

THE ZGS INJECTOR VACUUM SYSTEM

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The injector for the ZGS machine is a 50 Mev linear accelerator, with a volume of the linac cavity of the order of 25,000 liters. To evacuate this tank use is made of 9 "Vac-ion" pumps, each capable of a pumping speed of 2000 ℓ /sec. As added precaution a 2000 ℓ /sec mercury diffusion pump is employed. This, because "Vac-ion" pumps are known to have low pumping speeds for the noble gases. This diffusion pump proved to be especially useful during initial pumpout of the linac tank. With this pump the time necessary to bring the pressure down to such a level that the "Vac-ion" pumps can be started is greatly reduced. Added advantages are that the ion pumps can more easily be started in the 10^{-5} to 10^{-6} mm Hg pressure range and the life expectancy of the pump elements is greatly increased. The fore-vacuum system makes use of two 300 cf/m rotary pumps and two 1000 cf/m roots blower pumps. The roughing stage of pumpout takes about five minutes, then the roots blower pumps are turned on, requiring about seven minutes before the diffusion pump is started. Shortly after this the valves to the "Vac-ion" pumps are opened and those pumps which were not already running are started. A typical pumpout curve is shown in Fig. 1.

At the present time only limited experience is available with the "Vac-ion" pumps connected to the linac cavity. The ultimate pressure of these pumps when valved off is of the order of $3 \cdot 10^{-8}$ mm Hg pressure. With the pumps connected to the tank pressures in the range of 10^{-7} mm Hg

pressure have been obtained. Some trouble has been encountered with failures of the high voltage connectors to the feedthrough insulators on the pump. Also, some power supply transformers have failed due to high currents during starting of the pump. These have already been replaced (at no cost to ANL) with larger transformers.

A summary of costs of the linac vacuum system is given below:

1) Roughing pumps	2 - 300 cf/m rotary 2 - 1000 cf/m blowers 1 - 100 cf/m rotary	\$ 16,399.60
2) Valves	10 - 20" gates - 36,000 54 - other valves - 15,702	51,702.00
3) 400ℓ/sec pumps and power supplies (7 each)		27,615.00
4) 2000ℓ/sec pumps (includes 18 operating power supplies and 3 extra starting supplies)		109,000.80
5) Instrumentation (16 ion gauge units, 16 th.c. units, 2 magnavact and connectors, cabling, etc.)		10,811.32
6) Prefab. piping including traps		6,229.60
7) 24M4 Hg diffusion pump		5,225.00
8) Baffles for above		4,568.85
9) Refrigeration for above		936.13
10) 10" Hg diffusion pump		950.00
11) Baffles for above		2,150.00
12) Refrigeration for above		300.00
13) Misc. (including installation not accomplished by linac technicians)		15,836.22
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		\$251,724.52

Discussion

- R. B. Neal (Stanford): Are the "Vac-ion" pumps located far enough from the cavity axis such as not to disturb the accelerated beam with stray magnetic field components from the pump magnet?
- R. Perry (ANL): The location is such that the cavity wall, a heavy steel plate, provides sufficient shielding.
- R. B. Neal (Stanford): Do you have an estimate of the conductance of the pumpout holes in the cavity wall?
- R. Perry (ANL): This is of the order of 1000ℓ/sec, reducing the pumping speed by about a factor of two.
- G. W. Wheeler (Yale): Is there not a danger of stalling the pumps due to gas evolution driving initial pumpout?
- R. Perry (ANL): We have not had such problems when pumping air. With the pumps connected to the accelerator column it was found that the pump would stall on occasion and not start again, presumably due to the high hydrogen gas load from the ion source. However, pumping air for a short time would cure this.
- P. Grand (Yale): Do you have any experience with the "Vac-ion" pumps getting dirty under certain conditions?
- R. Perry (ANL): Not really. We have, however, taken the precaution of cleaning the linac cavity by circulating steam through the tank cooling system and pumping simultaneously, without the "Vac-ion" ion pumps.
- I. J. Polk (BNL): Did you align the drift tubes after doing this?

R. Perry (ANL): Yes.

R. P. Featherstone (Minnesota): We have used a similar bake-out technique, but had trouble with leaking "O" ring seals after this.

R. Perry (ANL): In our case only a very few leaks developed. Viton "O" rings are used on the Argonne linac, this type "O" ring is fabricated to withstand higher temperatures.

Pressure

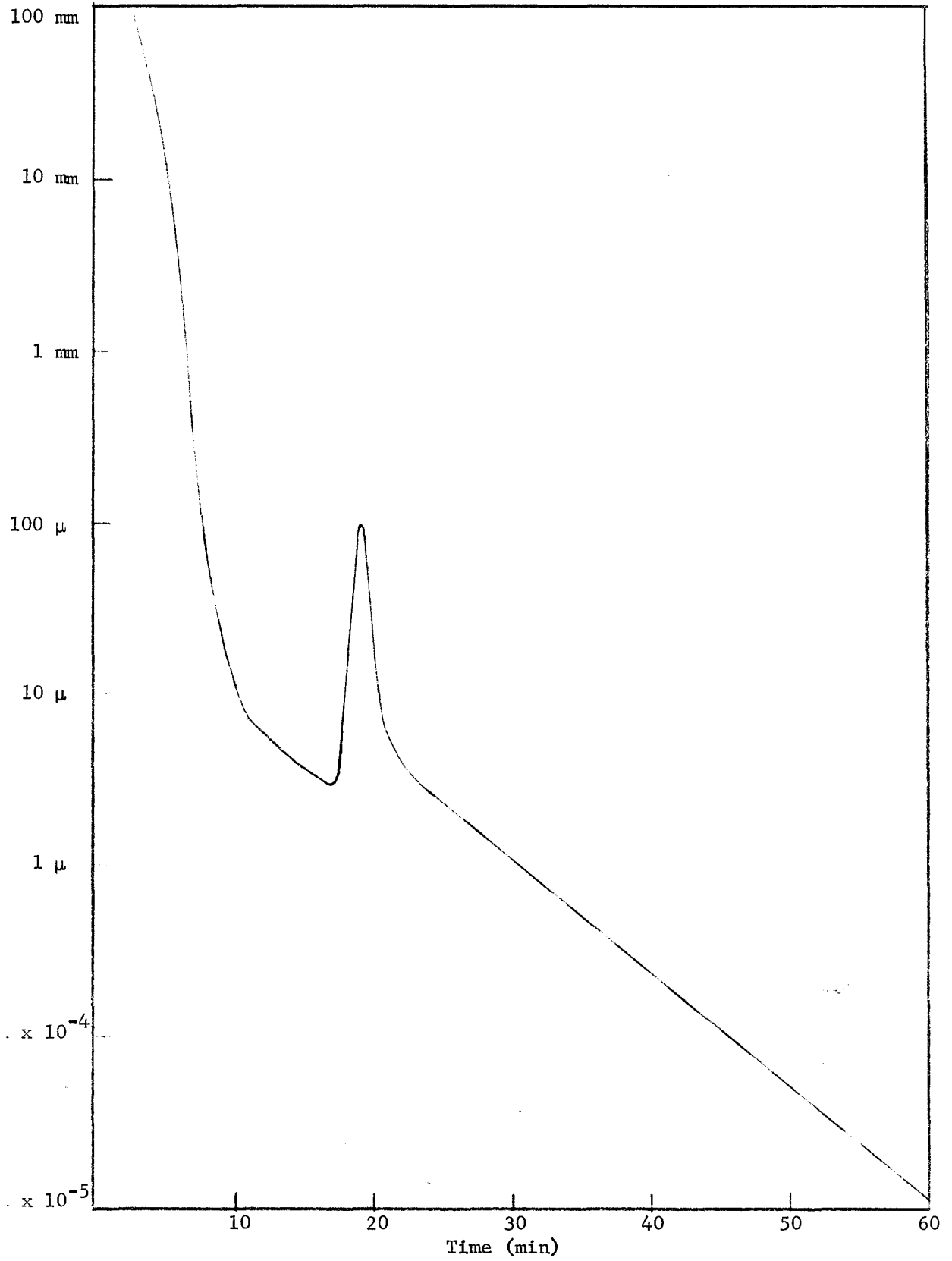


Fig. 1
Pumpout behavior of linac tank