Rutherford Laboratory

Technical Leaflet

A5.5

NIMROD INJECTOR VACUUM SYSTEM

The aim is to keep the pressure in the injector below certain values which vary for different components between 10-5 and 10-6 torr.

The main radio frequency cavity has to be kept clean and free from oil, and for this reason mercury diffusion pumps are used throughout the injector.

There are 10 diffusion pumps of varying size with a total speed of 10,000 litres per second. Each pump is supervised by an automatic control unit. At a signal from the control room it will start up the pumps through a set sequence after which the isolation valve may be opened remotely. The automatic control continues to look after each pumping unit and will shut it down in the event of certain faults and will close the isolation valve if the pressure rises above 5 x 10-4 torr.

Due to the high vapour pressure of mercury at room temperature ($\sim 10^{-3}$ torr) refrigerated baffles have to be used in conjunction with mercury pumps. A lower baffle is maintained at about -25°C which arrests the bulk of the backstreaming mercury vapour whence it drips back into the pump. The final baffle is cooled by the evaporation of liquid air ($\sim$ -190°C) which reduces the vapour pressure of mercury to $\sim 10^{-27}$ torr; this baffle also acts as a very good pump for other condensible vapours from the system.

The liquid air system is self contained requiring only electricity and cooling water. The air is dried, liquefied and stored; it is then distributed to the baffles on a time schedule. The 4 gas liquefiers are of the condensation type with a total capacity of 25 litres per hour.

There are two storage vessels, the large of which is capable of being pressurised. When this is done it is isolated from the smaller storage vessel which continues to be fed by the liquefiers. The liquid air is thus forced down a distribution line by this excess pressure and runs into the baffles which, when full, are isolated by magnetic valves. The baffles are topped up every 8 hours and are capable of lasting for more than 12.

The vacuum system of the accelerator tank is somewhat complicated by the fact that the drift tubes have to be pumped separately. Each drift tube contains components which emit gas at such a rate as to prohibit their being pumped by the main vacuum system. The drift tube walls are not strong enough to maintain 760 torr, so a separate rough vacuum system is used. To allow for faults and differences in pumpdown times a mechanical equalising valve is placed between the two vacuum systems, this opens for a difference of $\sim$ 20 torr in either direction.

Since the drift tubes and the cavity are water cooled there are about 600 water joints inside the vacuum shell, all of which are inaccessible once the lid

is on. A special technique was therefore used to vacuum test these potential leaks before closing up the system. The best leak rate achieved for the accelerator was 2.5×10^{-4} litre torr per second.

A rough pumping facility is provided so that any number of the components can be pumped at one time. This roughing manifold is served by three Kinney-Roots combinations, each fitted with a refrigerated baffle to reduce oil backstreaming.

The whole injector system can be pumped from ambient pressure to working pressure in ~ 8 hours.