Thermal Interface materials Characterization In Vacuum Environment.

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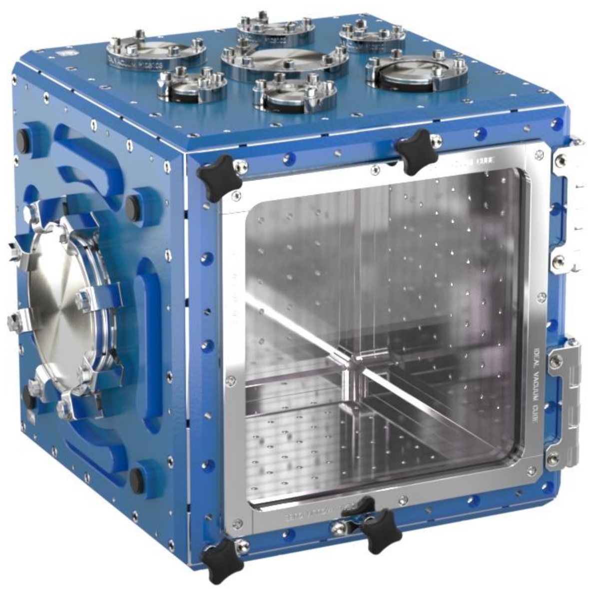
INTRODUCTION

- TIMs aid in the transfer of heat between surfaces in contact and minimize the thermal resistance across the interface.
- LCLS operates high-power X-rays, some of which are contact-cooled via cooling plates pressed against the substrate.
- Vendors give conductance values that are only measured in air and since most of the testing is done in a vacuum environment, there is a need for the conductance value to be measured in vacuum.

RELEVANCE

- Explore and use the best TIM models existent in the industry.
- Use reliable thermal conductance data for our thermal performance estimates, measured at the same environment conditions that LCLS operates.
- Have greater and quicker success in our device's safety reviews.
- Have machine ready for challenging new TIM models as the industry develops them.

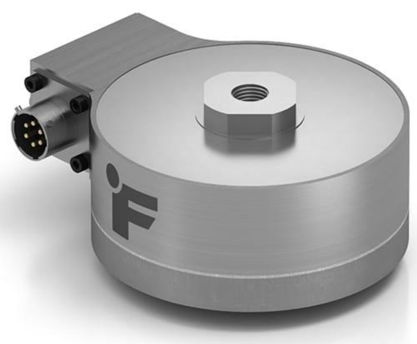
MAIN COMPONENTS



12x12x12 Vacuum chamber

Button Heater

Cooling plate



1000 lb Load Cell

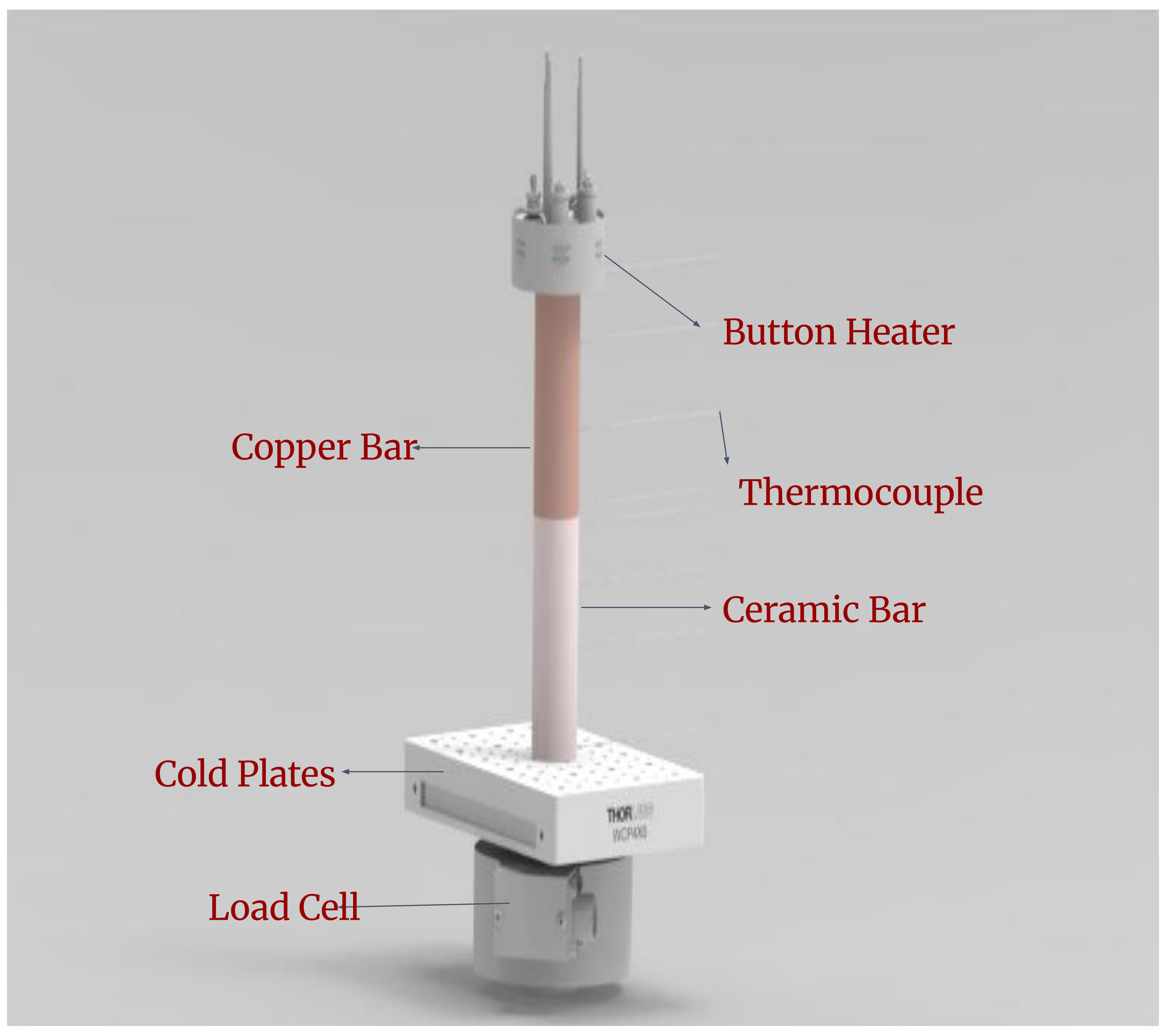


FIG.1 Conceptual CAD model of test stack.

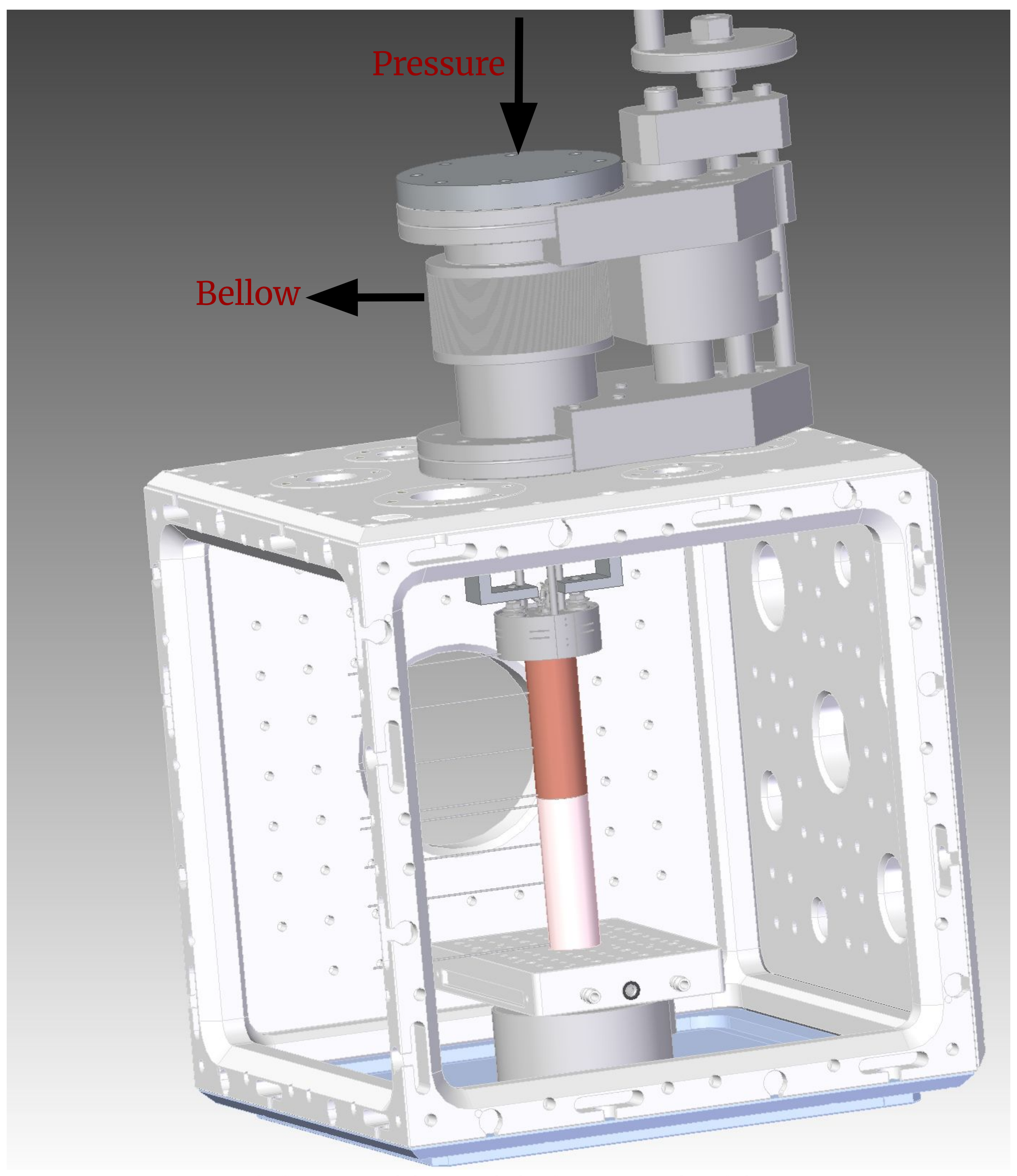
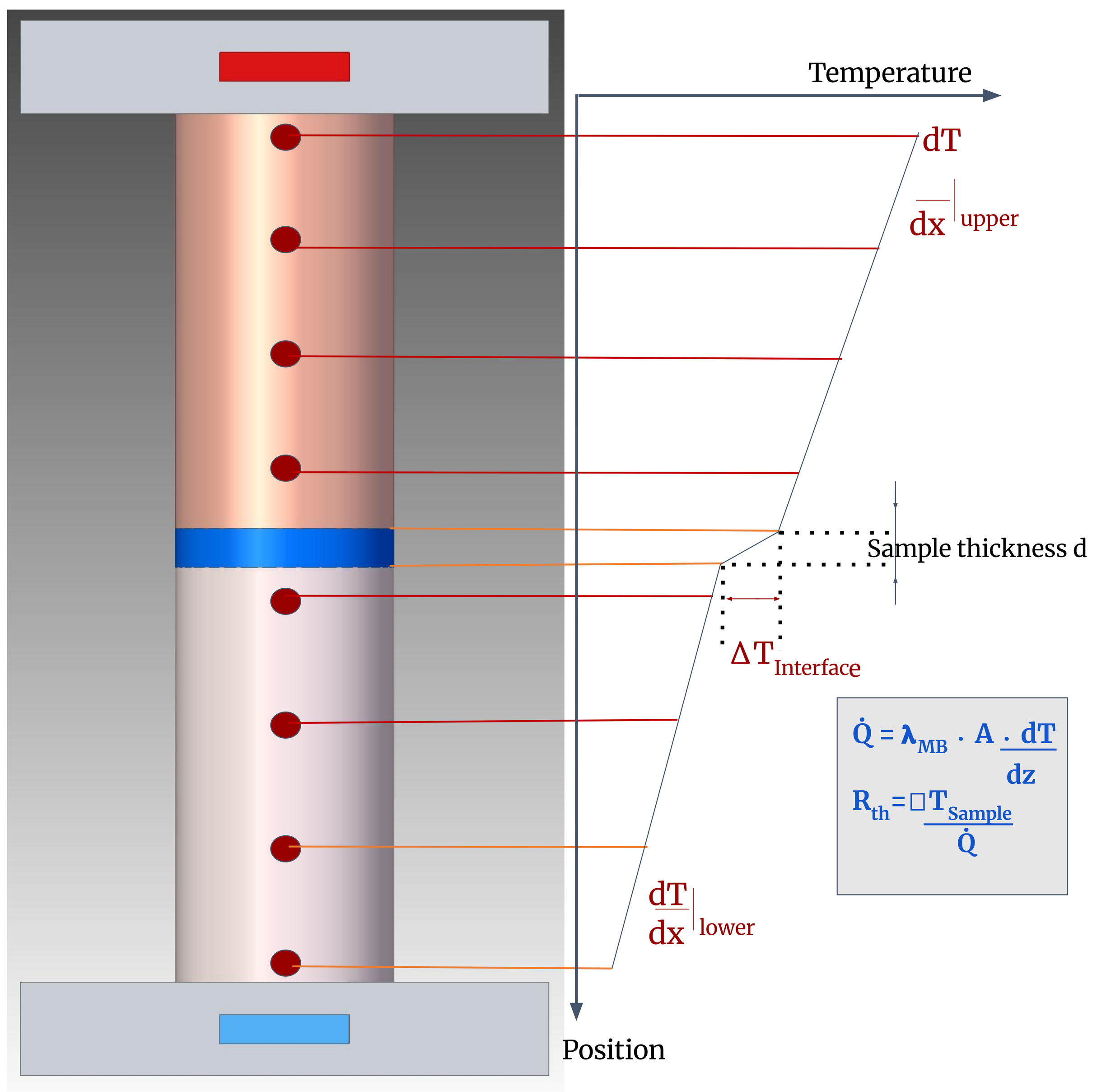


FIG.2 Assembly model of test stack with vacuum.



OBJECTIVES

- Design a test system compliant with ASTM D5470.
- Develop preliminary design of test stack geometry + vacuum integration.
- Identify key components: vacuum chamber, load. application, heating/cooling instrumentation, feedthroughs.
- Establish procurement plan (including custom parts).

EXPERIMENTAL METHOD

a. Two meter bars are in contact inside a vacuum chamber.
b. One-dimensional static heat flow is established.
c. Each bar has 4 thermocouples: one 1.5 mm away from the contact surface, remaining 3 inserted at 5 mm intervals along the bar axis.
d. The sample foil (indium foil) placed at the contact between bars.
e. Pressure in the vacuum is measured by a gauge.
f. Contact (clamping) pressure applied and measured via load cell.

FUTURE DEVELOPMENTS

- Detailing the design i.e Fasteners, water fittings, flange, O-rings.
- Identify the Thermal Interface material foil needed; brand, model.
- Characterise the meter bars: thermal conductivity of the Cu & Si materials, Roughness and Flatness characterisation of the contact surfaces.

Qty	Vendor	Component Description	Cost (USD)
	Chamber& Structure		
1	Ideal Vacuum	12 x 12x 12 Cubic Modular Vacuum Chamber	$9,105.92
1	Ideal Vacuum	Edwards 3 RV3 Vacuum Pump (1.5 X 10-3 Torr)	$2,844.45
1		Ceramic Bar	$2,000.00
1		Copper Bar	$700.00
1	Ultra High Vacuum Design	HLSML Series Linear actuator/Bellow	$9,797.00
8	Ideal Vacuum	Electrical Thermocouples	$545.04
	Sensing & Power		
1	Futek	LCF400 , 1000 lb , Tension & Compression Load Cell+ Pin to cable assembly	$4,423.00
1	Thermic Edge	VB-1-0800-KA-O2 1" Button Heater	$8,335.00
	Fixturing		
1	Ideal Vacuum	IVP Liquid Feedthrough, Swagelok Connectors, KF-40 Flange	$578.25
2	Ideal Vacuum	K-Type Thermocouple feedthrough	$2,301.54
1	Sager Electronics Advanced thermal Electronics.	152x127x15mm Tube 4 pass Liquid Cold Plates	$230.20
	Total		$40,860.40

REFERENCES

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