# HOW TO FIX A THOMSON TH2075 KLYSTRON WITH VACUUM PROBLEMS WITHOUT SPENDING A LOT OF MONEY

M.N. Martins, A.L. Bonini, R.R. Lima, A.A. Malafronte, L. Portante, J. Takahashi, Laboratório do Acelerador Linear, Instituto de Física da Universidade de São Paulo, PO Box 66318, 05315-970 São Paulo, SP, Brazil

*Abstract*

This paper documents the repair of a Thomson TH2075 klystron, which was presenting vacuum problems. We detected the leak that was causing the problems, fixed it, and developed a procedure that allowed the introduction of an auxiliary pumping system, without the need to expose the tube to atmospheric pressure. All the work was done at the Laboratório do Acelerador Linear of the University of São Paulo.

## 1 INTRODUCTION

After purchase, the tube was stocked, with the vacuum pump on, for a few years, and developed a vacuum problem. It was sent to the manufacturer for repair, at a cost of approximately US$ 60,000. When returning from the manufacturer, we had bureaucratic problems, and the tube was held at customs for 4 months. When it finally arrived at the lab, and the ion pump was turned on, the vacuum was not good. After approximately 4 months of continuum pumping the vacuum reached a level that allowed the tube to be turned on. After that, the tube was turned on periodically, but the vacuum still presented an erratic behavior. After several tests we suspected that the ion pump was not working properly. The manufacturer suggested hi-poting the pump.

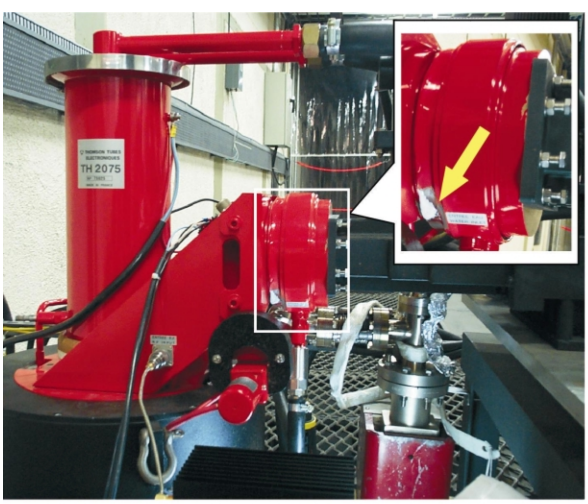


Figure 1: Photograph of the TH2075 klystron, with an enlargement showing the RF output. The leak was detected on the welding between the RF output and the RF output window flange, and fixed with vacuum cement, as shown by the arrow.

After hi-poting the behavior of the pump improved, but not for long. We had no means to evaluate whether the tube vacuum was adequate for operation or not. So we decided to install an auxiliary pumping system, without breaking the tube vacuum, in order to increase the pumping capacity.

We also found out the origin of the vacuum problem. There was a leak on the welding between the RF output and the RF output window flange. The leak was caused by a crack in the welding, which was covered by the painting of the tube. It is important to state that the whole welding is irregular. Figure 1 shows a photograph of the tube, showing in an inlet, the place where the leak was found and fixed with vacuum cement.

## 2 AUXILIARY PUMPING SYSTEM

The auxiliary pumping system consists of an ion pump (30 l/s), two right-angle manual valves, and connections that allow external pumping to the system, as shown in Figs. 2 and 3.

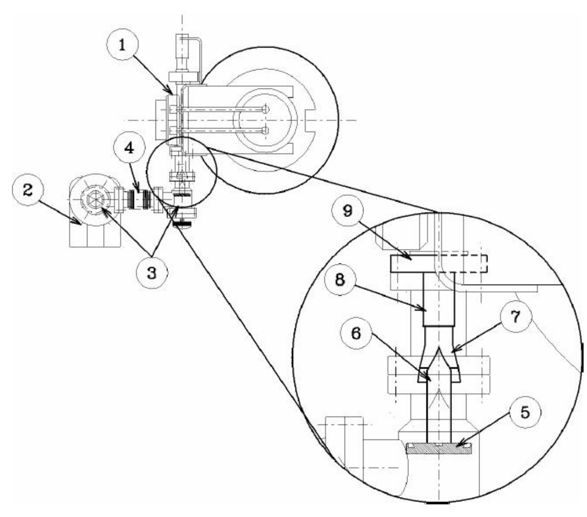


Figure 2: top view of the klystron and the auxiliary pumping system. The inlet shows a detail of the apparatus used to break the vacuum of the tube. 1 – TH2075 Klystron; 2 – Ion pump (30 l/s); 3 – Right-angle valves; 4 – Bellows; 5 – Bonnet; 6 – Stainless steel spike; 7 – Pinch off port; 8 – Support tube; 9 – Special CF40 flange.

The first right-angle valve, closer to the pump, is used to open the system to the outside, in order to pre-evacuate the system plus pump and get the ion pump started. The second valve has two functions: the first one was to break the pinch off port of the tube (see the installation procedure below). The second one is to isolate the tube form the auxiliary system, allowing for maintenance procedures.

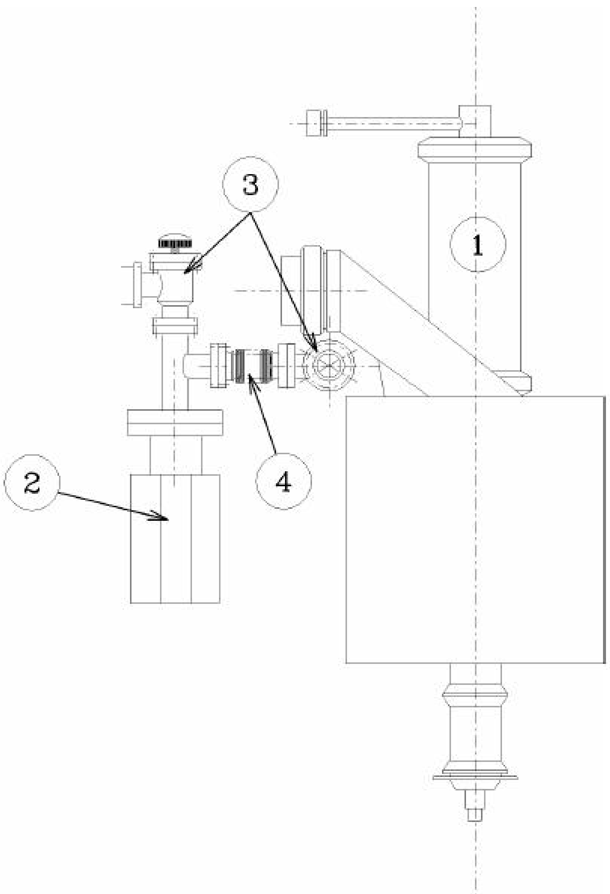


Figure 3: side view of the tube with the auxiliary pumping system. 1 – TH2075 Klystron; 2 – Ion pump (30 l/s); 3 – Right-angle valves; 4 – Bellows.

## 3 INSTALLATION PROCEDURES

In the description that follows, the numbers in parentheses represent the parts described in Fig.1, in order to ease the understanding. The auxiliary pumping system was connected to the klystron (1) through the pinch off port (7) of the tube. A special CF40 flange (9) was machined with an internal diameter matching the external diameter of the tube (8) that supports the pinch off port. This flange was then welded to the support tube. A 5-cm diameter tube, with CF40 flanges at both ends was connected to the welded flange, so that the pinch off tube was inside and coaxial to the new stainless steel tube. This tube was coupled to a leak detector, to check for possible leaks at the welding between the flange and the support tube.

A right-angle valve (3) was coupled to the flange of the external tube. Welding a stainless steel spike (6) to the bonnet modified this valve, so that, when the valve was closed, the spike protruded out of the valve towards the pinch off port. The other end of this valve was connected, through a bellows and another right-angle valve, to the ion pump.

After all the parts were fastened together, the whole system was checked for leaks. After that we pumped the system down to $10^{-6}$ torr with a turbo-plus-mechanical pumping system, closed the right-angle valve that opened the system to the outside, and started the ion pump. After baking, the system reached a final pressure of $2x10^{-9}$ torr. We were then ready to break the pinch off port seal. This was done by closing the right-angle valve (closer to the tube), so that the bonnet pushed the stainless steel spike through the pinch off port seal, tearing it. The valve was then open again, connecting the body of the tube to the auxiliary pumping system.

## 4 RESULTS

After the procedure described above, we pumped down the tube with the auxiliary system for a few days, and the pressure reached $4x10^{-9}$ torr. The reading on the Thomson ion pump was down to less than 1 μA, within the specifications of the manufacturer.

## 5 ACKNOWLEDGMENTS

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