TVAC TKR Thermistors’ analysis

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Purpose
- Check the TKR thermistors response using the results from the TKR TV test in Alenia (Eduardo’s talk in Meeting 26)

Scope
- Compare and correlate the TKR thermistors data and the TCs results

Summary
- TKR Towers Thermal- vacuum test set-up at Alenia (Rome)
- Correlation: thermistors vs Thermocouples;
- TKR Tower thermal gradient issue
- Conclusions
TKR Tower - TV Test Set-up (1)

TCs are installed on top, on bottom and on one sidewall
An aluminum shield (with dark inner surfaces) equipped with heaters surrounds the tower to make the warm up faster and control radiation loss from the TKR tower walls.

An MLI blanket covers the aluminum shield to further reduce the heat loss from the tower versus the environment (chamber walls @ room temperature).

The Vacuum level is $\sim 10^{-5}$ Torr. Convective effects are definitively negligible.
More details in Eduardo’s presentation Meeting 26
Acceptance TV test cycle (@Alenia)

TKR Tower SN B -> Bay 4

Acceptance TV test cycle: bake-out, thermal balance, and cycles (4 between -15°C +45°C)
TKR SN B: Thermistor-Thermocouple correlation

Thermistor and TC close to each other show good correlation

The correlation worsens if the same thermistor is compared with a thermocouple installed on the Bottom of the Tower (TC4)
The temperature gradient between bottom and top trays can be observed by assuming no radiation loss or gain through the walls.

The gradient reflects the boundary conditions of the source power in the TV set-up (i.e. IGS heaters power).

\[ T = \text{cost} \]
\[ m_c \gg 1 \]

The TKR tower gradient in vacuum:

\[ \Delta T \sim z^2 \]

TWR Thermal Model consists of an electrical equivalent circuit with nodes, resistors and sources.

Each node is connected with other nodes through thermal resistance.

Heat sources can be modeled with an equivalent current source.

Voltage drops throughout the circuit \( \Leftrightarrow \) thermal gradients.
LATTE p 04.05.00 version used for TKR Tower SN B
TEM used is SN 28 (non flight unit)

$\Delta T \sim 1.5 \, ^\circ C$
Conclusions

Good correlation between thermistors and Thermocouples data has been observed in all TKR towers test @ alenia

Thermistors have been demonstrated to be very reliable and precise systems to monitor temperature of the TKR towers

The measured gradient strongly reflects the boundary conditions of the test:

- the bottom is connected with almost infinite thermal capacity source (the CP)
- An Inner Guard Shield surrounds the tower and keeps low the heat loss
- An MLI further insulates the test item from the environment

No gradient should be expected in air due to convective heat transfer and due to the large TKR walls surface (about 1 m²) and a small TKR power value (about 10 W). Further investigation can be done ....