

OVERVIEW

Thermal blankets provide thermal, acoustic, and fluid protection to the nacelle structure from its engines.

Collins Aerospace is interested in the development of a lighter, cheaper, and more effective thermal blanket than current production blankets.

Students were tasked to further investigate the previous cycle's findings to refine the design and feasibility of integrating aerogel into the blankets.

REQUIREMENTS

- Thickness ≤ 0.50 "
- Weight ≤ 0.50 lbf/ft²
- Formable to a double curvature shape
- Protect Inner Fixed Structure (IFS) from engine failures and fluid contact
- Keep IFS temperature below 250°F under normal operating temperature
- Withstand vibration testing
- Retaining system to sustain ultimate tensile load of 144 lbf

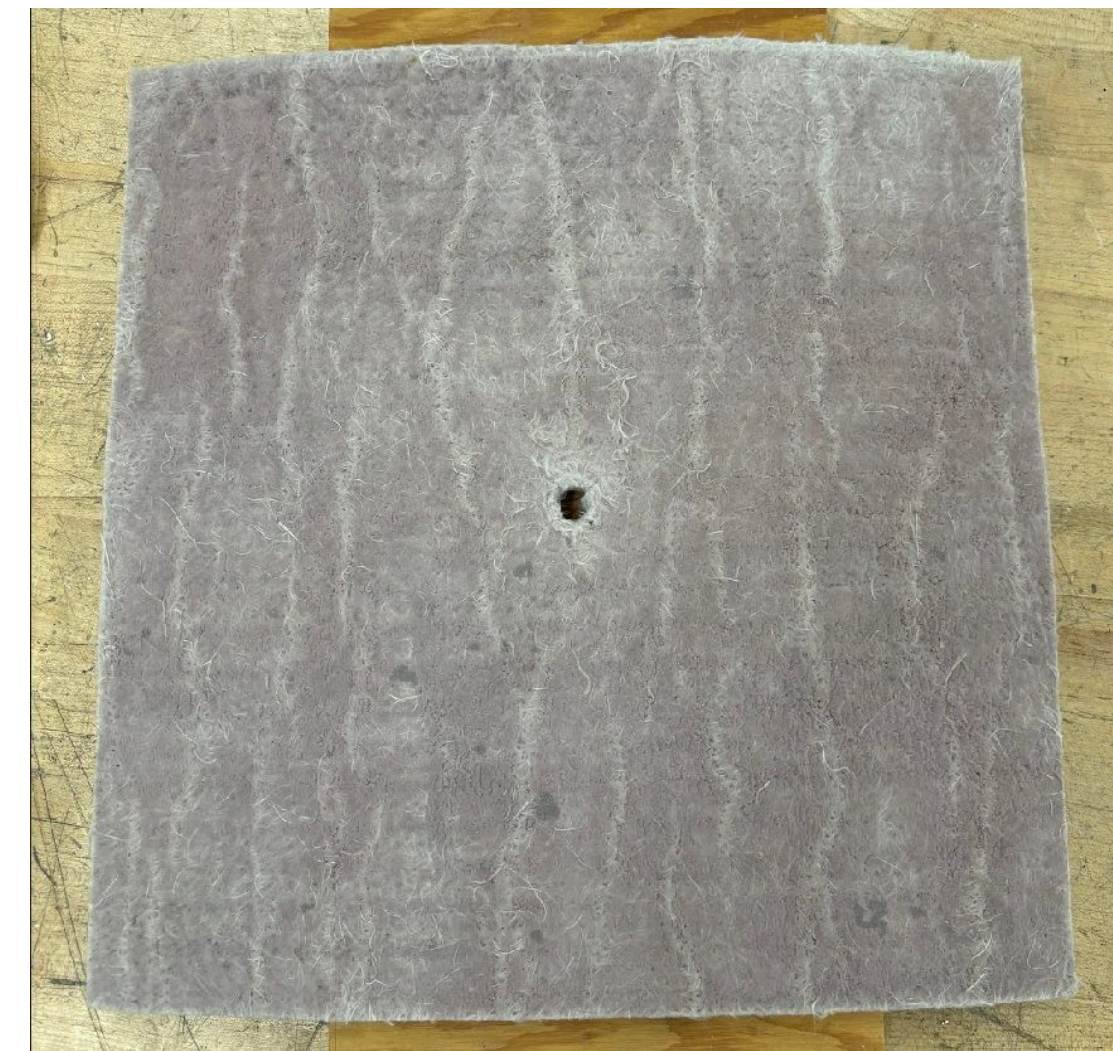
CONCLUSION

Aerogel and thermoplastic fastener performance had been characterized based on the range of testing performed. While the blankets performed as expected, the thermoplastic stud failed earlier than expected when subject to operating temperature conditions.

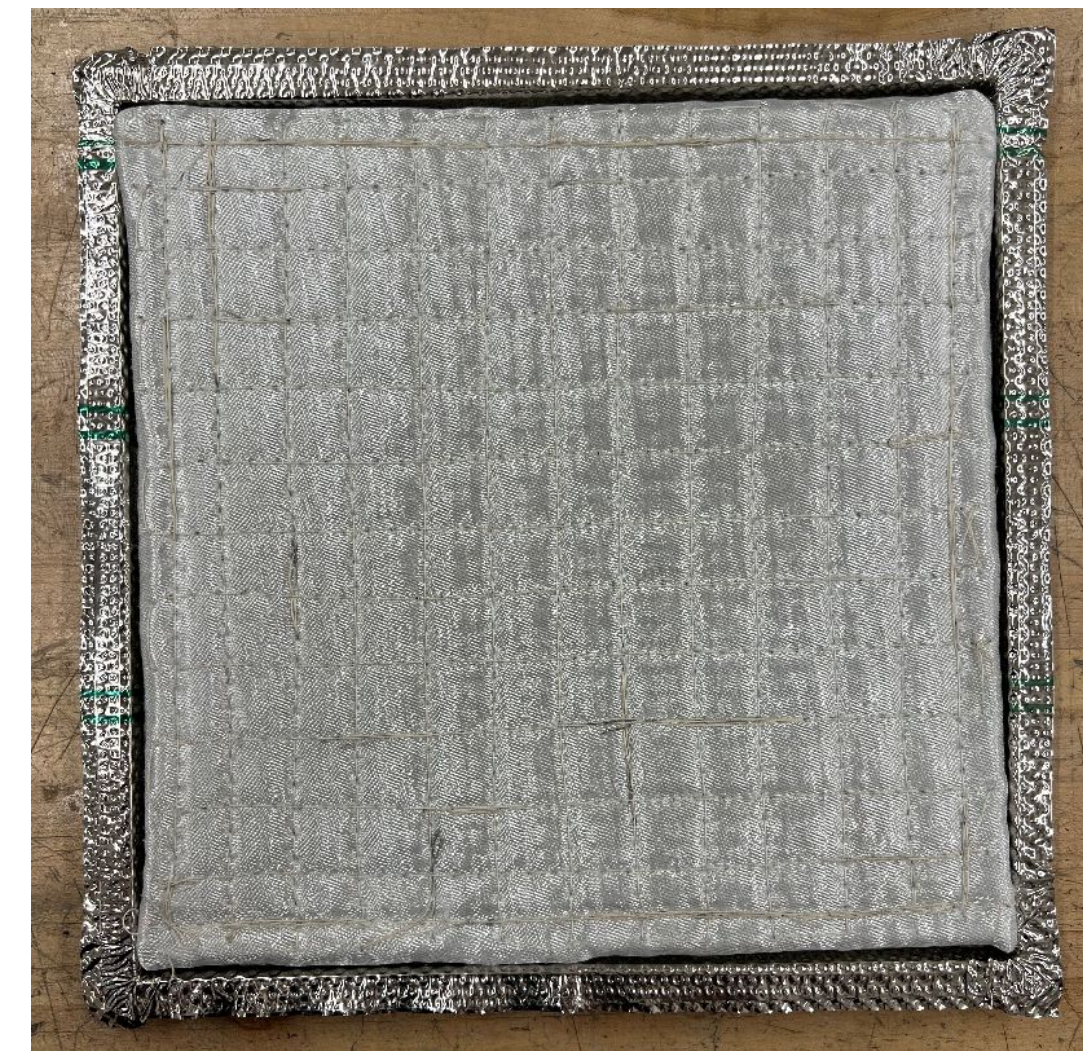
ACKNOWLEDGEMENTS

Our heartfelt thanks to the sponsors, Charlene Hu, Katie Holland, Jayvin Mistry, Bryan Huffman, Kevin Carty, Andrew Panduro, Mike Lester, and Dr. Lehman for their invaluable support in making our senior design project a success.

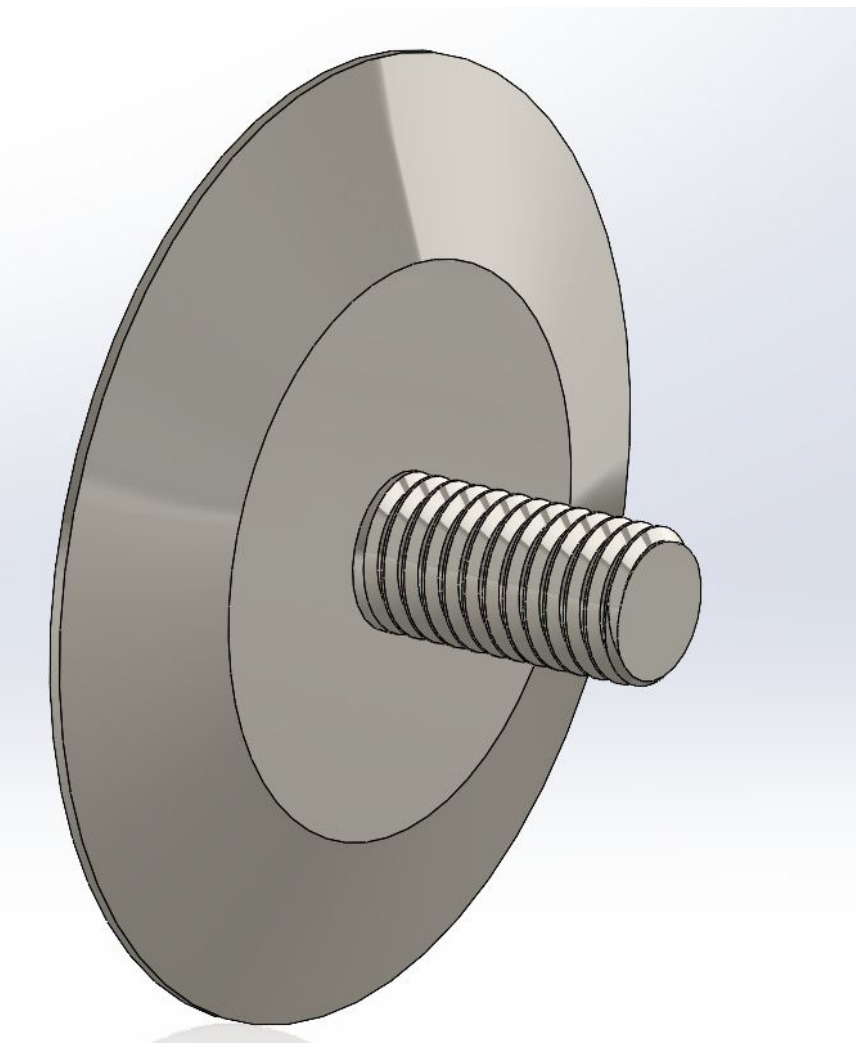
DESIGNS



Unencapsulated Pyrogel



Encapsulated HeetShield



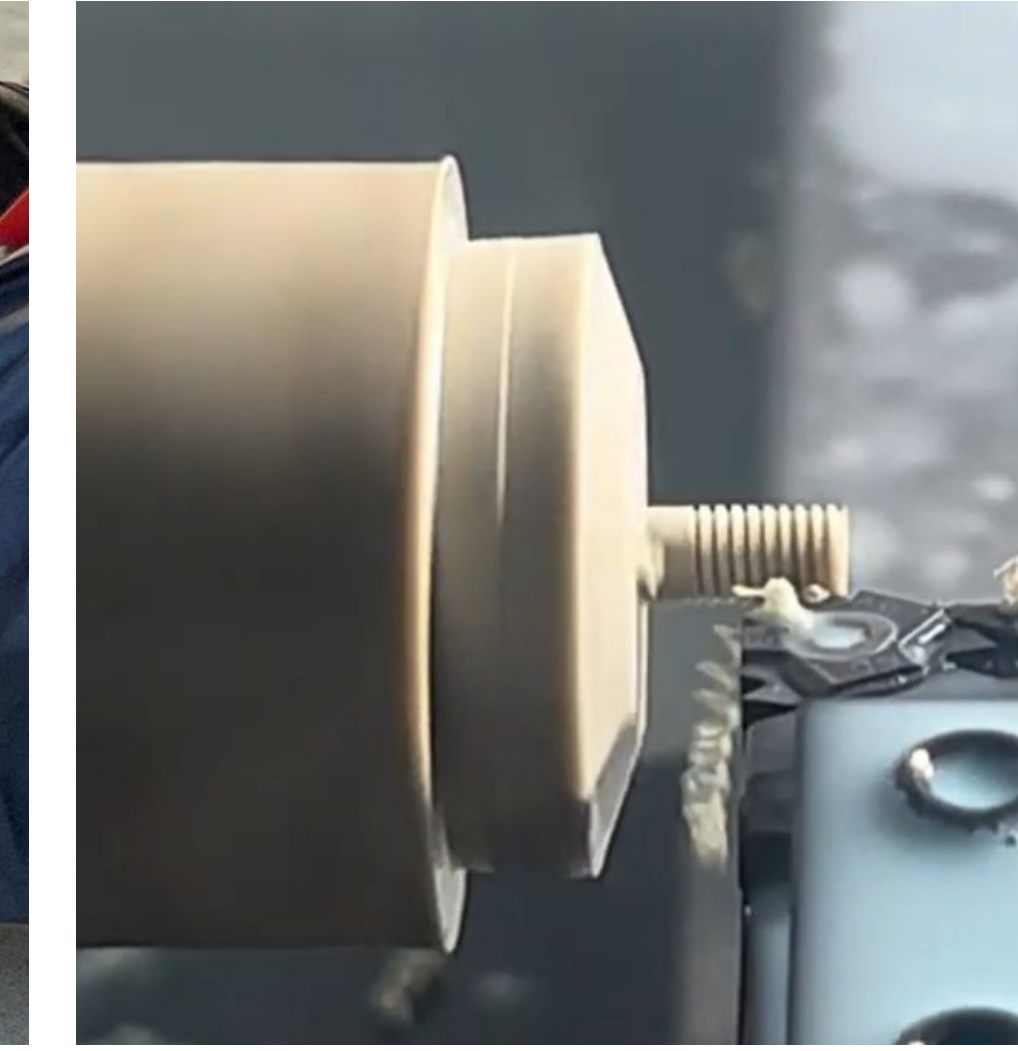
PEEK Thermoplastic Stud



3D Printing



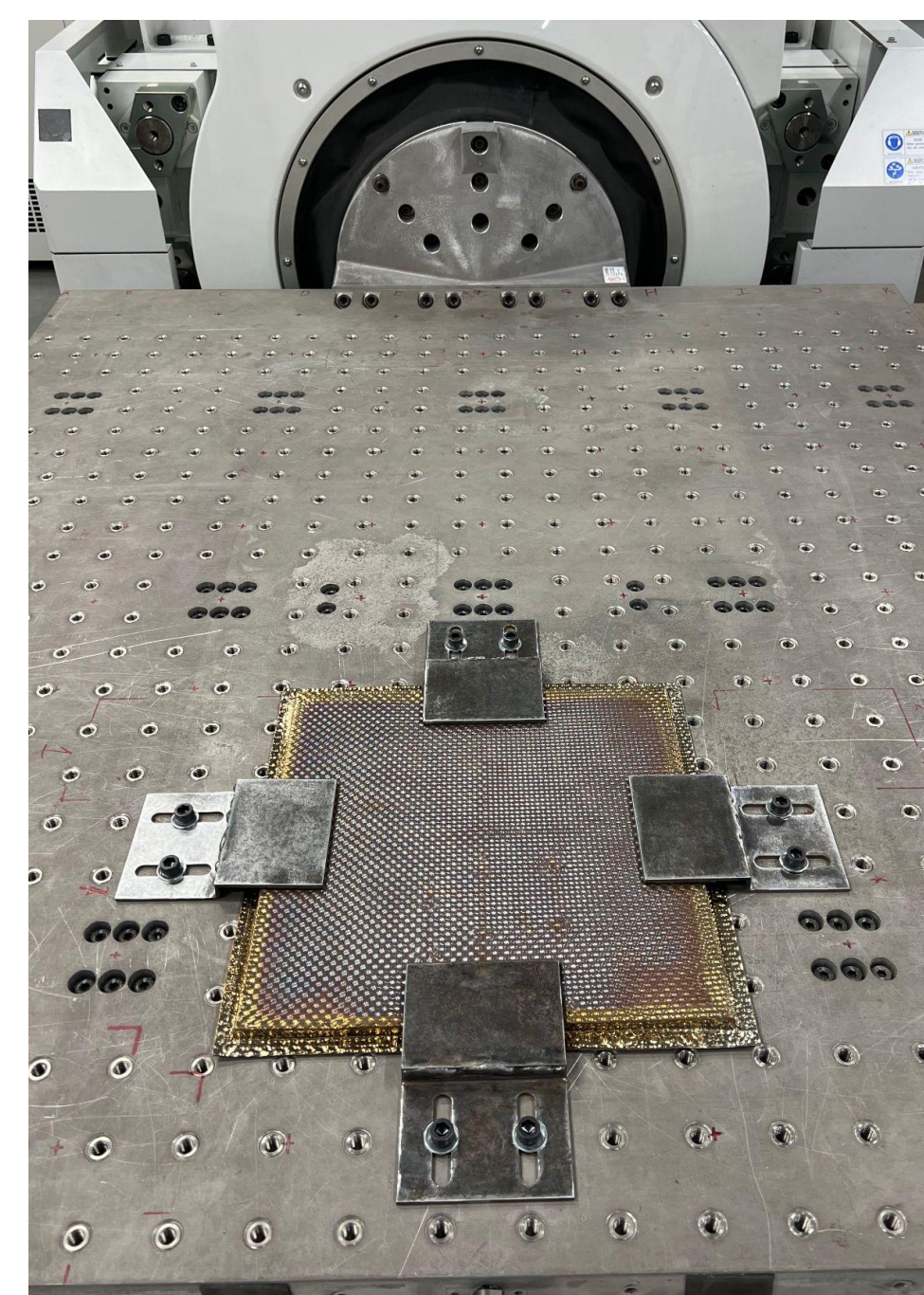
Welding



CNC Lathing

MANUFACTURING TECHNIQUES

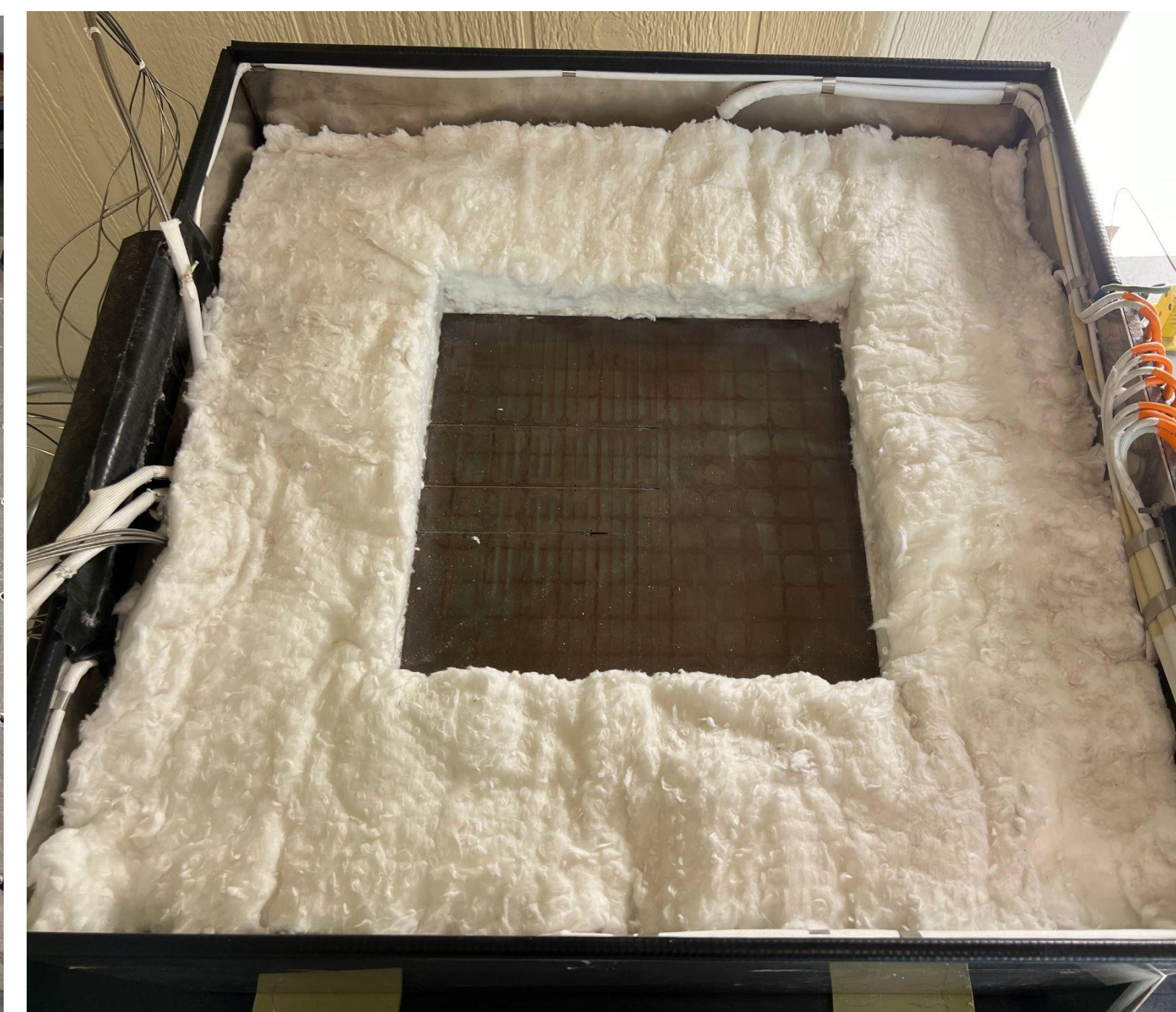
TESTING



DO-160 Vibration Test

→ Random Sinusoidal

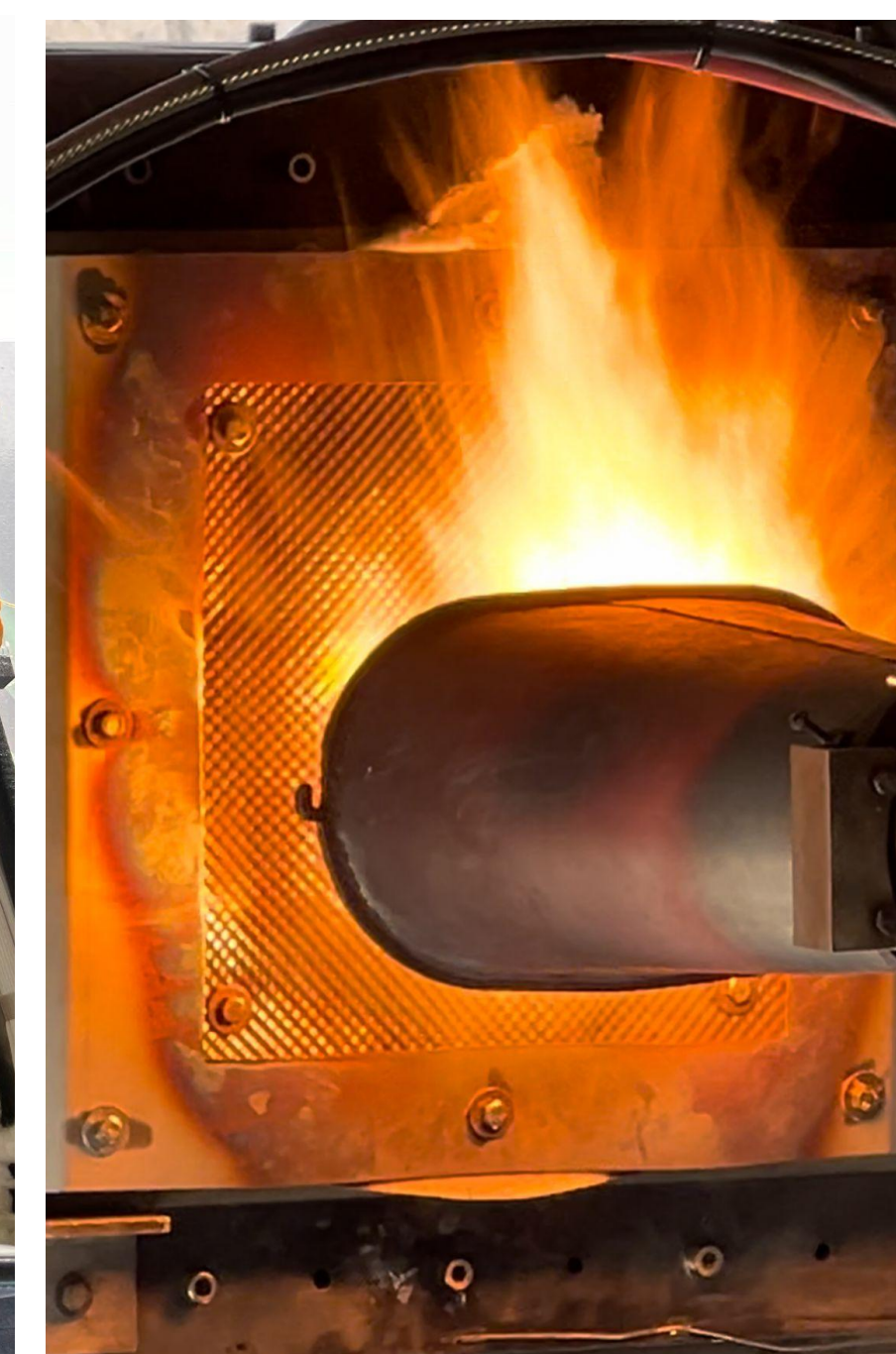
→ 1 hour on X/Y Axis



ASTM C518 Thermal Conductivity Test

→ Setpoints of 200°F to 1200°F

→ Steady state temperature readings



FAA AC 20-135 Fire Test

→ 1984°F Average Flame Temperature

→ 4232 Average BTU

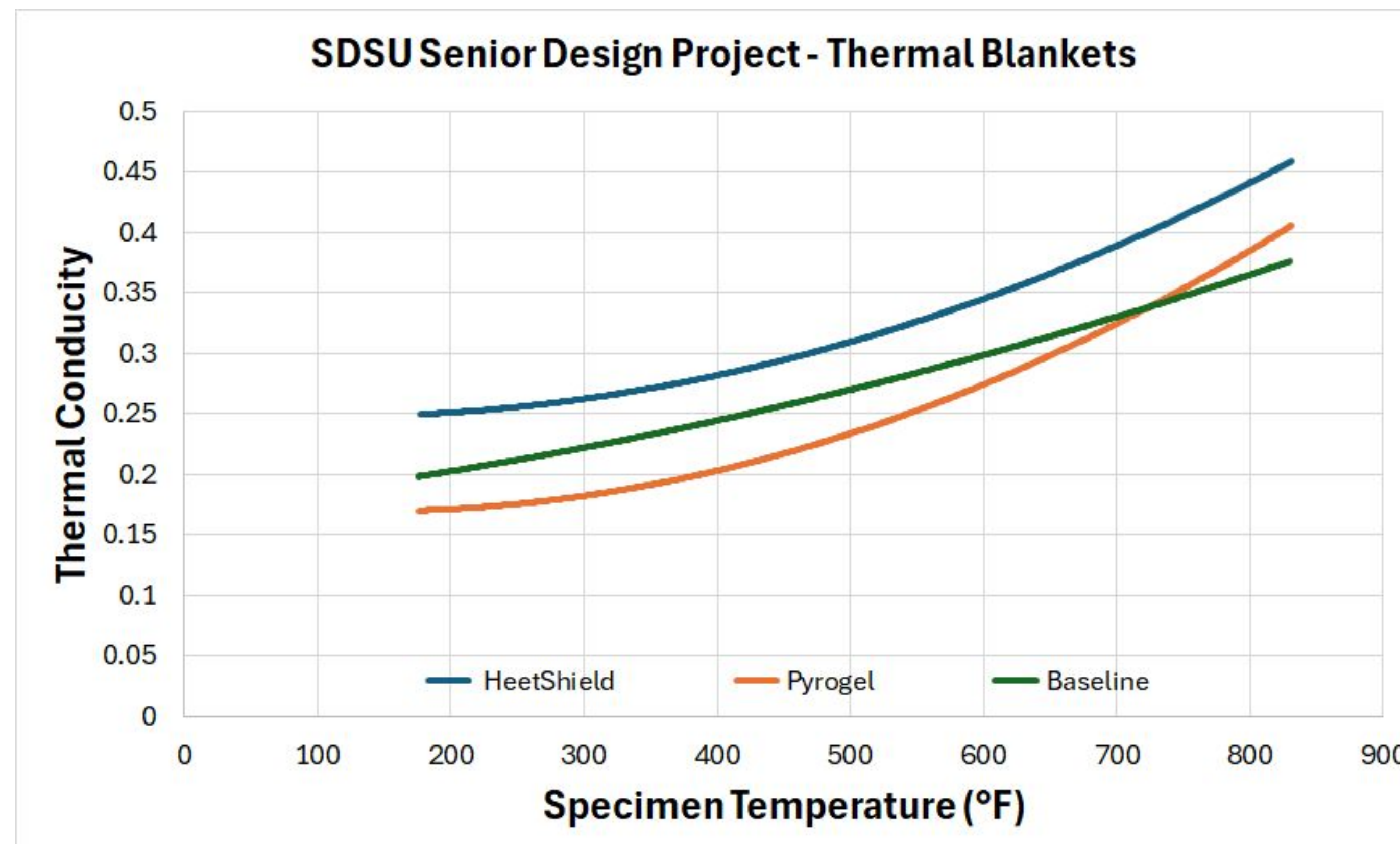


Tensile Testing

→ Focused on: Fastener Thread and Adhesive Strength



RESULTS



Thermal Conductivity characterization of blankets with baseline

Thermal Blanket Testing & Properties			Retaining System Tensile Testing		
Test Type or Property	Test/Property Value		Test Type	Test Value	
	Pyrogel	HeetShield		Sample 1	Sample 2
Thermal Conductivity (Btu-in/hr-ft ² -°F)	0.311 @500°F	0.235 @500°F	Adhesive (lbf)	213.6	256.3
DO-160 Vibration	Pass	Pass			
FAA AC 20-135 Fire Test	Pass	Pass			
Weight (lbf/ft ²)	0.811	0.725	Stud (lbf)	308.0	326.0
Thickness (in)	0.43	0.41			