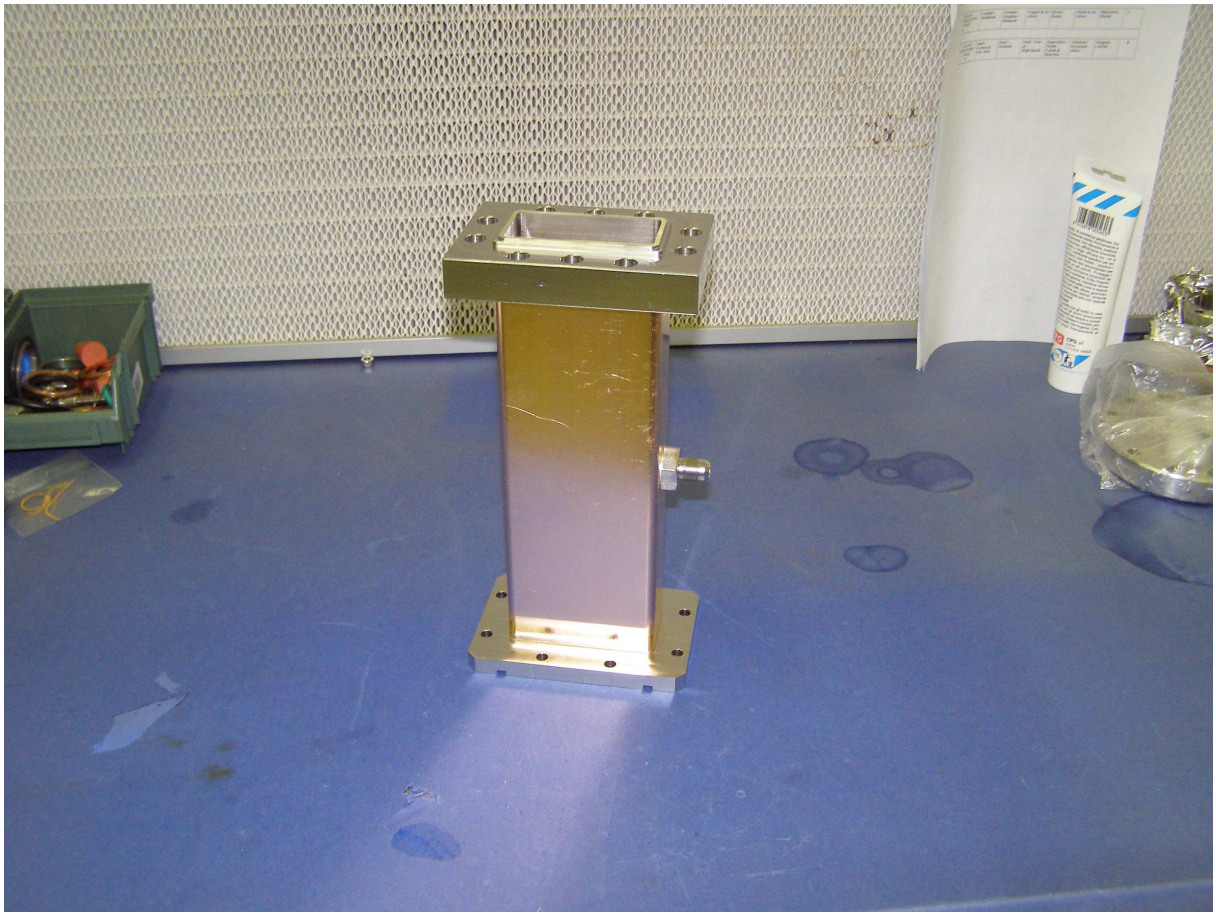

Fig 6 : Example of brazed joints for the Wave Guides of the SPARC Frascati accelerator.

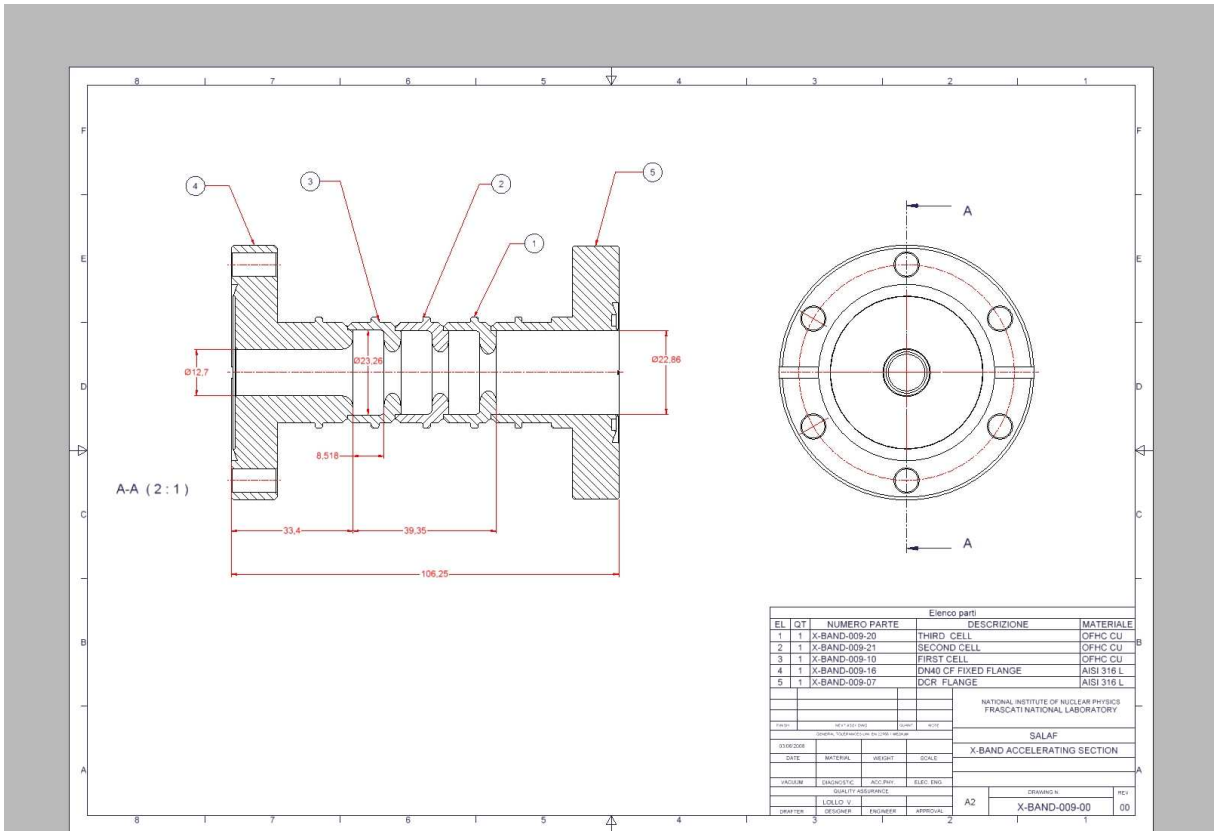

Fig 7 : Design of an electroforming 3 cells structure .

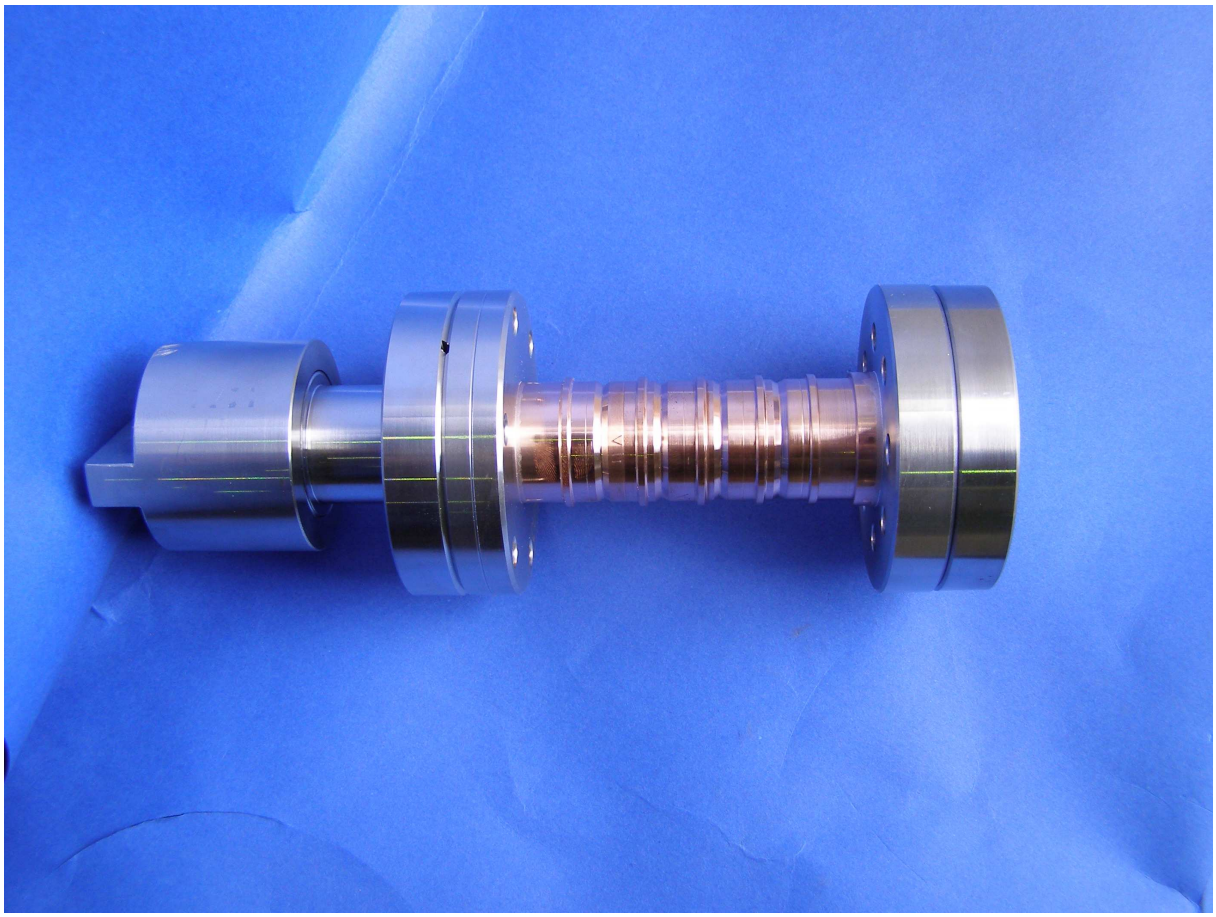

Fig 8 : Electroformed 3 cells structure.

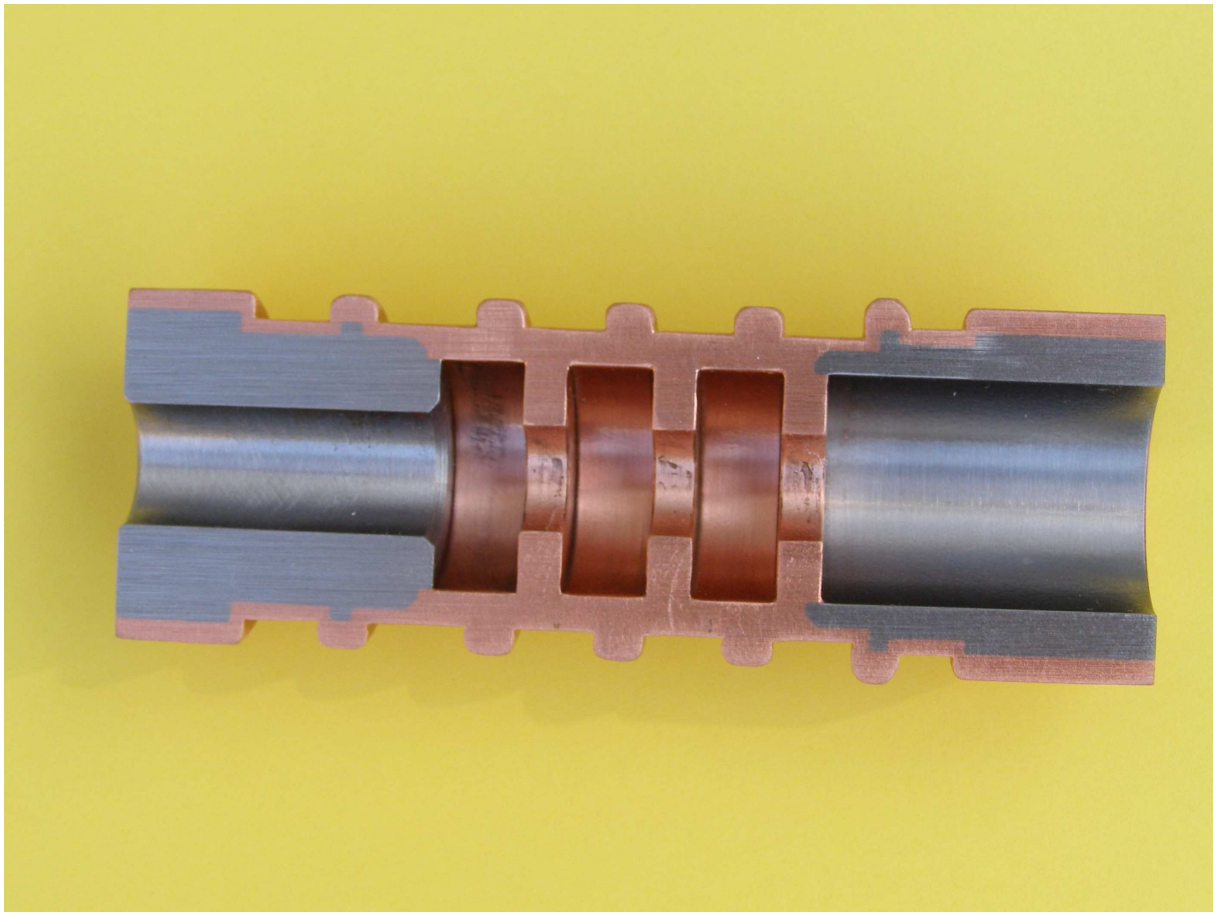

Fig 9 : The inner surface of an electroformed 3 cells structure.