

A Tribometer in Space-like Conditions

Team 501: Branham Channell, Javier Ibanez,
Cobi Johnson, Madison Retherford, Joshua Wesley

Objective

The objective of this project is to design, develop, and implement a system that enables the **simultaneous testing of multiple samples within a vacuum chamber using a tribometer.**

Final Design

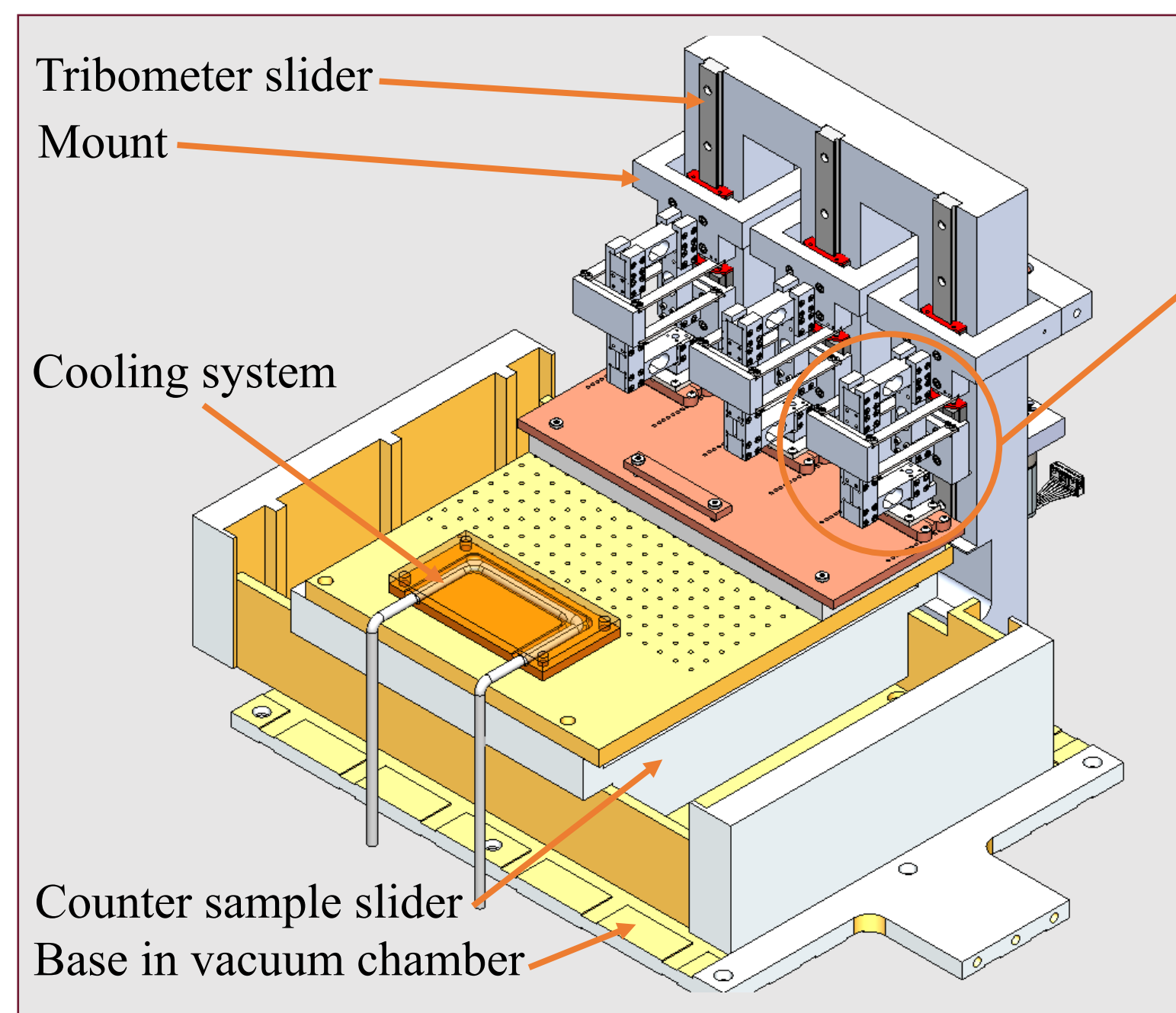


Figure 1. Front view of full tribometer.

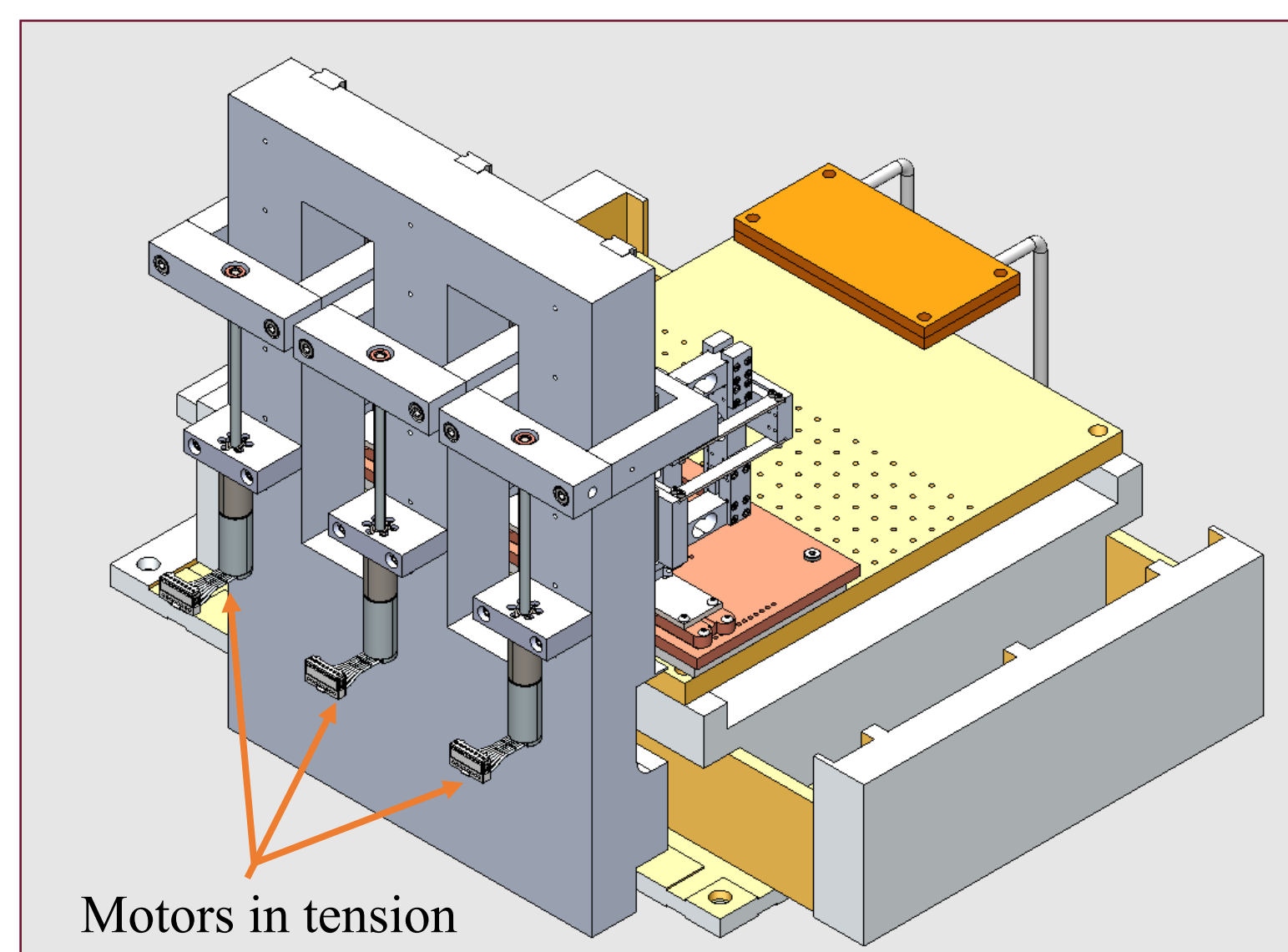


Figure 2. Back view of full tribometer.

Finite Element Analysis

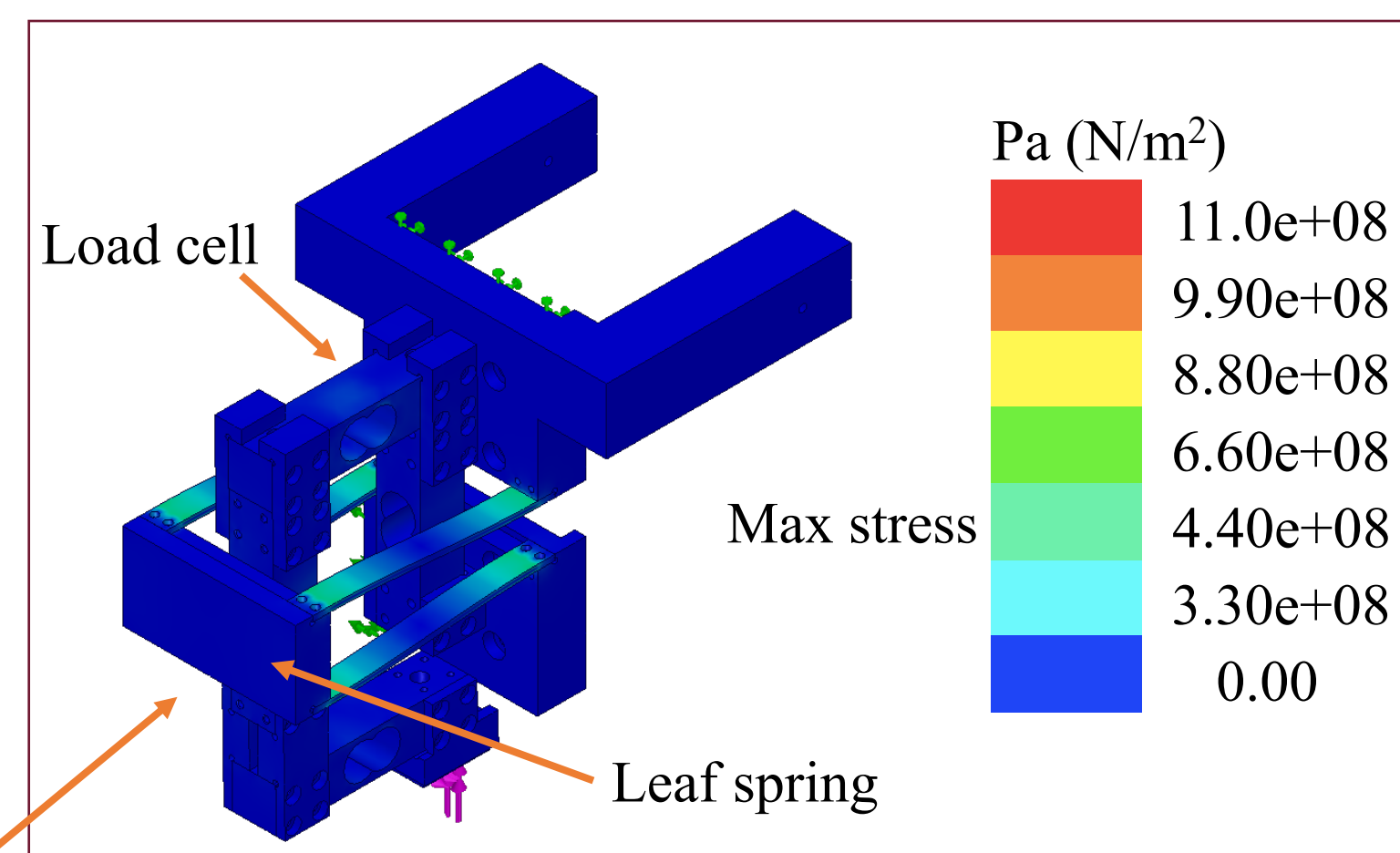


Figure 3. Stress FEA on the load head assembly.

- Force is evenly distributed across the leaf spring to **ensure constant and even contact of sample to counter sample.**
- **Max stress: ~4.40e+08 Pa**
- **Titanium Leaves Yield Strength: ~11e+08 Pa**

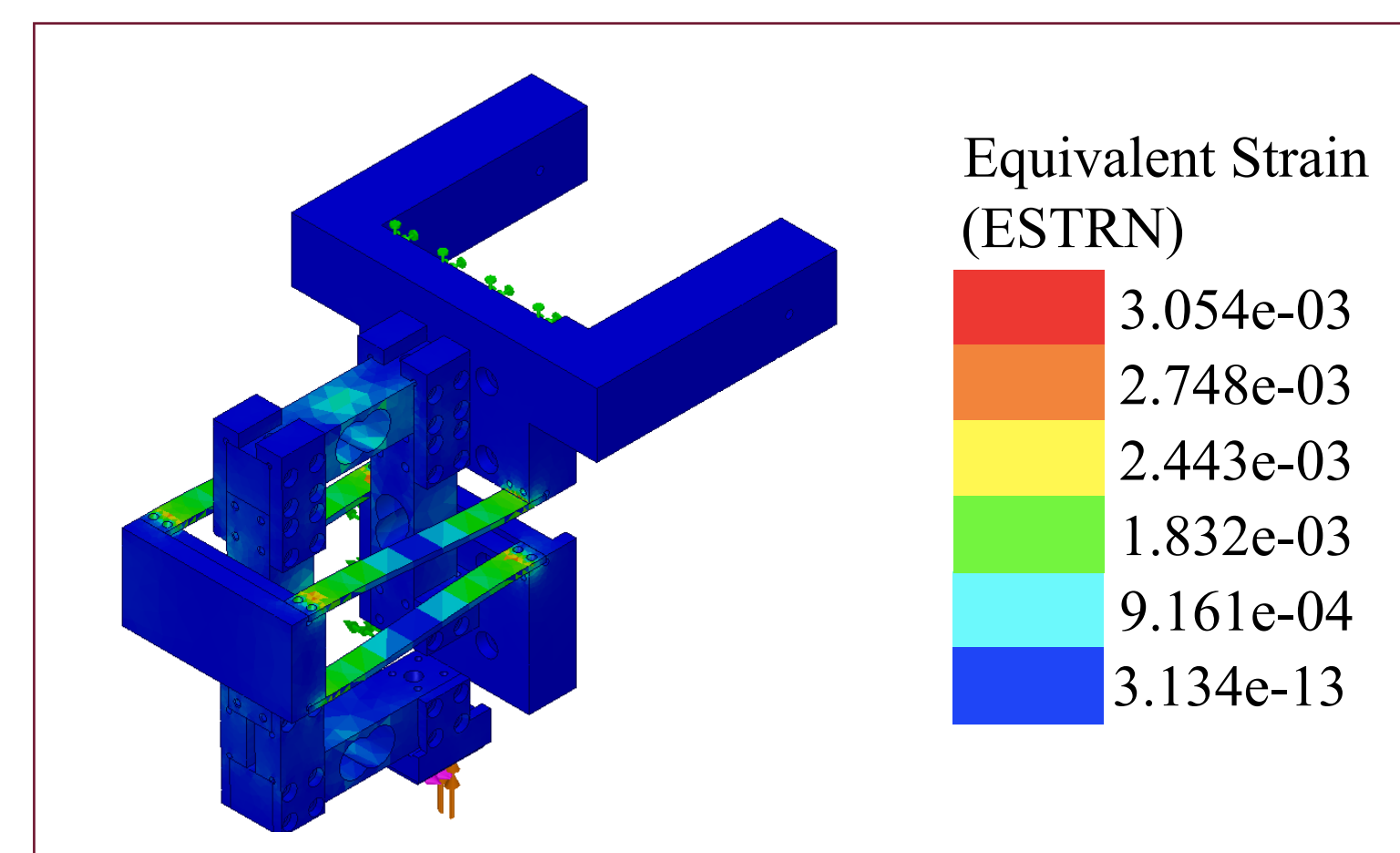


Figure 4. Strain FEA on the load head assembly.

Strain is all in the leaf spring and load cells.

Thermal Assembly

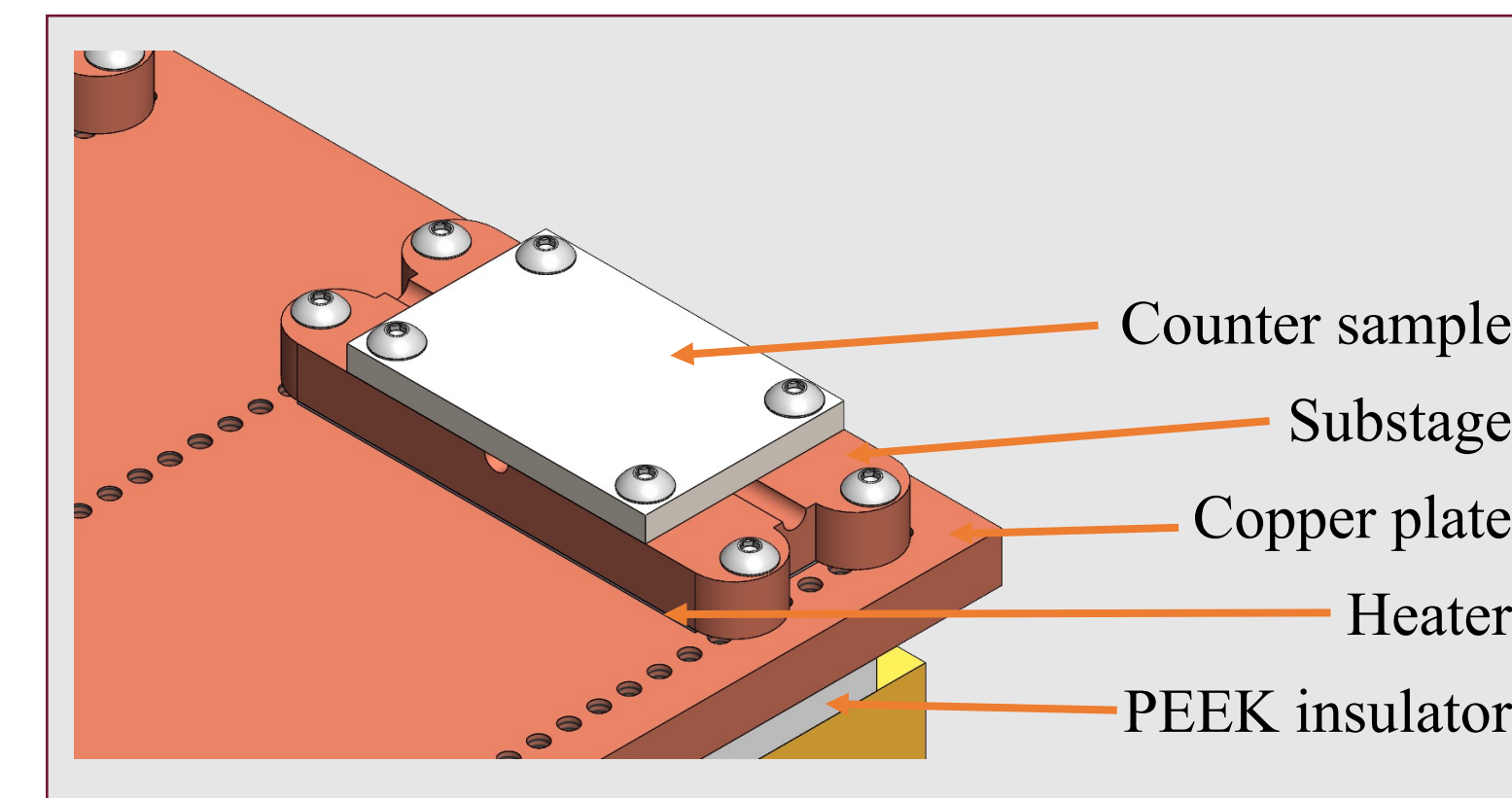


Figure 5. Close look at the counter sample and thermal assembly.

Heat required to take material from -196C to 200C in 30 minutes:

- Copper substage = 6.28 Watts
- Aluminum counter sample = 1.95 Watts

Maximum heater output is 88 Watts so,

$$Q_{heater} > Q_{copper} + Q_{aluminum}$$

Load Head Test

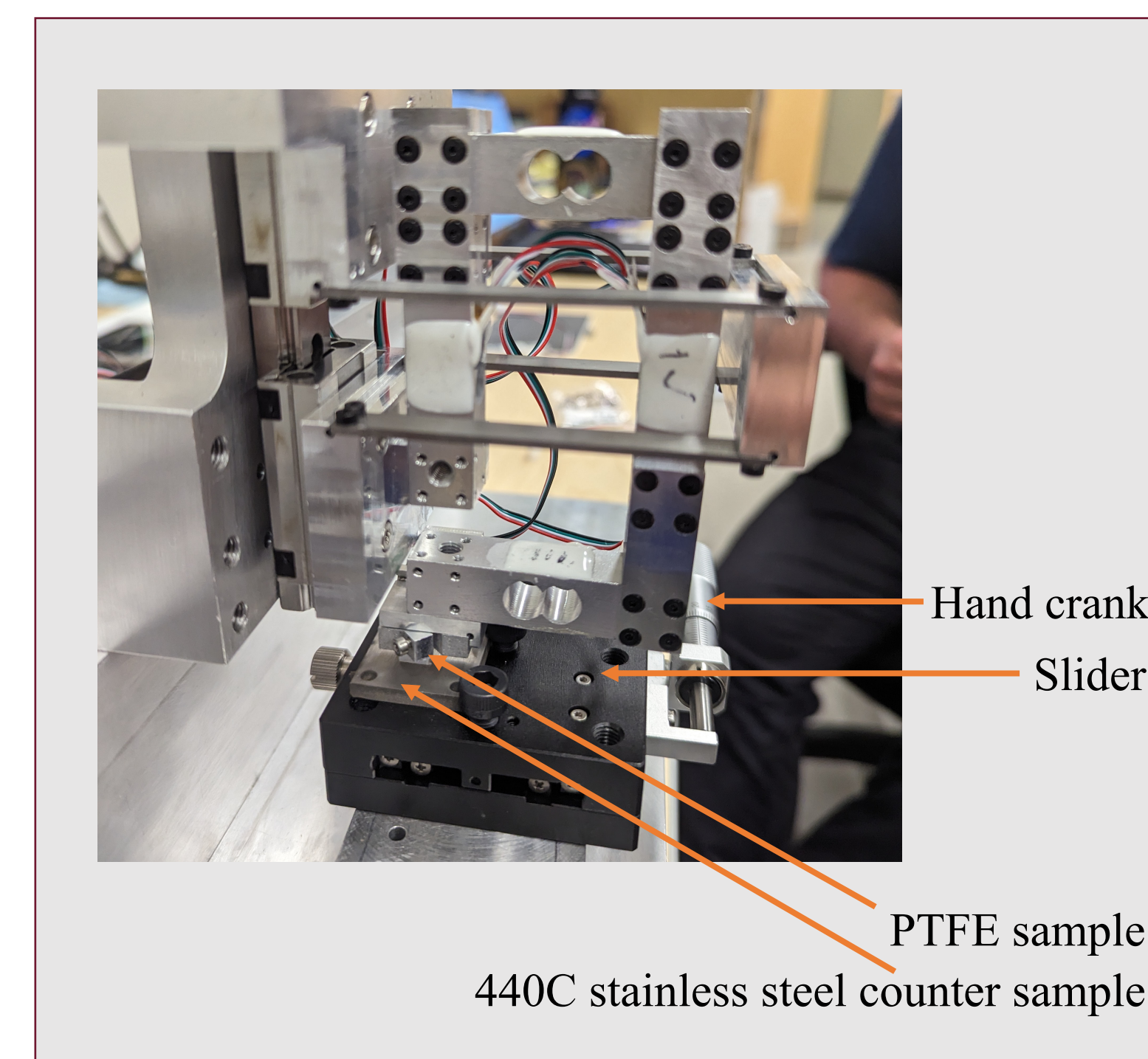


Figure 6. Experimental setup for coefficient of friction test using barbell plates and a hand crank counter sample slider.

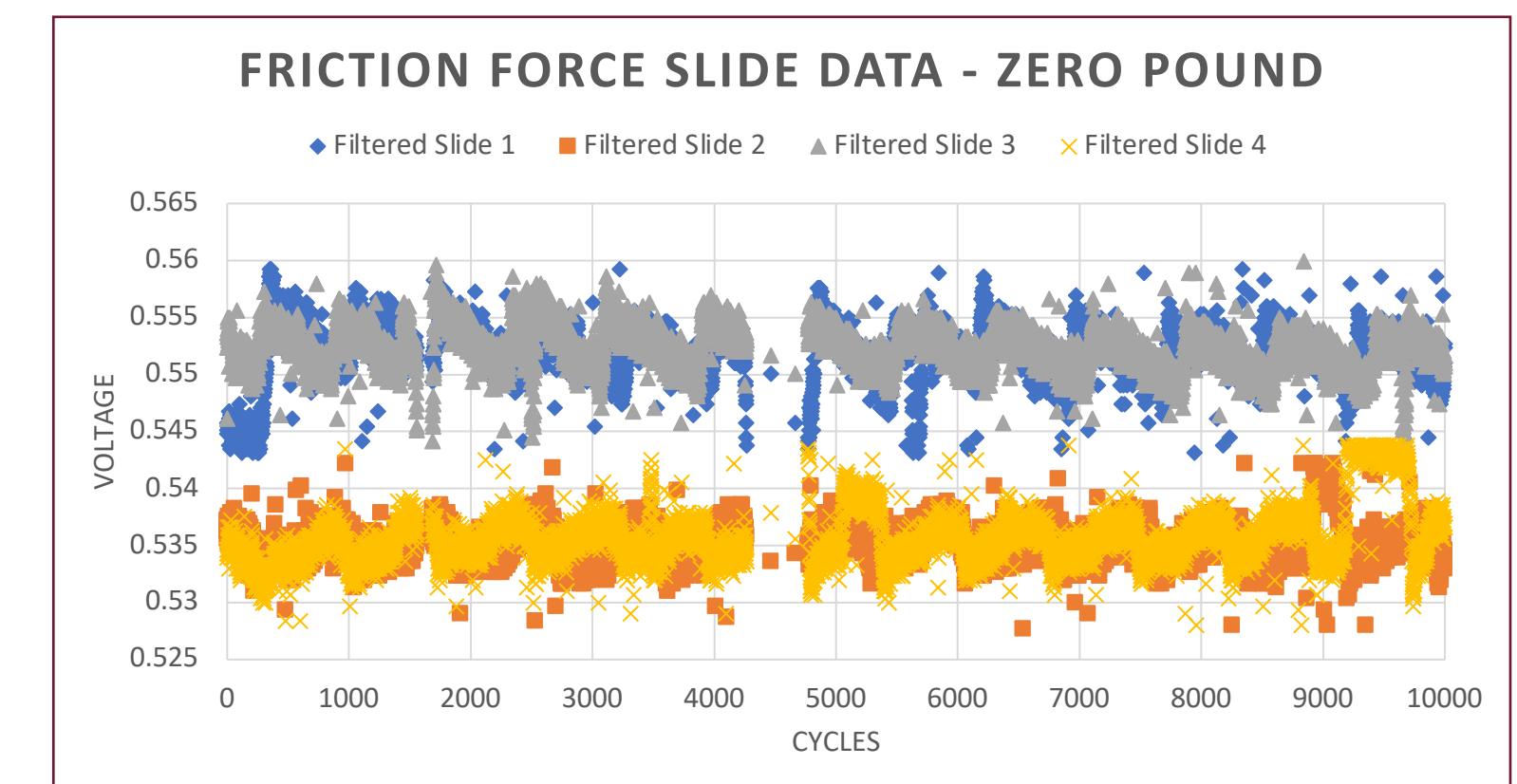


Figure 7. Data from the friction force load cell. Waves from the start and stop of the hand crank slide. Repeated trials for five-, ten-, and fifteen-pound weights.

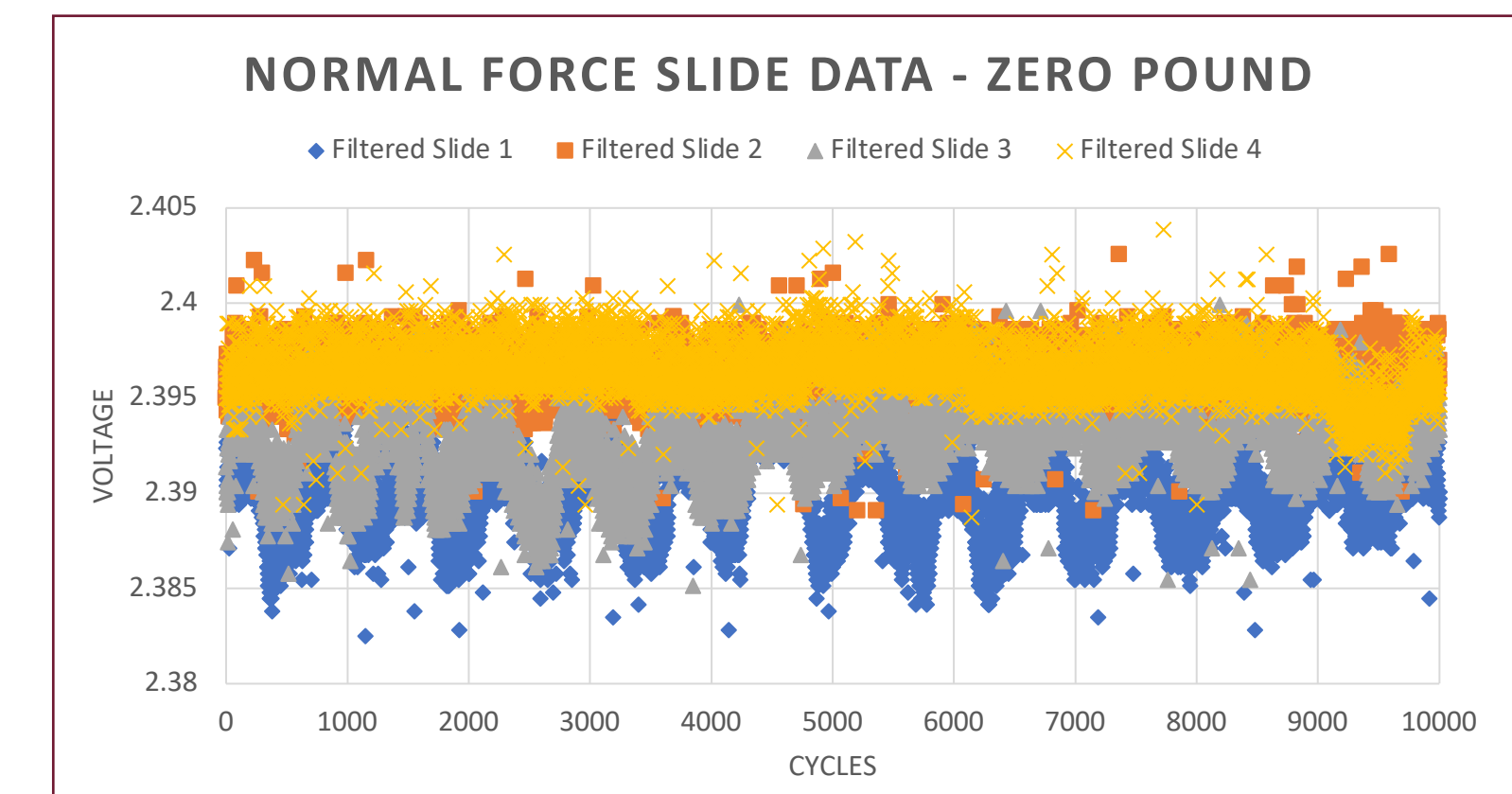


Figure 8. Data from the normal force load cell. Repeated trials for five-, ten-, and fifteen-pound weights.

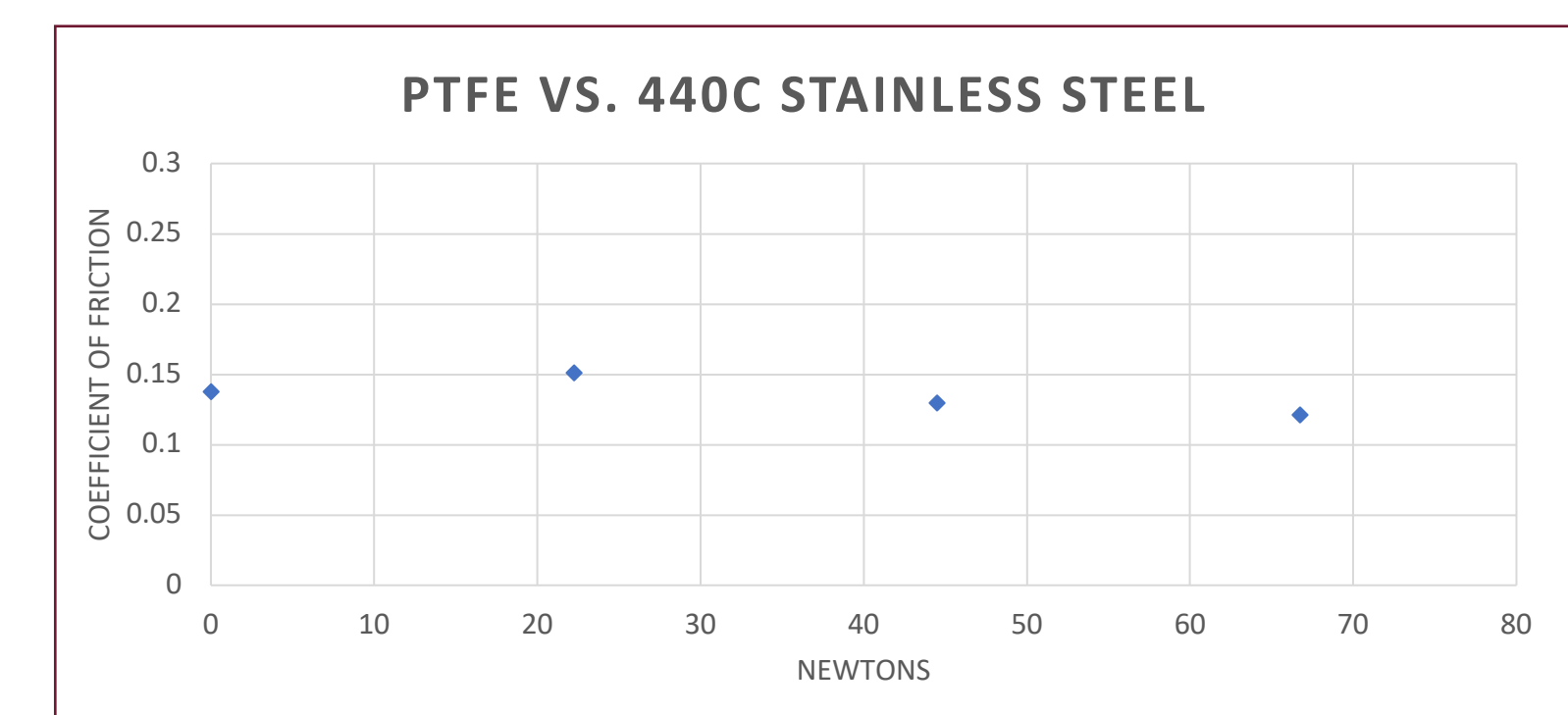


Figure 9. Plot of the coefficient of friction from the friction and normal force data. After averaging these results, we found a coefficient of 0.134.

Future Work

- Assemble full tribometer.
- Integrate the new motor controller functionality with MATLAB.
- Test critical loads with motors moving the sliders.