Determine if Adding insulation barrier increases Heat inside chamber with same wattage applied

☼ Status	Done
◎ Project	◎ Heat Fiber Bundle Mounting Block
🏷 Tags	

Goal: Does adding insulation (reducing heat loss) increase the temperature of the heater cart when the same wattage is applied?

How: Using an iso80 full nipple with KF 50 adapter as a cap, 3 scenarios are tested. No insulation, 0.25 in Rubber insulation, and 0.2in foam insulation. Thermocouple is attached to heater cart and one is resting in air inside the chamber. DMM is attached to power supply for voltage monitoring.

1. Ambient resting temperature measured/recorded at 0V for both the air and heater cart, This is labeled T1

2. 4V is then applied, Wait 10 minutes for temperature to stabilize. Record air and heater cart temp. (labeled T2)

3. Let Temperature lower to room temperature

4. 8V is then applied, Wait 10 minutes for temperature to stabilize. Record air and heater cart temp. (labeled T2)

Temps in Celsius	No insulation	0.25in Rubber	0.2in Foam
T1 Heat Cart	26	26	26
T1 Air	26	26	26
4V Attempt	4.008V @ 0.16A	4.008V @0.16A	4V @0.16A
T2 Heat Cart @ 4V	86	86	86
T2 Air @ 4V	27	27	28
8V Attempt	8.01V @0.32A	8.02 @ 0.32A	8.02V @0.32A
T2 Heat Cart @ 8V	188	194 (187 @ 10 min)	192
T2 Air @ 8V	31	31 (41 Tape)	37

*Note: 4V & 8V attempt is what I actually managed to set the power supply to based on the DMM for voltage and the power supply current monitor. The turn knob is sensitive…
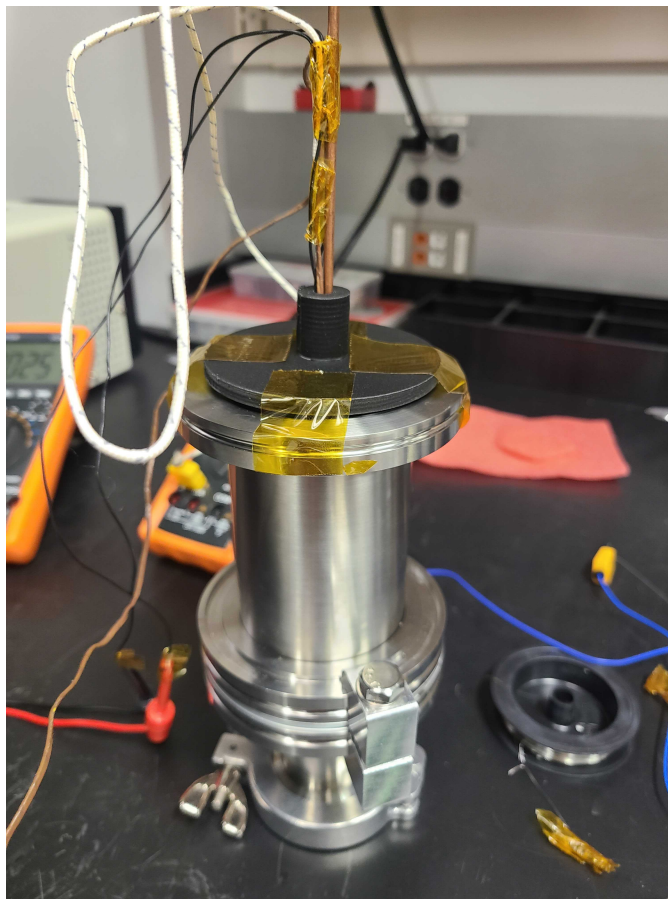
Setup:
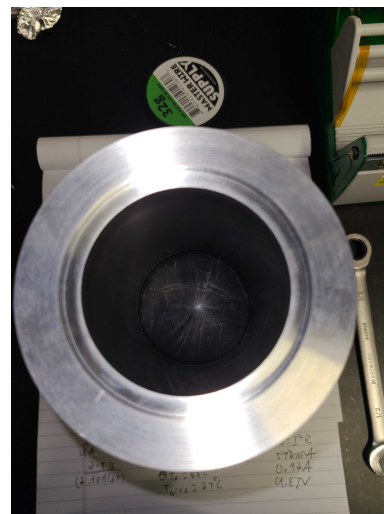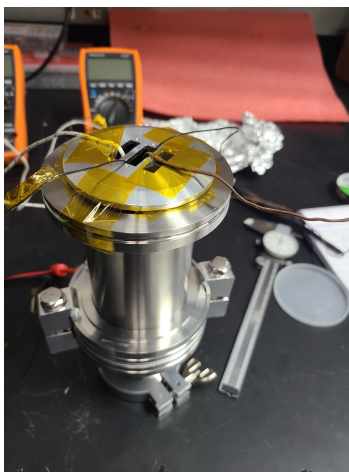
Repeating the experiment again but with the top covered with tape and new mount:

Temps in Celsius	No insulation	0.25in Rubber	0.2in Foam
T1 Heat Cart	26	25	26
T1 Air	26	25	26
4V Attempt	4.001V @ 0.16A	4.002V @0.16A	4V @0.16A
T2 Heat Cart @ 4V	83	79	83
T2 Air @ 4V	30	29	32
8V Attempt	8.02V @0.32A	8.0 @ 0.32A	8.00V @0.32A
T2 Heat Cart @ 8V	188	184	188
T2 Air @ 8V	39	37	48

Setup:

Stuffing the Heater cart into insulation:

4V is applied to the heater cart in two different insulation materials. One is a porous foam material used to pack GM coolers. The other is a more dense packing material found in the heat exchanger motor's box.

The Heater cart is set into its environment, 4V is applied and a time is set for 5 minutes.

No insulation:

- Air Temp = 25 C

- Initial temperature inside foam = 25C

- 3.998V @ 0.16mA Temperature = 55C

Porous insulation:

- Air Temp = 25 C

- Initial temperature inside foam = 26C

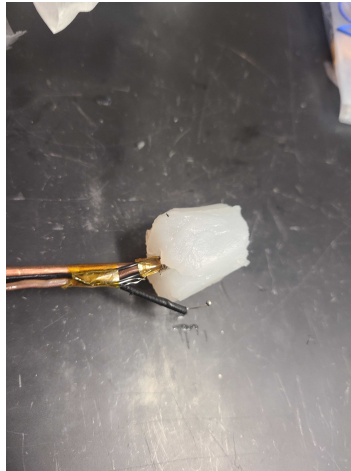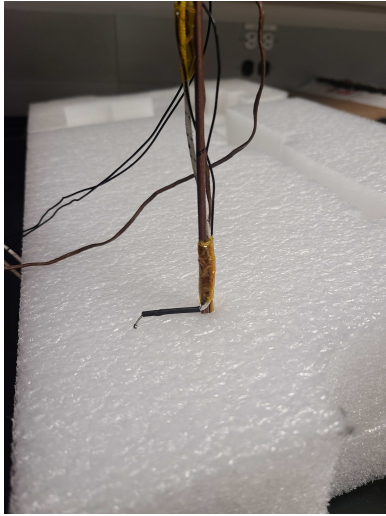- 4V @ 0.16mA Temperature = 75C

Non-Porous insulation:

- Air Temp = 25 C

- Initial temperature inside foam = 26C

- 4.01V @ 0.16mA Temperature = 81C

RTV 108 (.0005 cal/sec/cm2, °C/cm = 0.2092 W/mK I used online calc)

- Air Temp = 25C

- Initial Temp = 25C

- 4.01V @ 0.16mA Temperature = 55C

  - Pushed thermocouple deeper into RTV = 65

Setup:

Conclusion:

- Smaller Chamber: No obvious improvement unless by foam (lowest thermal conductivity)

  - Downside: Potentially could be getting cooled from convection currents inside the chamber.

    - How to improve:

      - Lower air pressure

      - Reduce volume available in its vertical position.

        - Proof of concept is done by sticking heater cartridge into foam

- Cart inside Foam: Observable improvement in max temperature when same power is applied when insulated.