Newsletter

CENTRE FOR ADVANCED TECHNOLOGY

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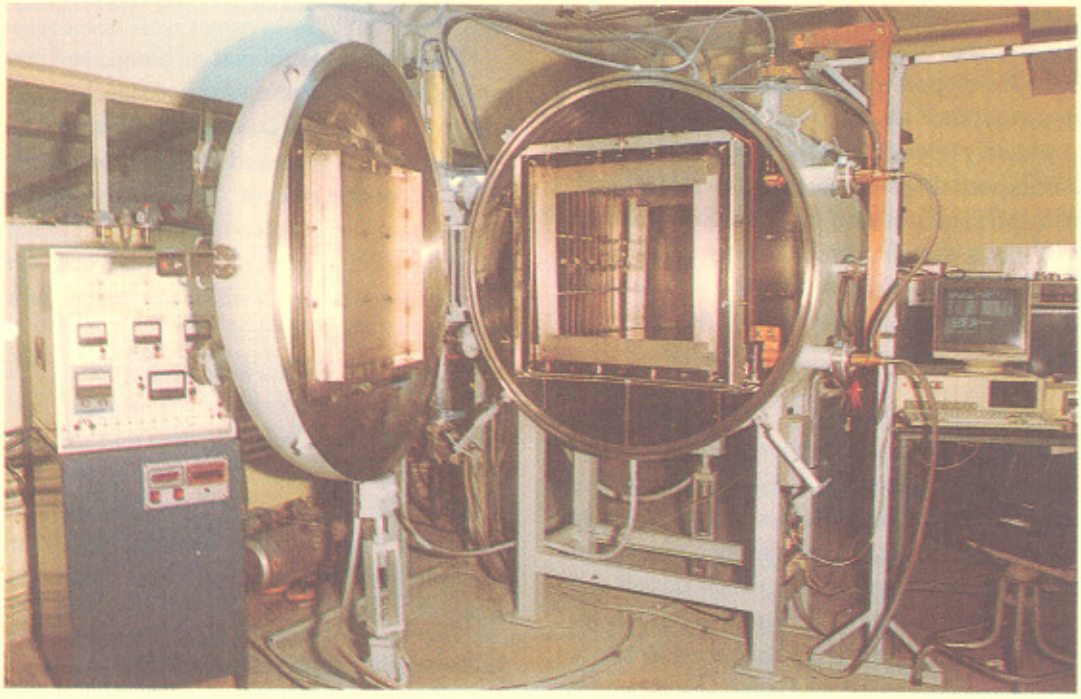


RESEARCH AND DEVELOPMENT

ACCELERATOR PROGRAMME

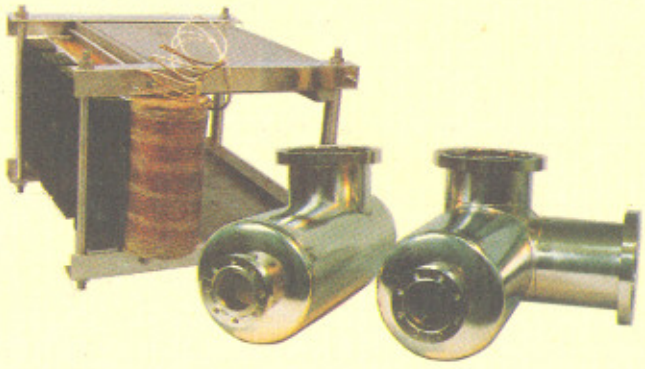
Vacuum furnaces for pre-treatment of ultra high vacuum (UHV) components

Synchrotron Radiation Sources (Indus-1 & 2), proton accelerator and other accelerators being built at CAT incorporate a variety of UHV system components, apart from a large number of UHV pumps, gauges etc. For high temperature vacuum degassing of these components, to ensure outgassing rate several orders of magnitude lower than the unbaked materials, two vacuum furnaces have been designed and commissioned. One of these furnaces, in use for last three years, has a hot zone of 450 mm diameter and 900 mm length and operates at 500°C with the corresponding vacuum level of 10^{-5} mbar. This is a vertical furnace comprising of a SS vessel electrically

heated from outside. The components to be degassed are suspended inside the furnace from the top flange cover. Closed cycle helium cryopump and ion pump developed at CAT, are being used for pumping and providing clean hydrocarbon-free vacuum condition inside the furnace. Another, higher temperature degassing furnace has been designed, constructed and commissioned at CAT recently. The furnace assembly is shown on the cover photograph. The hot box of a clear working zone 600 mm x 650 mm x 700 mm is enclosed in a double walled SS vacuum chamber within which cooling water is circulated. It can attain a temperature of 800°C with the corresponding vacuum level of 10^{-4} mbar. The furnace has resistance type heating elements made of Kanthal and six radiation shields. The innermost radiation shield is of molybdenum and the rest are of polished stainless steel. In order to prevent any hydrocarbon contamination, the furnace is initially evacuated using a DRYSTAR rotary mechanical pump and final evacuation is carried out by a closed cycle helium refrigerated cryopump with a pumping speed of 3000 lit/sec (air). Except for these two pumps all the other components are indigenously developed. The furnace operations are controlled by a computer and incorporates all the interlocks for safe and easy operation of the furnace. An identical furnace if imported, would have cost nearly 80 lakh rupees, while the present furnace has been built in less than half this price. A third, even bigger furnace with a hot zone of 850 mm diameter and 2500 mm length has also been designed and is under construction. This will be a horizontal type furnace operating at 800°C and 10^{-4} mbar.

Fabrication of accelerator components for CERN

CAT had received a proposal from the European Organisation for Nuclear Research (CERN), which is a premier centre for particle accelerators and their use in high energy physics, to fabricate and supply a number of vacuum components and magnets as per their design and specifications. The components to be supplied initially include corrector magnets for Large Electron Positron (LEP) collider being upgraded at CERN, sublimation pumps and manifold bodies for use in proton synchrotron. CAT has successfully developed prototypes of these viz. corrector magnets and vacuum pumps shown in the figure. The corrector magnet is a C-shaped electromagnet having pole gap of 200 mm and length of 400 mm. Cold Rolled Non Grain Oriented (CRNGO) silicon steel laminations were punched and used for assembly. H-class copper enameled wire of about 2.6 km length has been used to wind a race - track type coil on an epoxy former. The coil specifications required that the copper conductor used should not have any joint. Full length H-class enameled copper wire of 1.6 mm diameter was, therefore, specially got drawn from an industry. This was wound on the epoxy former (race-track shape) using a motorised fixture, so that constant tension is maintained. This avoided breaking of wire while winding.



(From left to right) The corrector magnet, sublimation pump and a manifold body developed for CERN.

Fabrication of sublimation pumps and manifold bodies to CERN specifications required development of the technology for single and double pull-outs on a 2 mm thick, 20 cm diameter SS pipe and their welding to thin SS dished ends with nozzle pullout. To meet the ultra high vacuum requirement for these components, full penetration welding, without crevices/trapped volumes was carried out. The fabricated components were leak tested for a leak rate of less than 10^{-10} std. cc/sec.

These components were delivered to CERN within the specified delivery schedule of 5 months. They have been tested by CERN engineers at their end and certified to meet the specified mechanical tolerances and other constructional details. However, CERN has suggested the use of a different CRNGO sheet material. This material is being procured and batch supply of these components will begin soon.

Bakeable ultra high vacuum (UHV) grade view port

A bakeable, zero length UHV grade view-port of 35 mm clear view has been developed. It consists of a glass plate sealed on a kovar eyelet without any deterioration of visibility. The kovar eyelet is then TIG welded to a SS flange which can be mounted on any UHV system. This window can be baked upto 400°C. Facilities now exist for fabrication of these windows to any required size. These windows will be required for beam viewers of electron accelerators and various other UHV chambers.

COVER: Vacuum furnace developed at CAT for pre-treatment of UHV components.