SNS Linac Technical Memo

DTL BPM Outgassing Rate

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WBS 1.4.5.2.1 (Diagnostics – BPM)
and
WBS 1.4.2.4 (DTL - Vacuum)

Inner surfaces exposed to vacuum, cover and electrodes, is:

$A_{ft_transface} := .222 \cdot in^2$

$A_{ft_tranedge} := 2 \cdot \left(0.014 \cdot in^2 + 0.005 \cdot in^2\right)$

$A_{ft_cuseat} := 0.259 \cdot in^2$

$A_{ft_cuhole} := 0.058 \cdot in^2$

$A_{ft_sscolled} := 0.015 \cdot in^2$

$A_{ft_sscollsurf} := 0.070 \cdot in^2$

Total copper surface area from feedthrough area is (4 feed throughs):

$A_{ft_cu} := 4 \cdot \left(A_{ft_transface} + A_{ft_tranedge} + A_{ft_cuseat} + A_{ft_cuhole}\right)$

Total stainless steel surface area from feed through area is:

$A_{ft_ss} := 4 \cdot \left(A_{ft_sscolled} + A_{ft_sscollsurf}\right)$

Area of electrode (copper)

$A_{in_surf} := 10.71 \cdot in^2$

for largest bpm tank 6 #6 excess subtracted off at end.

$A_{fwd_face} := 4 \cdot 0.054 \cdot in^2$

$A_{chamf} := 8 \cdot 0.041 \cdot in^2$

$A_{bk_face} := 4 \cdot 0.031 \cdot in^2$

$A_{flat} := 4 \cdot 0.32 \cdot in^2$

$A_{outerrad} := 4 \cdot 0.652 \cdot in^2$

$A_{hole} := 4 \cdot 0.02 \cdot in^2$

$A_{braze_end} := 0.425 \cdot in^2$

$A_{back_face} := 4 \cdot 0.031 \cdot in^2$

$A_{elec_edge} := 8 \cdot .049 \cdot in^2$

$A_{elec} := A_{in_surf} + A_{fwd_face} + A_{bk_face} + A_{outerrad} + A_{braze_end} + A_{elec_edge} + A_{chamf} \cdots$
$+ A_{flat} + A_{hole} + A_{back_face}$

$A_{elec} = 16.287 in^2$

$A_{elec_2_3} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 1.874) \cdot in$

$A_{elec_2_3} = 10.408 in^2$

The area of the cover is the same for all bpms:

$A_{id} := 5.86 \cdot in^2 - \pi \cdot 1.276 in \cdot .226 \cdot in$

$A_{taper} := 0.728 \cdot in^2$

$A_{bore} := 0.968 \cdot in^2$

$A_{cover} := A_{id} + A_{taper} + A_{bore}$

$A_{cover} = 6.65\ in^2$

The area of the tube extension is:

$A_{tube_2_3} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - .9028) \cdot in$

$A_{tube_2_3} = 2.018 in^2$

The total copper surface area exposed to vacuum is:

$A_{cu} := A_{ft_cu} + A_{elec_2_3} + A_{cover} + A_{tube_2_3}$

$A_{cu} = 21.384 in^2$

The total stainless surface area exposed to vacuum is:

$A_{ss} := A_{ft_ss}$

$A_{ss} = 0.34\ in^2$

The outgassing rate for both copper and stainless is:

$OGR := 1 \cdot 10^{-10} \cdot \frac{torr \cdot L}{s \cdot cm^2}$

Seal type is, ceramic (Al2O3 , borosilicate strengthened).

$LR_{glseal} := 2 \cdot 10^{-10} \cdot \frac{atm \cdot cm^3}{s}$

$LR_{glseal} = 1.52 \times 10^{-10} \frac{torr \cdot L}{s}$

$OGR_{t2_dt3} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t2_dt3} = 1.462 \times 10^{-8} \frac{torr \cdot L}{s}$

The only pieces that change for the remaining drift tube bpms are the electrode and cover lengths. The appropriate number must be subtracted off each end.

For bpm tank 2 dt 6 you get

$A_{elec_2_6} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 1.874) \cdot in$

$A_{elec_2_6} = 10.408 in^2$

The area of the tube extension is:

$A_{tube_2_6} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 1.0074) \cdot in$

$A_{tube_2_6} = 2.342 in^2$

$A_{cu} := A_{ft_cu} + A_{elec_2_6} + A_{cover} + A_{tube_2_6}$

$OGR_{t2_dt6} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t2_dt6} = 1.483 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 3 dt 3 you get

$A_{elec_3_3} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 2.5714) \cdot in$

$A_{elec_3_3} = 12.564 in^2$

The area of the tube extension is:

$A_{tube_3_3} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 1.8634) \cdot in$

$A_{tube_3_3} = 4.988 \ in^2$

$A_{cu} := A_{ft_cu} + A_{elec_3_3} + A_{cover} + A_{tube_3_3}$

$OGR_{t3_dt3} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t3_dt3} = 1.793 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 3 dt 6 you get

$A_{elec_3_6} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 2.6158) \cdot in$

$A_{elec_3_6} = 12.701\,in^2$

The area of the tube extension is:

$A_{tube_3_6} := 8.711\,in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 1.9078) \cdot in$

$A_{tube_3_6} = 5.125\,in^2$

$A_{cu} := A_{ft_cu} + A_{elec_3_6} + A_{cover} + A_{tube_3_6}$

$OGR_{t3_dt6} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t3_dt6} = 1.811 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 4 dt 3 you get

$A_{elec_4_3} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 2.1407) \cdot in$

$A_{elec_4_3} = 11.232\,in^2$

The area of the tube extension is:

$A_{tube_4_3} := 8.711\,in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 2.4327) \cdot in$

$A_{tube_4_3} = 6.748\,in^2$

$A_{cu} := A_{ft_cu} + A_{elec_4_3} + A_{cover} + A_{tube_4_3}$

$OGR_{t4_dt3} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t4_dt3} = 1.821 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 4 dt 6 you get

$A_{elec_4_6} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 2.1754) \cdot in$

$A_{elec_4_6} = 11.341\,in^2$

The area of the tube extension is:

$A_{tube_4_6} := 8.711\,in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 2.4674) \cdot in$

$A_{tube_4_6} = 6.855\,in^2$

$A_{cu} := A_{ft_cu} + A_{elec_4_6} + A_{cover} + A_{tube_4_6}$

$OGR_{t4_dt6} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t4_dt6} = 1.835 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 5 dt 3 you get

$A_{elec_5_3} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 3.5136) \cdot in$

$A_{elec_5_3} = 15.476 in^2$

The area of the tube extension is:

$A_{tube_5_3} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 2.8056) \cdot in$

$A_{tube_5_3} = 7.9 in^2$

$A_{cu} := A_{ft_cu} + A_{elec_5_3} + A_{cover} + A_{tube_5_3}$

$OGR_{t5_dt3} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t5_dt3} = 2.169 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 5 dt 6 you get

$A_{elec_5_6} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 3.5378) \cdot in$

$A_{elec_5_6} = 15.551 in^2$

The area of the tube extension is:

$A_{tube_5_6} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 2.8298) \cdot in$

$A_{tube_5_6} = 7.975 in^2$

$A_{cu} := A_{ft_cu} + A_{elec_5_6} + A_{cover} + A_{tube_5_6}$

$OGR_{t5_dt6} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t5_dt6} = 2.179 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 6 dt 3 you get

$A_{elec_6_3} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 3.7639) \cdot in$

$A_{elec_6_3} = 16.25 in^2$

The area of the tube extension is:

$A_{tube_6_3} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 3.0559) \cdot in$

$A_{tube_6_3} = 8.674 in^2$

$A_{cu} := A_{ft_cu} + A_{elec_6_3} + A_{cover} + A_{tube_6_3}$

$OGR_{t6_dt3} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t6_dt3} = 2.269 \times 10^{-8} \frac{torr \cdot L}{s}$

For bpm tank 6 dt 6 you get

$A_{elec_6_6} := A_{elec} - \pi \cdot .984 \cdot in \cdot (3.7758 - 3.7758) \cdot in$

$A_{elec_6_6} = 16.287 in^2$

The area of the tube extension is:

$A_{tube_6_6} := 8.711 in^2 - \pi \cdot .984 \cdot in \cdot (3.0678 - 3.0678) \cdot in$

$A_{tube_6_6} = 8.711 in^2$

$A_{cu} := A_{ft_cu} + A_{elec_6_6} + A_{cover} + A_{tube_6_6}$

$OGR_{t6_dt6} := (A_{cu} + A_{ss}) \cdot OGR + 4 \cdot LR_{glseal}$

$OGR_{t6_dt6} = 2.273 \times 10^{-8} \frac{torr \cdot L}{s}$

Summary

This file calculates the outgassing rates for the drift tube beam position monitors. The bpms are constructed in the same manner throughout tanks 2 -6. They occupy drift tube #3 and #6 in each of the tanks. The body and feed through areas are identical for each bpm. The only parts that change are the lengths of the up and downstream tubes. These differences are compensated for in this calculation. The largest out- gassing rate is from tank 6 dt 6 and is:

$OGR_{t6_dt6} = 2.273 \times 10^{-8} \frac{torr \cdot L}{s}$

The smalles out-gassing rate is from tank 2 dt 3 and is:

$OGR_{t2_dt3} = 1.462 \times 10^{-8} \frac{torr \cdot L}{s}$

All other rates vary between these values.