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SUBJECT:	Rai's LX vacuum model

NUMBER OF PAGES FAXED INCLUDING THIS COVER SHEET:	3
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NOTE: Brad: please call me after you've looked this over

## Vacuum model for Livingston X arm

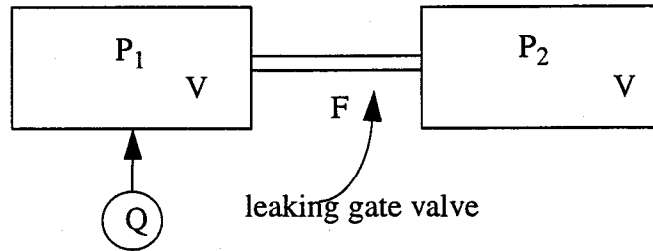


Figure shows the model for the beam tube during the accumulation of the leak  $Q$ . The gate valve makes a connection between the two modules with a pumping speed  $F$ . The volume of the two modules is identical and designated by  $V$ .

The coupled equations for the pressure on the two sides are

$$\frac{dP_1}{dt} + \frac{(P_1 - P_2)}{\tau} = \frac{Q}{V}$$

$$\frac{dP_2}{dt} + \frac{(P_2 - P_1)}{\tau} = 0$$

the time constant of the coupled system is  $\tau = \frac{V}{F}$ .

Limiting behaviour of the coupled equations when the starting pressure in both modules is  $P_0$  is described by

$t \ll \tau$

$$P_1 = \frac{Qt}{V} + P_0$$

$$P_2 = \frac{Qt^2}{2V\tau} + P_0$$

$t \gg \tau$

$$P_1 \sim \frac{Qt}{2V} + \text{constant}$$

$$P_2 \sim \frac{Q(t - \tau)}{2V} + \text{constant}$$

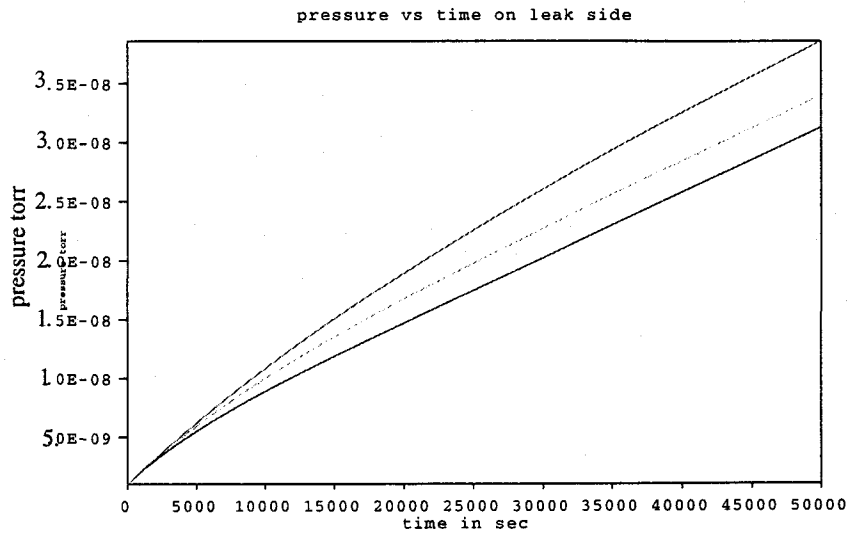


Figure shows the pressure vs time in module 1 for three values of the gate valve leak: top curve  $F = 60$  liters/sec ( $\tau = 4 \times 10^4$  sec), middle curve 121 liters/sec ( $\tau = 2 \times 10^4$  sec, bottom curve 242 liters.sec ( $\tau = 1 \times 10^4$  sec). The starting pressure is  $1 \times 10^{-9}$  torr and the calibration leak is the one used by CB&I ,  $Q = 2.66 \times 10^{-6}$  torr liters/sec .

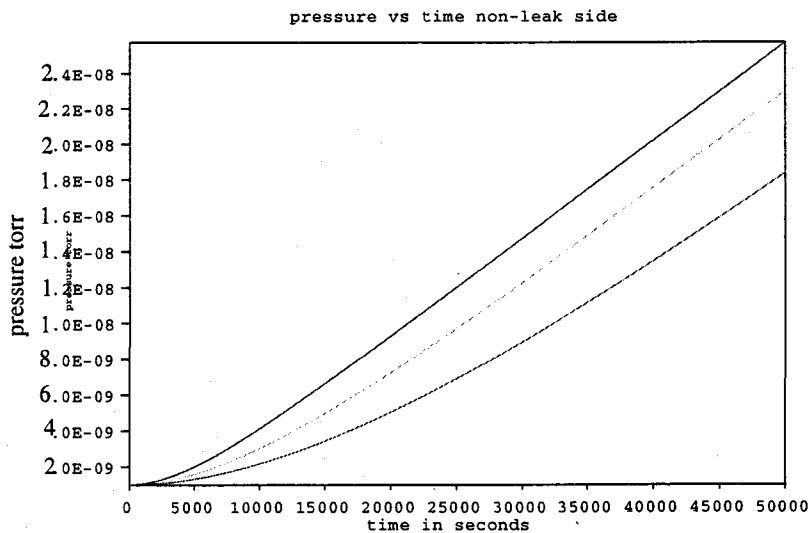


Figure shows the pressure vs time in module 2 for the same conditions as in the figure above. Now, the curve with the largest value of the gate valve leakage is on top. The sum of the pressure derivatives in the two modules is constant and proportional to the calibration leak size