ENGINEERING DESIGN AND FABRICATION OF X-BAND DAMPED DETUNED STRUCTURE

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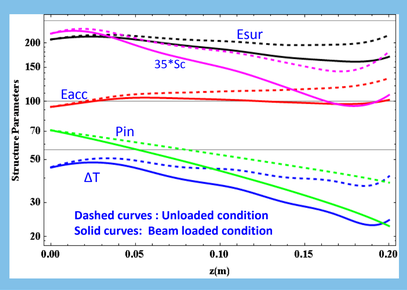
Abstract

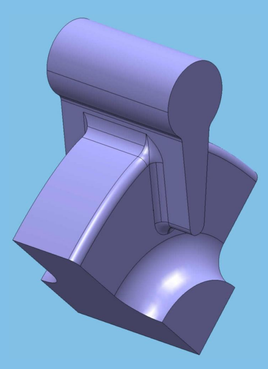
A Damped Detuned Structure (DDS), known as CLIC_DDS_A [1], has been designed and is presently under construction. The wakefield in DDS structures is damped using a combination of detuning the frequencies of beam-excited higher order modes and by light damping, through slot-coupled manifolds. The broad principles of the design are similar to that used in the NLC/GLC [2]. This serves as an alternative to the present baseline CLIC design which relies on heavy damping. CLIC_DDS_A is conceived to be tested for its capacity to sustain high gradients at CERN. This structure operates with a 120 degrees phase advance per cell. We report on fabrication details of the structure consisting of 24 regular cells plus 2 matching cells at both ends, diffusion bonded together. This design takes into account practical mechanical engineering issues and is the result of several optimizations since the earlier CLIC_DDS designs.

RF Design Inputs

RF parameters	Unit	Values
Q (In / Out)	-	5020 / 6534
R' (In / Out)	MΩ/m	51 / 118
vg/c (In / Out)	%	2.07 / 1.0
P_{in}	MW	71
$Eacc^{max}$ (L./UnL.)	MV/m	105 / 132
ΔT^{max}_{sur}	°K	51
E^{max}_{sur}	MV/m	220
S_c^{max}	W/μm²	6.75
RF-beam efficiency	%	23.5

RF parameters table and diagram [1]



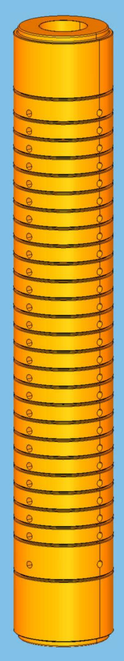


Vacuum Cell volume

Assembly sequence (bonding and brazing)

1. Disk stack

Diffusion bonding of high-precision RF disks under H_2 at about 1035°C.

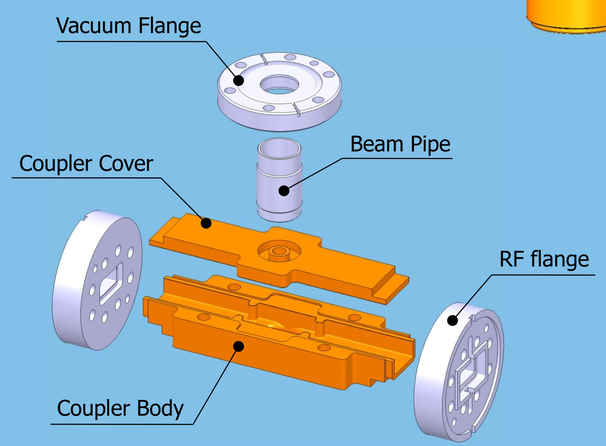


2. Couplers

-Vacuum brazing of two parts of the coupler at about 1045 C;

- Machining of brazed coupler surface for installation of RF flanges;

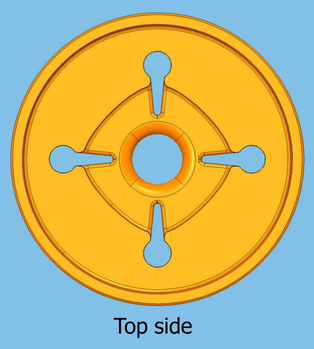
- Vacuum brazing of stainless steel adapter, RF and vacuum flanges at about 1035 C.



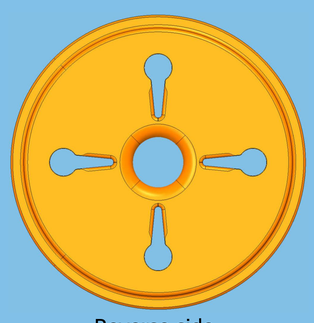
3. Final Assembly

Vacuum brazing of the bonded disk stack, couplers subassemblies, cooling blocks and tuning studs at about 1020°C.

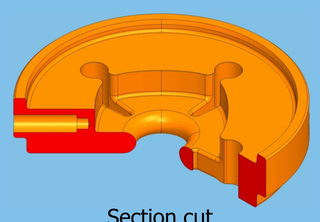
Mechanical Design of RF Disks



Top side



Reverse side



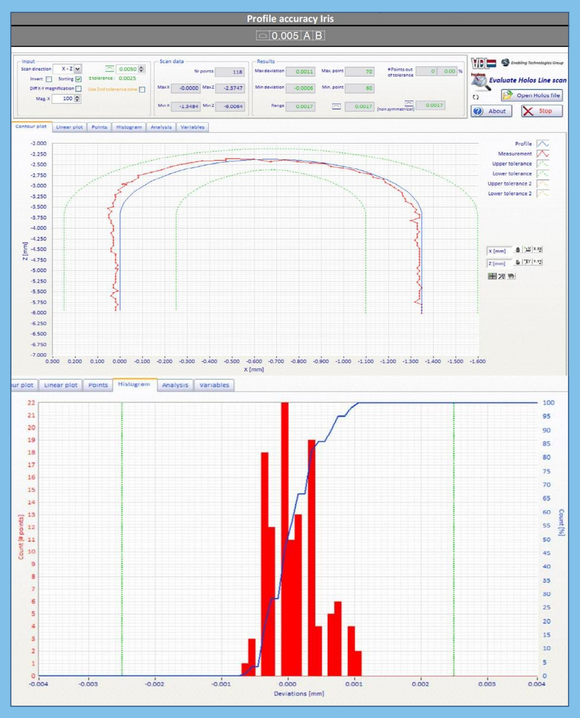
Section cut

Main features

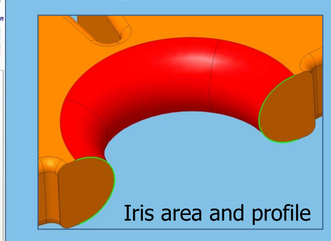
- Thick cylindrical copper disks;
- Four radial holes;
- Elliptical profiled iris diaphragm;
- Sharp edge blending with variable radius.

Tolerancing

- Cell shape accuracy 0.005 mm;
- Flatness accuracy 0.001 mm;
- Cell shape roughness Ra 0.025.

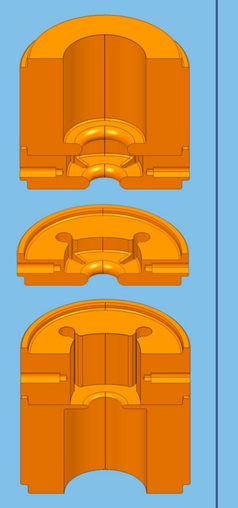


Crucial geometries



Iris area and profile

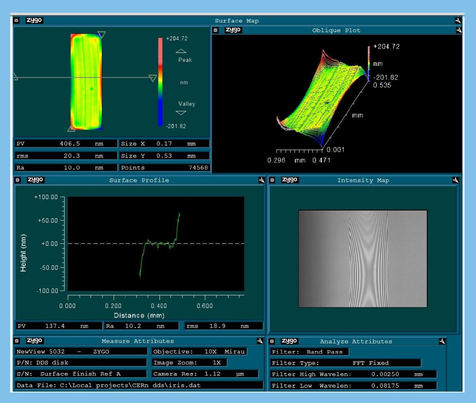
Disk set



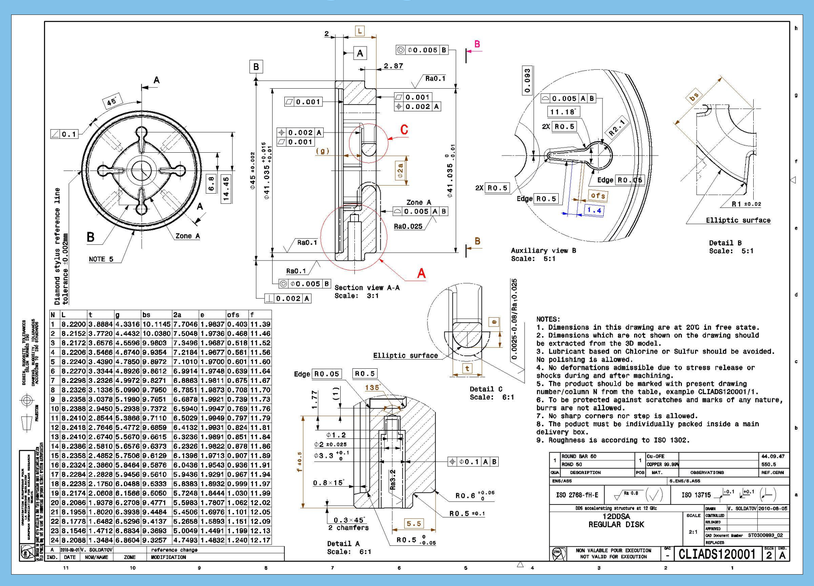
Dimensional control results (provided by *VDL ETG*).

On the left: Iris profile accuracy.
Measured with 3D CMM, Zeiss UPMC 850 Carat.

On the right: Surface roughness.
Measured with White light Interferometer, Zygo NewView 5032

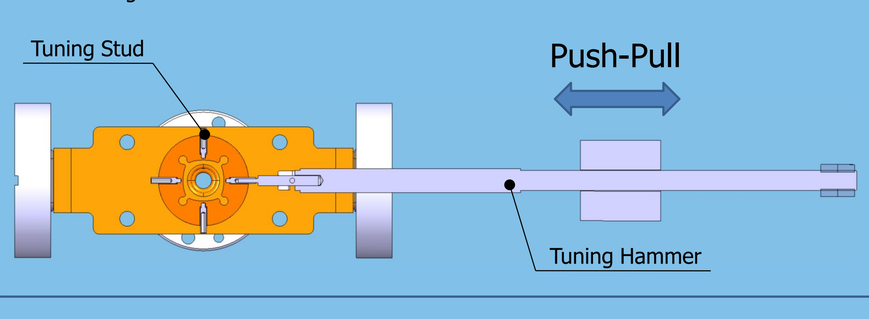


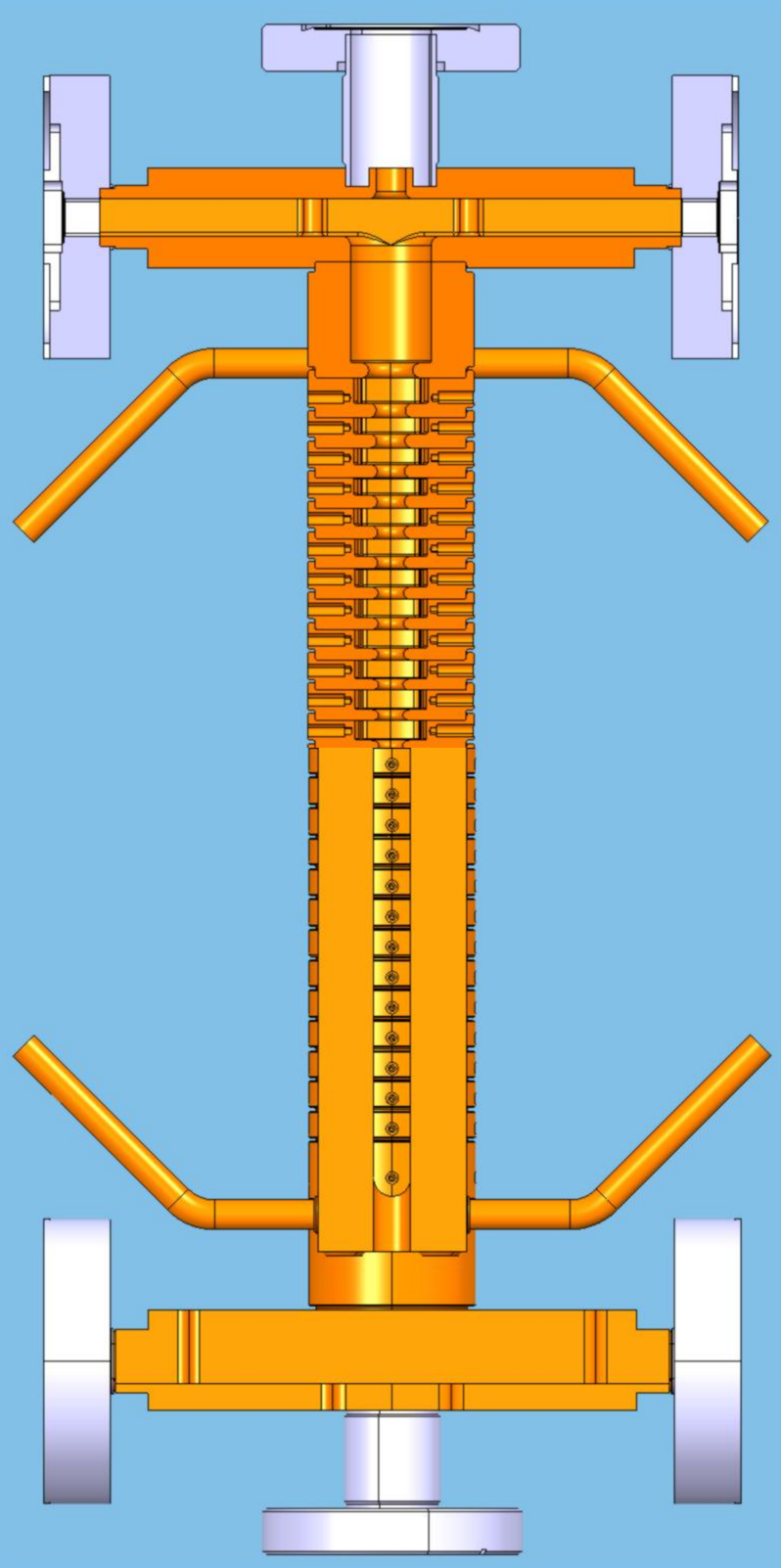
Drawing of Regular RF Disk



Tuning System

- Integrated tuning system;
- Push-Pull Principle [3];
- 4 tuning studs inside each RF disk.

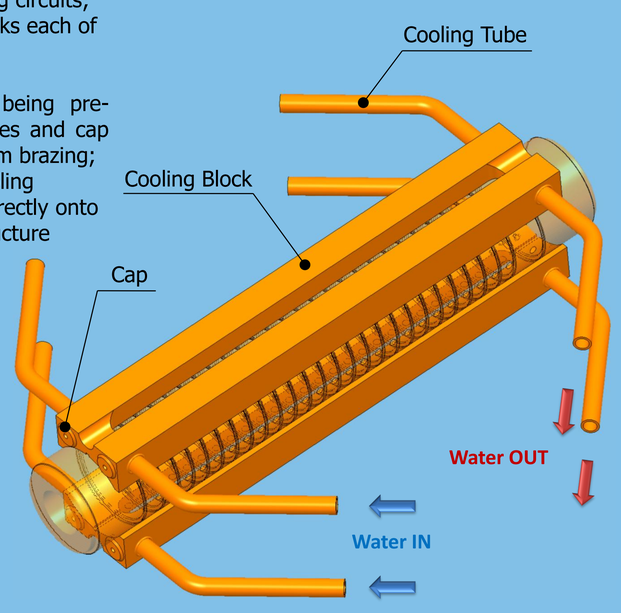




Cooling System

- Two parallel cooling circuits;
- 2 twin cooling blocks each of 250 mm long;

- Cooling block is being pre-assembled with tubes and cap by the use of vacuum brazing;
- Pre-assembled cooling blocks are brazed directly onto the accelerating structure body.



Manufacturing Strategy

The manufacturing of the accelerating structure is proceeding in two steps. The fist step is the production of four prototypes of the regular RF disk. Three of these disks are passing the bonding test and the last prototype disk undergoes the dimensional control.
Based on test results the whole structure is being produced in the second step.

ACKNOWLEDGMENT

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REFERENCES

[1] V. F. Khan, A. D'Elia, R. M. Jones, A. Grudiev, W. Wuensch, R. Zennaro "Recent Progress on a Manifold Damped and Detuned Structure for CLIC", IPAC10
[2] R.M. Jones, et al., 2006, Phys. Rev. STAB, 9, 102001
[3] Juwen W. Wang et al. "Fabrication Technologies of the High Gradient Accelerator Structures at 100MV/m Range", IPAC10.