

Molten Aluminum Energy Storage with Supercritical Heat Transfer Fluid

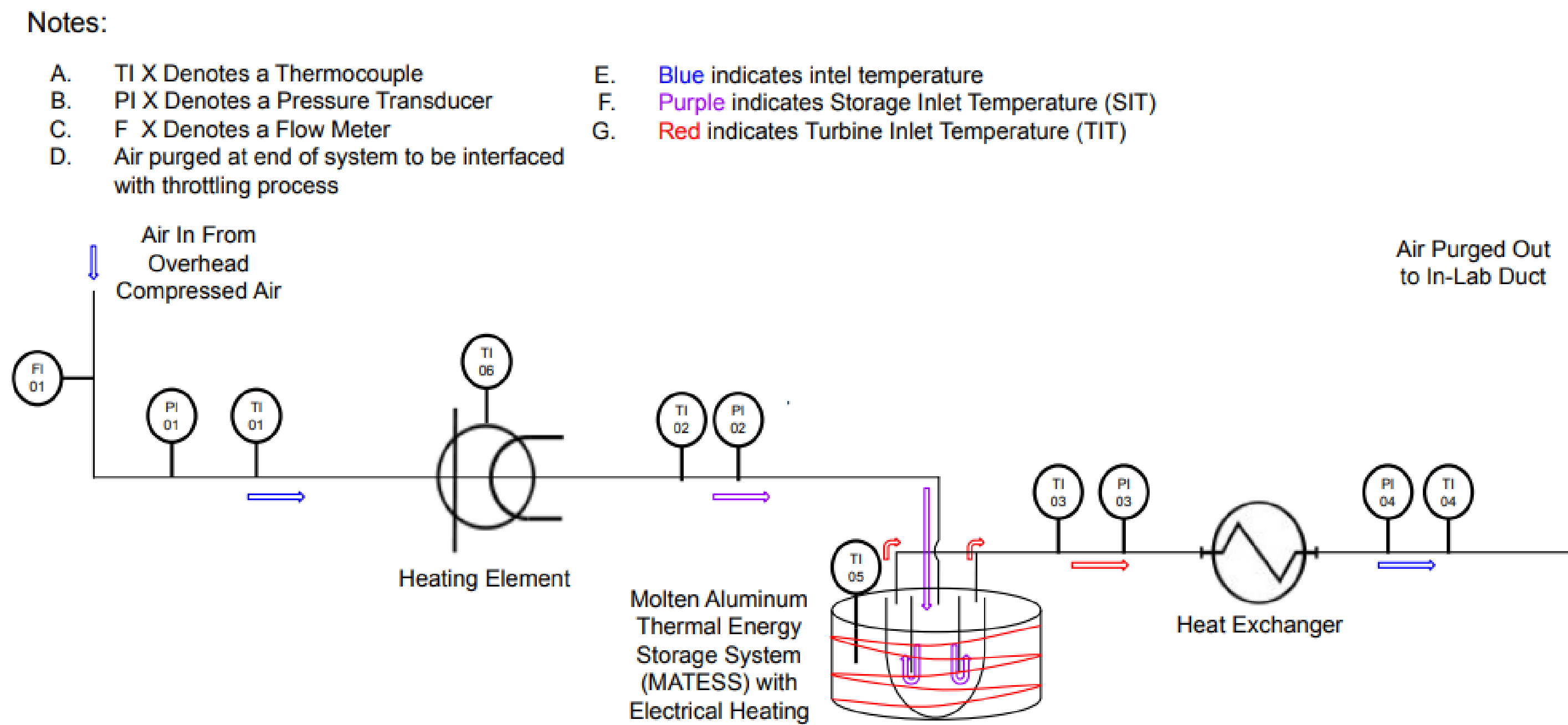
Project Overview

The US Department of Energy is invested in supercritical CO₂-based thermodynamic cycles, often paired with solar heat. Consequently, implementing a storage system is crucial for the off-peak operation of such a cycle. The SDSU Combustion and Solar Energy Lab possesses substantial numerical modeling of the high-temperature, latent storage using molten aluminum silicide. However, experimental validation is pending. This system is vital for verifying calculations and material suitability in challenging conditions.

Objective

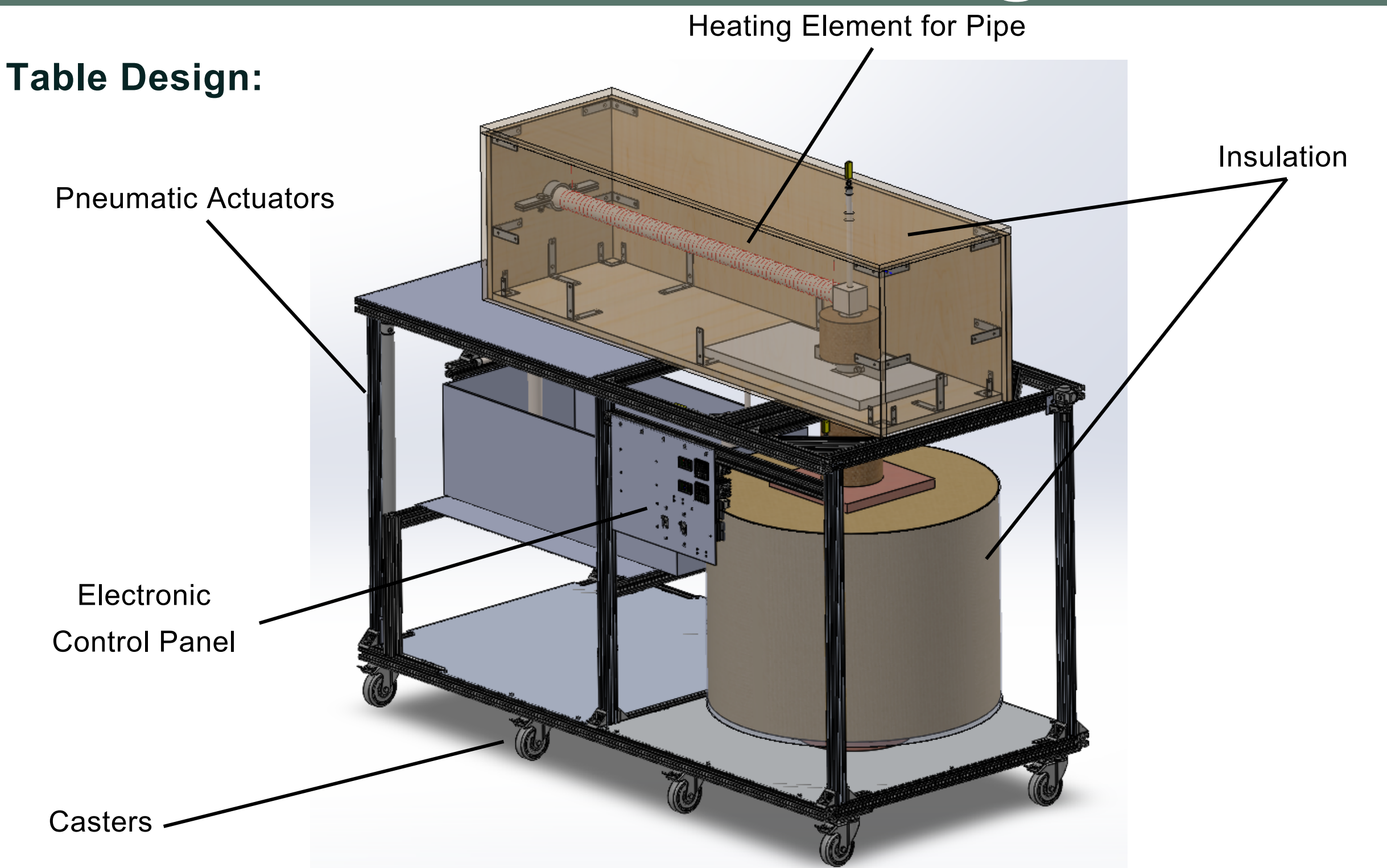
Design and construct an open thermal system with considerations to future development of a supercritical carbon dioxide loop. This system shall mimic the discharge cycle where the working fluid is heated to the modeled thermal storage inlet temperature. Heat from the phase change material is to raise the temperature to the desired turbine inlet temperature of the perviously explored Brayton Cycle. The fluid temperature is then to be safely lowered to be purged out of an in-lab duct.

Flow System Diagram

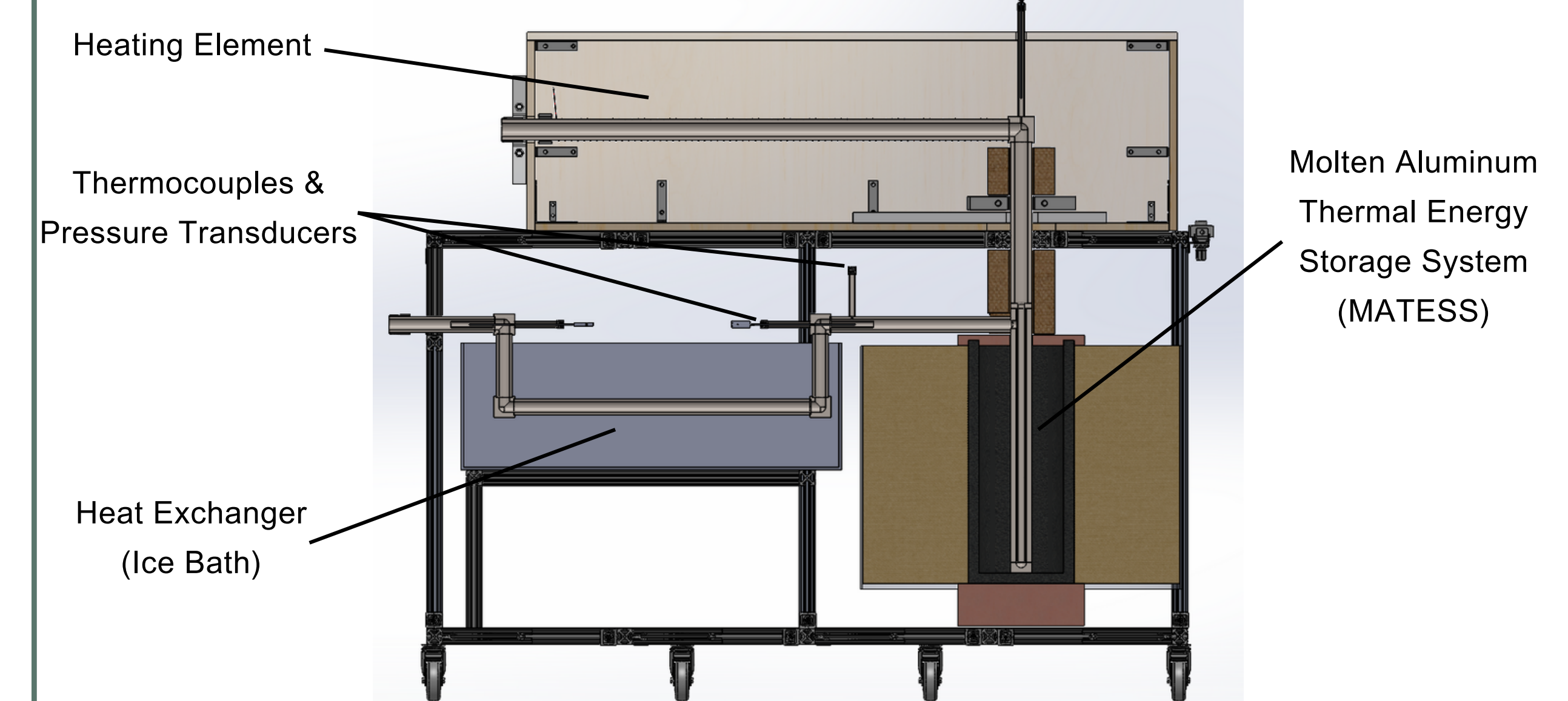


About the Design

Table Design:

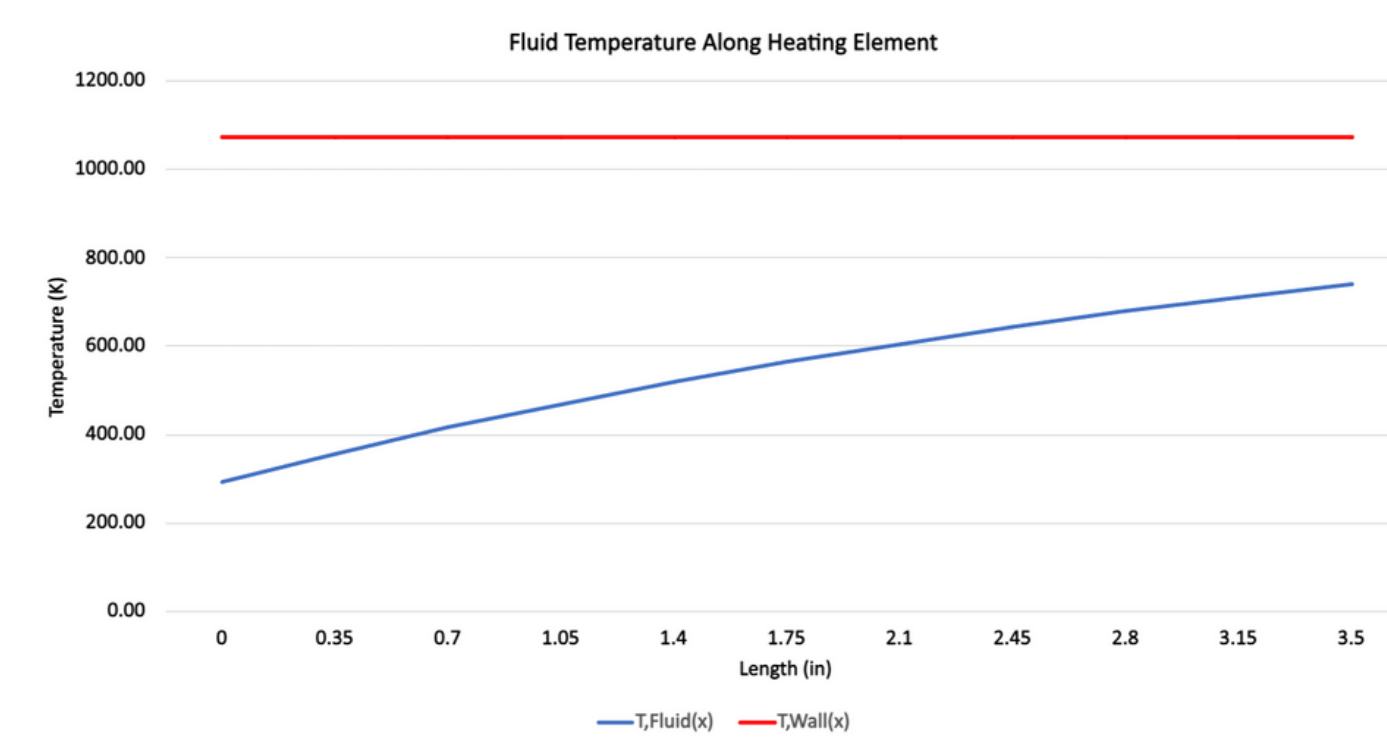


System Design:

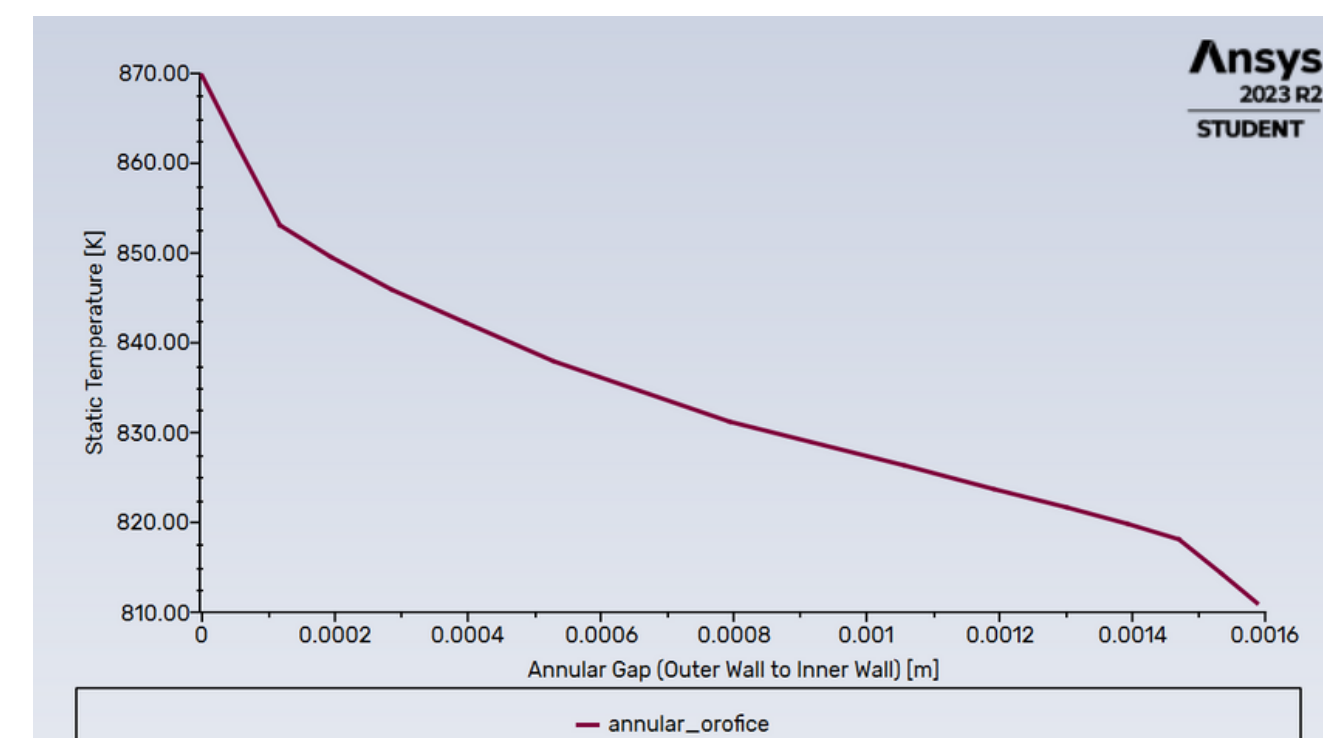


Analysis

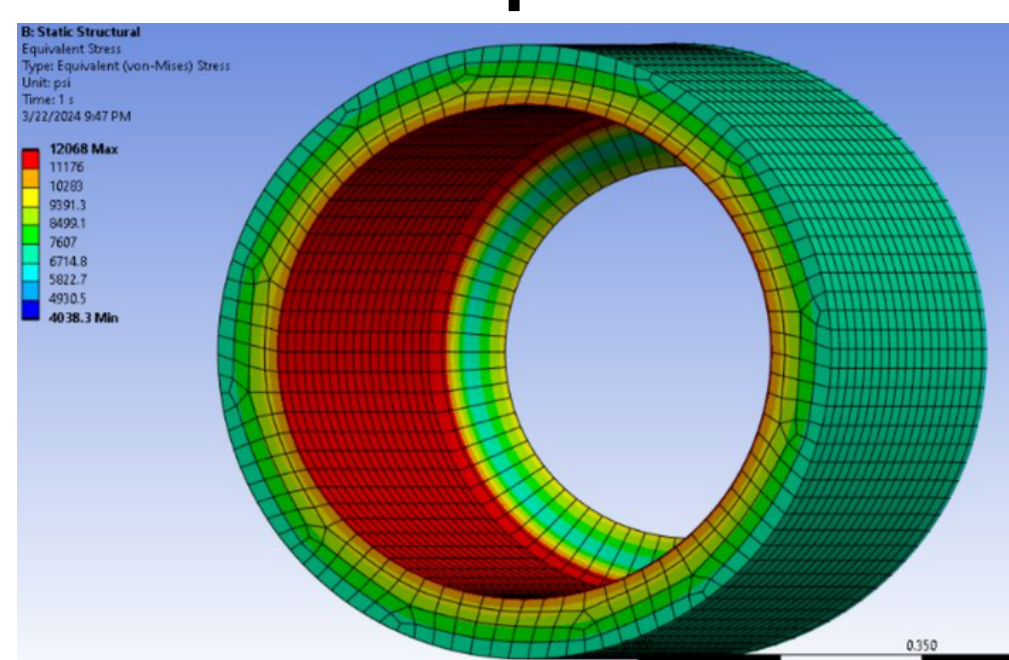
Temperature Along Heating Element



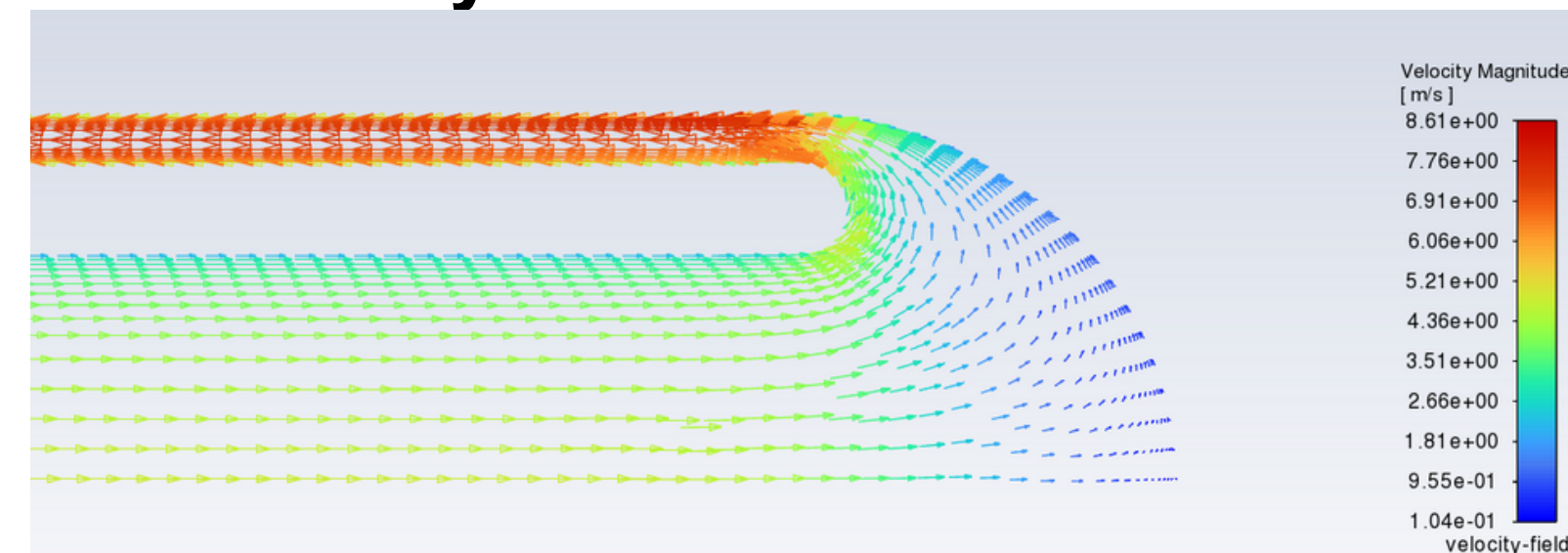
Temperature Along Annular Outlet



Stanoff Pipe Stress



Velocity Vector Field in Borehole

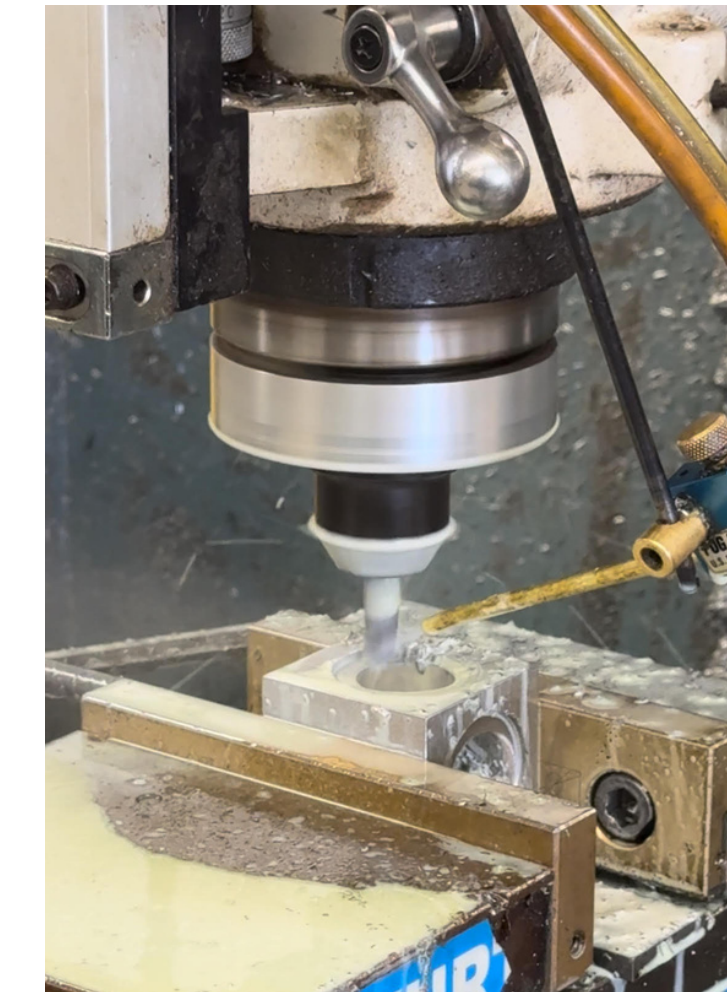


Manufacturing

Turnaround Point in the Borehole



Elbow Machining



Pneumatic Mount



Insulation Box



Team Members



Jorge R. Balvaneda
Team Lead



Brandon M. Wells
Test & Evaluation Lead



Jason Nguyen
Manufacturing Lead

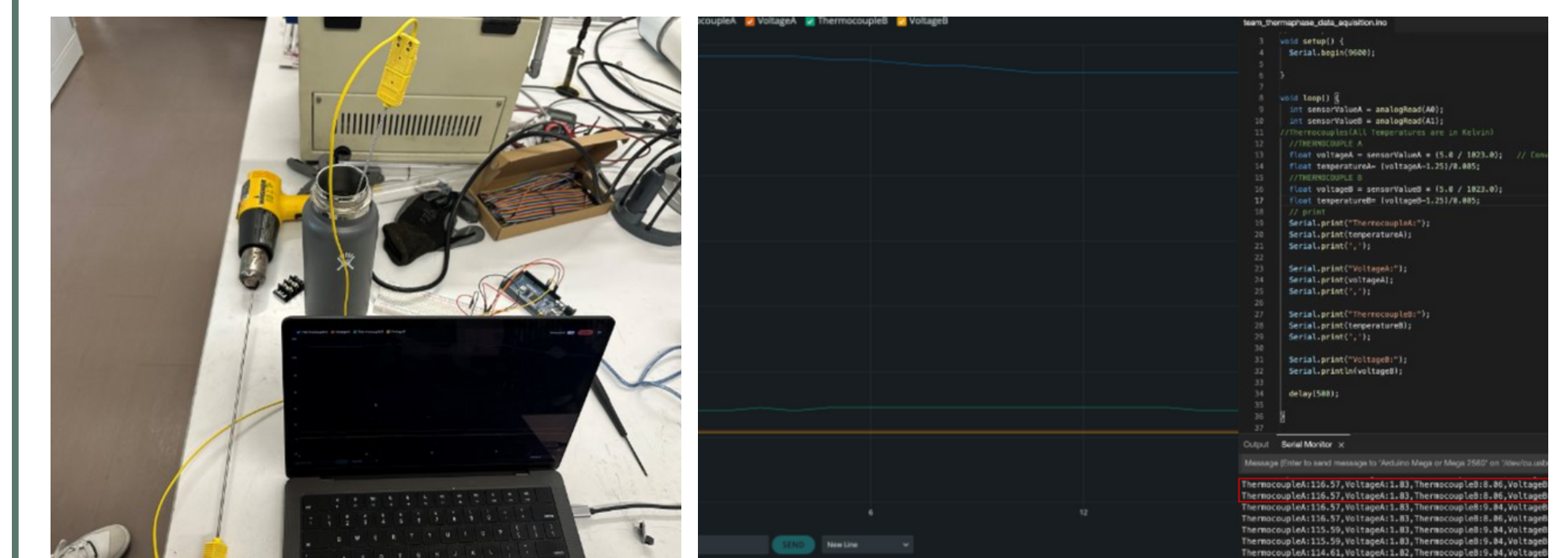


Aden F. Hussein
Structures

Acknowledgements

Team Thermaphase would like to express our gratitude to Dr. Shaffar, Dr. Miller, Mike Lester, Paul Ahlers, and the Combustion and Solar Energy Laboratory for their continual guidance and support throughout all elements of this project. We would also like to thank the Studen Success Fee (SSF) and their staff for their financial and logistical support.

Testing



Thermocouple Calibration

Boron Nitride Coat

