Project: PS-TGT-14-001 Hall A Tritium Target

Tittle: Estimated Temperature of Tritium Cell in Ambient Air

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Code(s) of Record:

References:

1. Phys. Rev. 121, 232 Tritium Decay Energy
2. Incropera and DeWitt Fundamentals of Heat and Mass Transfer
3. TGT-CALC-103-006
4. REFPROP 9.1 (NIST)

Description:

Tritium decay is a source of heat. The cell temperature in ambient air is determined. A simple geometrical model is used with the shipping covers installed on the cell to determine the surface area. Only the top surface of the cell is considered see below. This is both conservative and simplifies the model. The ambient air temperature is assumed to be 100 F.

Reference Drawing(s):

TGT-103-1000-0013	Cell assembly with shipping covers

Units and definitions:

$$dQ := 0.324 \cdot \frac{W}{gm}$$

Heat from tritium decay from Ref 1

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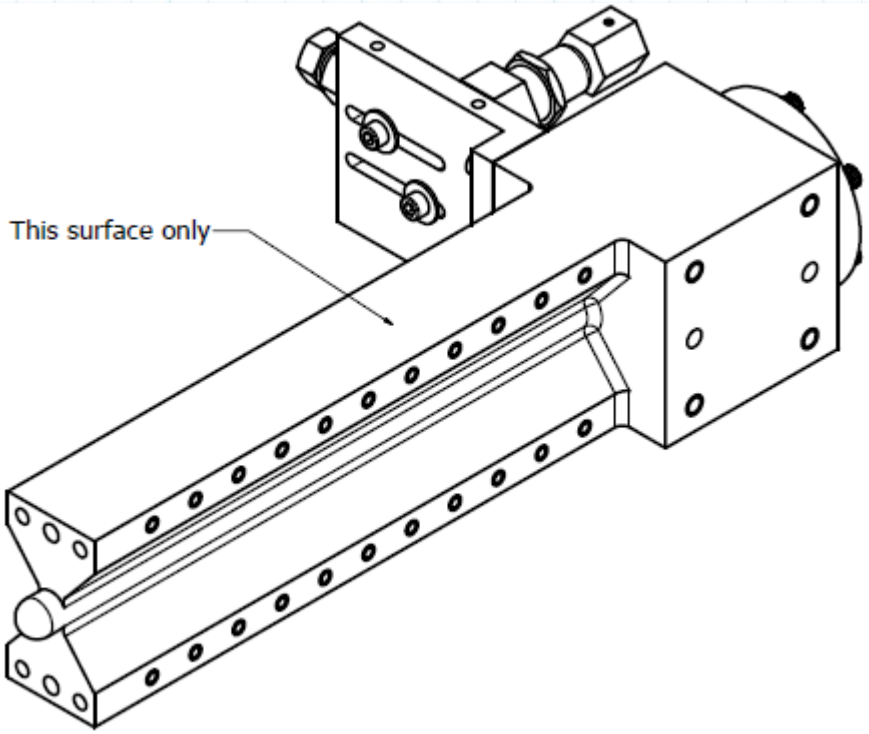

Using top surface only for heat dissipation

$A := 22.7 \cdot in^2$	area of cell top only
$P := 30.2 \cdot in$	perimeter of cell top
$m_t := 0.11 \cdot gm$	mass of tritium
$T_s := 101.5\ °F$	assumed surface temperature for air properties
$T_{air} := 100\ °F$	assumed air temp
$T_f := \frac{T_s + T_{air}}{2} = 100.75\ °F$	film temp

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$\Delta T := T_s - T_{air}$ temp difference

$\beta := \frac{1}{T_s}$

$L := \frac{A}{P} = 0.019\ m$ characteristic length

$\alpha := 0.238 \cdot \frac{cm^2}{s}$ thermal diffusivity

$\nu := 0.168 \cdot \frac{cm^2}{s}$ kinematic viscosity

$k := 0.0272 \cdot \frac{W}{m \cdot K}$ thermal cond of air

$Ra := \frac{g \cdot \beta \cdot \Delta T \cdot L^3}{\alpha \cdot \nu} = 456.236$ Rayleigh number

$Nu := 0.54 \cdot Ra^{\frac{1}{4}} = 2.496$ assumed Nuslet number

$q := dQ \cdot m_t = 0.036\ W$ heat from tritium decay

$h := Nu \cdot \frac{k}{L} = 3.556\ \frac{W}{m^2 \cdot K}$ Convective heat transfer coef

$T_s := \frac{q}{h \cdot A} + T_{air} = 101.232\ °F$ surface temperature