

IN-VACUUM INSERTION DEVICE (FOR UHV UNDULATOR)

Application

This insertion device is a vacuum vessel for a in-vacuum undulator installed into the Diamond Light Source Storage Ring.

Supports for the undulator, cooling circuits and inner electrical connections (sliding contacts) are included.

The main features of the vessel are:

- Dimensions:
 - Outer diameter: 315 mm
 - Overall length: 2500 mm
 - Thickness of the vessel: 5 mm
- Vacuum ports: several vacuum ports, welded to Conflat flanges
- Two special vacuum pipes for the installation of *Titanium-Sublimators*.

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1 References

This product was produced, tested and delivered by CECOM for "DLS" (Diamond Light Source). The references of contact persons for this work are available under request.

2 CECOM activities

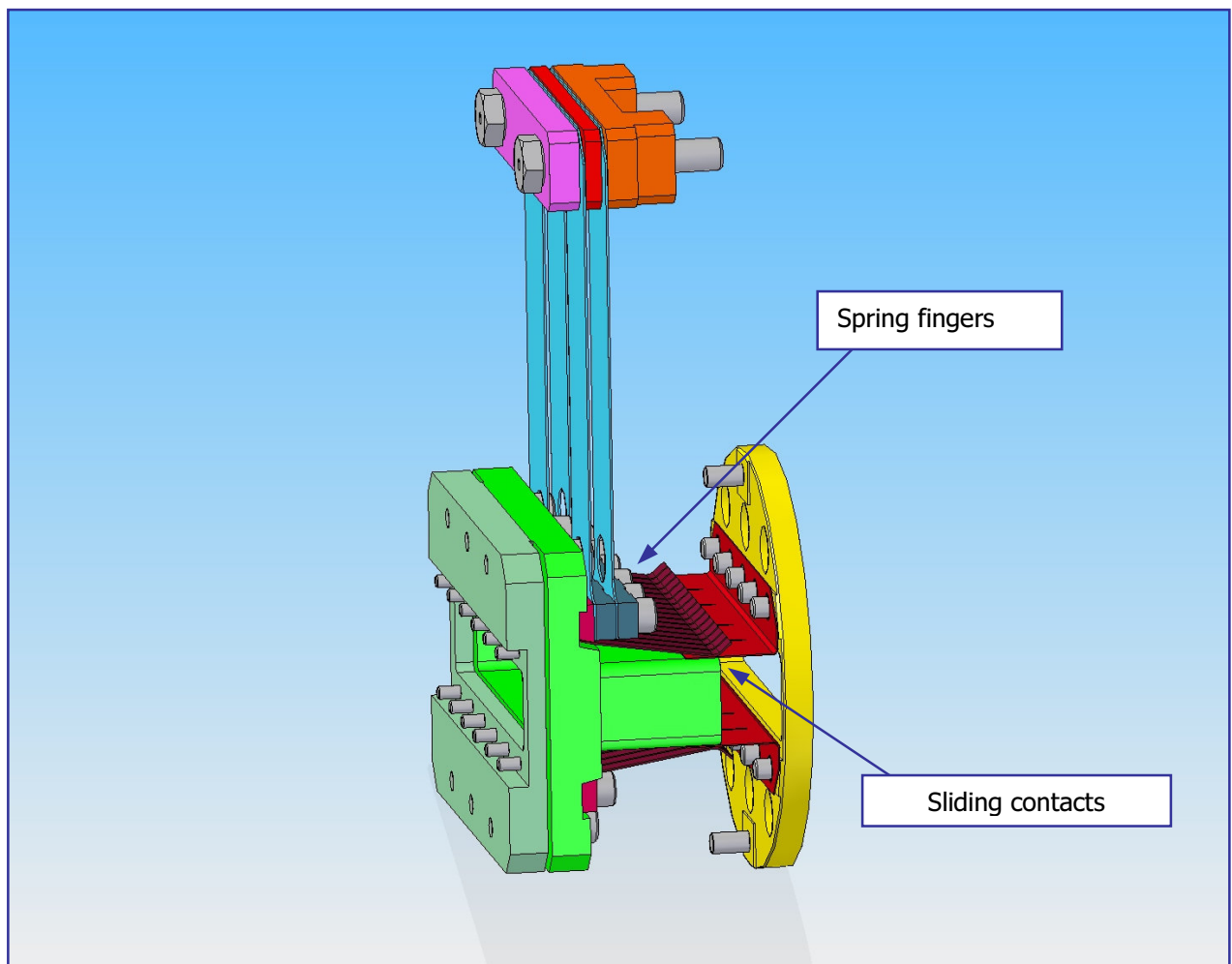
CECOM carried out the following activities:

- Development of manufacturing drawings (engineering design and development of tools and equipments needed for the manufacturing): see section 4.
- Material purchase
- Manufacturing of components
- Assembling, welding and brazing
- Cleaning (for UHV application)
- Quality check:
 - Dimensional check of components and assembly
 - Test of hydraulic parts (cooling circuits)
 - UHV test

2.1 Materials

Used materials:

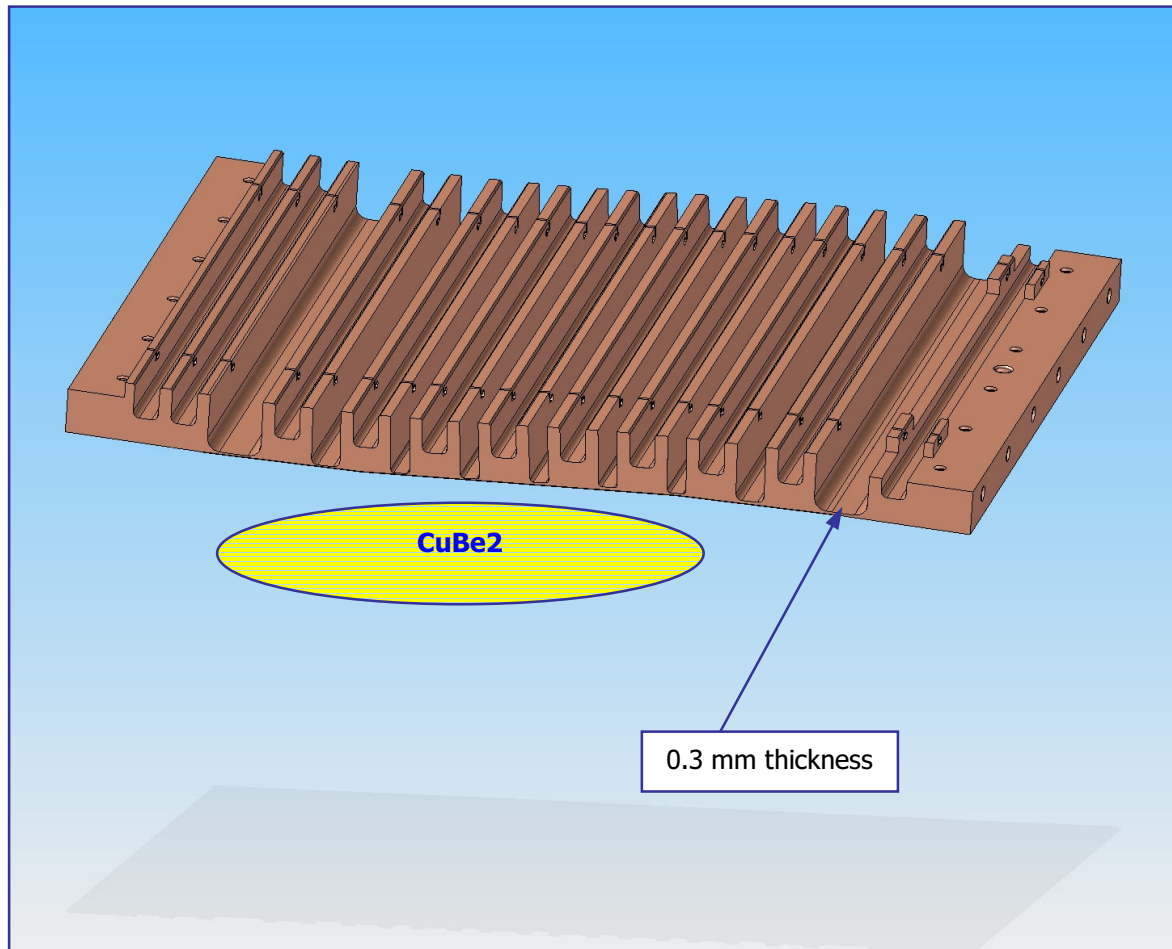
- Stainless steel "AISI 316 L" for vessel walls: In order to assure the required low magnetic permeability
- Stainless steel "AISI 316 LN (ESR) - forged" for CF flanges: low level of inclusions, hardness, small grain size and forging are important for the manufacturing of flanges, especially for Conflat flanges, due to the presence of the knife-edge
- OFHC Copper for cooling circuit
- Beryllium-copper alloy (C17200) for sliding contacts
- TiCN coating for spring fingers of sliding contacts:



2.2 Manufacturing, assembling and cleaning process

The most critical applications concerning the machining and cleaning of the vessel are:

- TIG welding (vacuum ports and flanges): vacuum ports have been welded with a positioning tolerance up to 0.25 mm
- Brazing (copper cooling pipes passing through the CF-flange)
- Bending of cooling pipes: a special bending was required for the cooling circuit.
- Wire-eroding machining for critical components (e.g.: CuBe2 copper support for cooling pipes):



- Vacuum firing: the vessel as been UHV-cleaned by means of the *vacuum-firing* process. This treatment assured an excellent cleanliness of surfaces, and welded regions; any eventual oxidation induced by welds is removed by the vacuum-firing.
- Manufacturing of in-vacuum cooling pipes: inner parts are cooled by means of in-vacuum cooling circuits, constituted of copper pipes. A special care has been used during the bakeout of the vessel in order to avoid the oxidation of pipes.

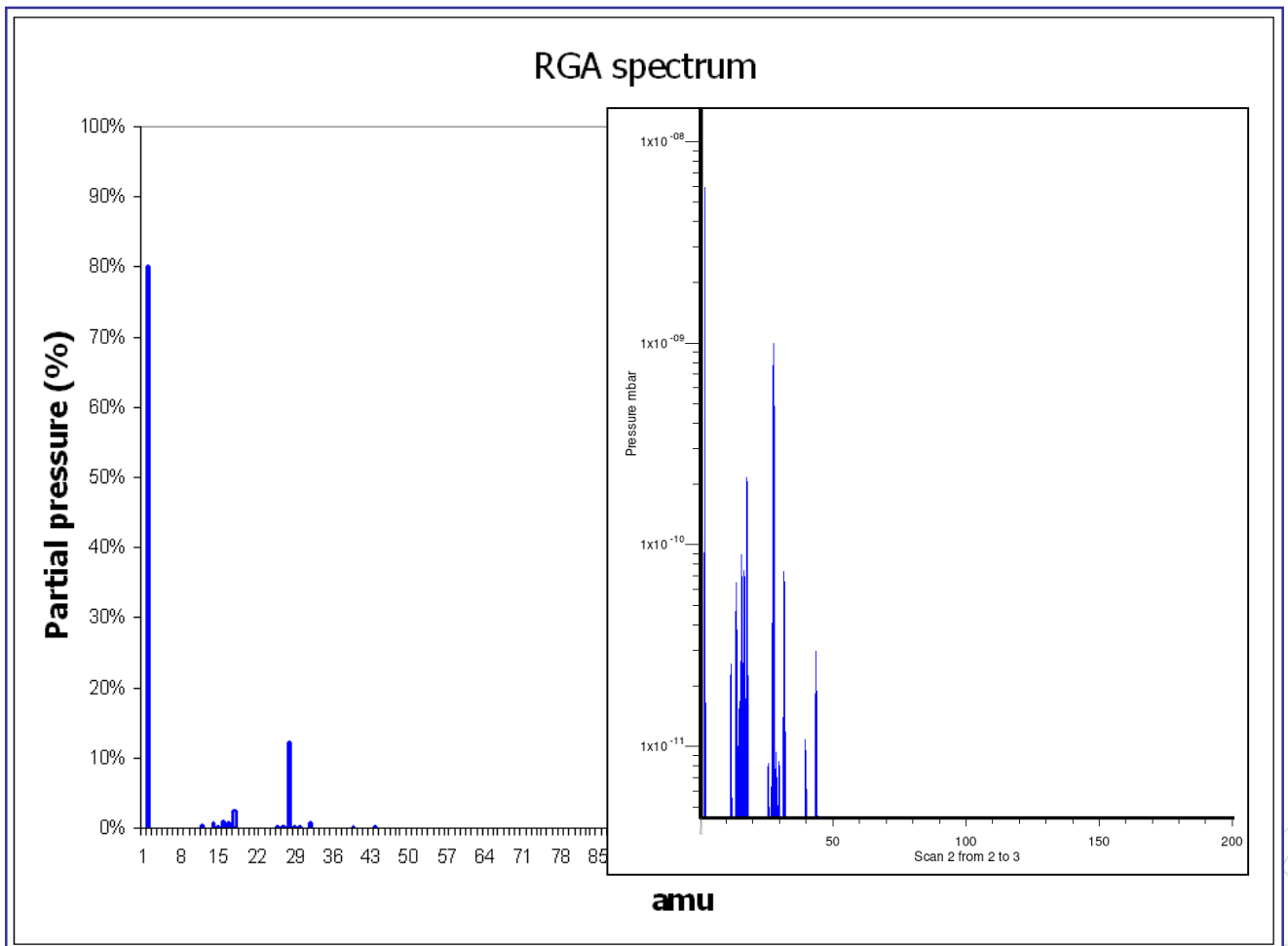
2.3 Vacuum performances (UHV)

The reference values for the vacuum performances of this product are:

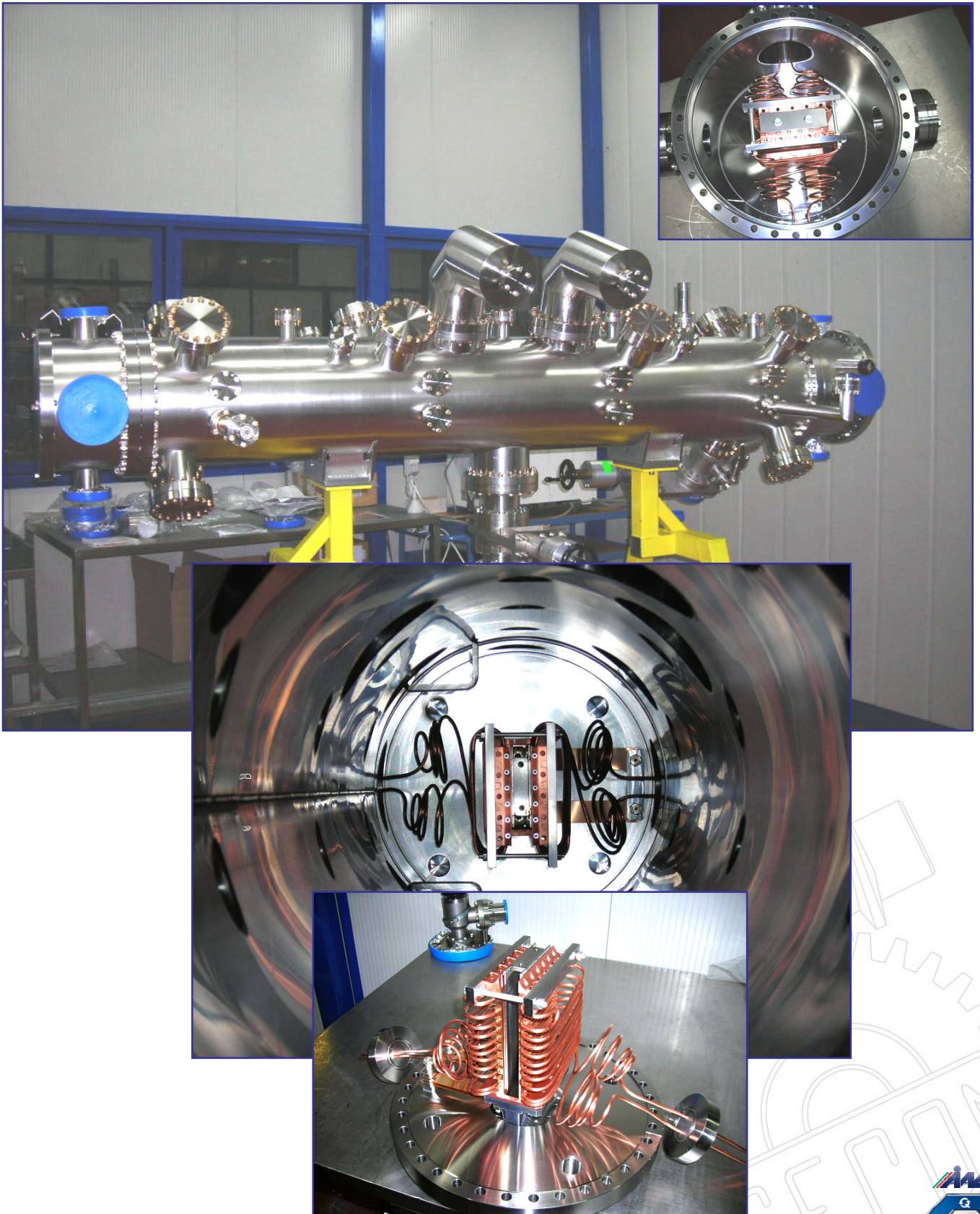
- Leak rate lower than 10^{-10} mbar·l/s
- Outgassing rate of the order of 10^{-12} mbar·l/(s·cm²).
- Clean RGA spectrum: negligible presence of Chlorine, Sulphures and general contaminants

During the UHV test the following equipment has been used:

- Turbo-Molecular pumps
- Ion pump
- Gauges:
 - Convection Pirani gauge
 - Inverted-Magnetron Gauge (Cold-Cathode)
 - RGA quadrupole (1-200 amu range)



3 Pictures



4 Reference drawings

