MASTER**VACUUM GUIDELINES FOR ISA INSERTIONS****D. Edwards, Jr.****Brookhaven National Laboratory**

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I. INTRODUCTION

Vacuum requirements place design restrictions on the ISA insertions. The vacuum tube diameter, given a distance L between pumps, is determined by the desorption of molecules from the wall under the impact of ions created by the beam, whereas the thickness of the tube must be sufficient to prevent collapse. In addition, the entire vacuum chamber must be able to be baked out at $\sim 200^\circ\text{C}$.

II. MINIMUM TUBE THICKNESS

For an Al tube with $L/d > 10$ where L is the tube length, d the tube diameter, t must be larger than $0.01d$ to prevent collapse under vacuum, t being the wall thickness.

III. MINIMUM TUBE DIAMETER

The tube diameter is restricted by the wall desorption processes. For $\eta = 2.5$, $I_{\text{crit}} = 20$ A the relation between the diameter and length of a circular tube is given by:

$$d_{\text{min}} = 3.1 L^{2/3} \text{ (cm) ,}$$

where d_{min} is the minimum allowable tube diameter in cm and L is the distance between large pumps in meters.

Using the tube thickness and η restrictions one finds:

L (m)	d_{min} (cm)	t (mm)
1	3.1	0.3
4	7.8	0.8
10	14.4	1.4
40	36.2	3.6

It is clear that fixing any 2 of the parameters determines the third.

In order to be able to easily evaluate tube diameters for arbitrary ηI_{crit} Fig. 1 has been drawn. Seen is the very slight dependence of the tube diameter on η for a given length, critical current.

FIGURE CAPTION

Fig. 1. The minimum tube diameter is plotted vs ηl_{crit} for various lengths between the large pumps.