

University of Idaho

College of Engineering

FITS LIKE A GLOVE

IDAHO NATIONAL LABS: TENSILE

TESTING SYSTEM

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Mentor: Anas Nawafleh

Sponsor: Randal Fielding, Idaho National Laboratory

OBJECTIVE



Design a tensile testing system that will fit through an 8-inch access port inside a glovebox and can perform tensile tests at temperatures reaching 700°C.

VALUE PROPOSITION



While small-scale tensile testing systems do exist, they are expensive, cannot be easily assembled in a glovebox, and do not perform high temperature tests. Our task for this project is to create a tensile testing system for Idaho National Laboratory that meets these requirements.

BACKGROUND

- A glove box is required to protect people from the potentially harmful conditions that could arise from the testing of certain alloy such as INL's current project using Ur-PI-Zr alloys.
- Current existing small-scale tensile testing systems are:
 - Extremely expensive
 - Do not have heating systems attached.
 - Cannot fit through a glovebox's 8in hole.









REQUIREMENTS

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- Small as possible to fit into 8" hole of glovebox
- Electronically sparse
- Assembled in glove box with thick gloves.
- Perform high temperature tests up to 700°C

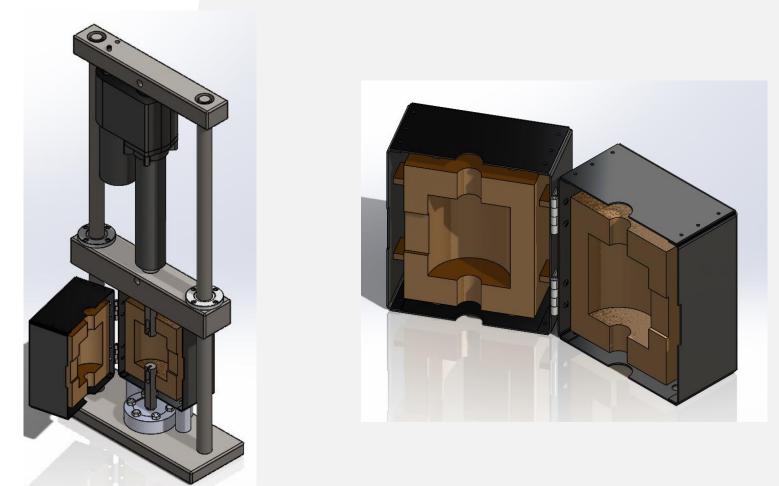




SYSTEMATIC REVIEW

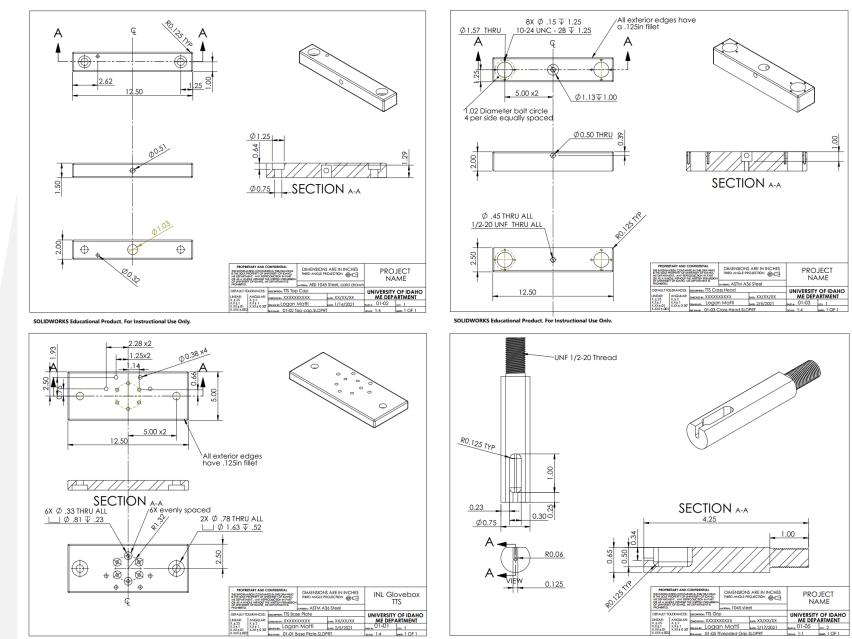


System SolidWorks: Frame (Showing physical models From SolidWorks)



DRAWINGS



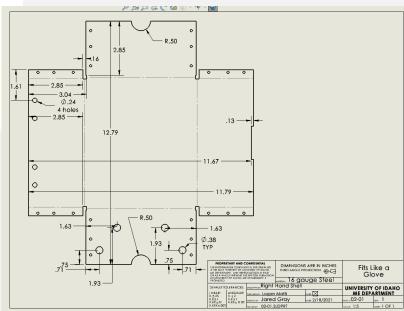


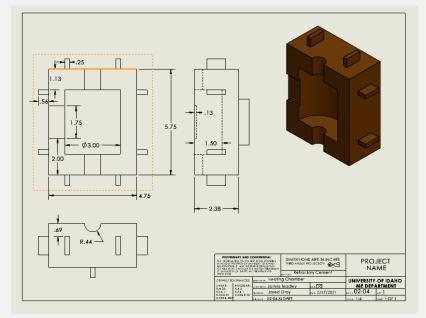
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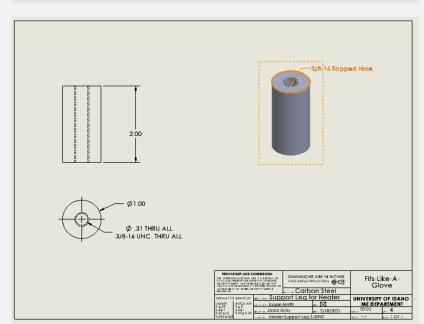
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DRAWINGS





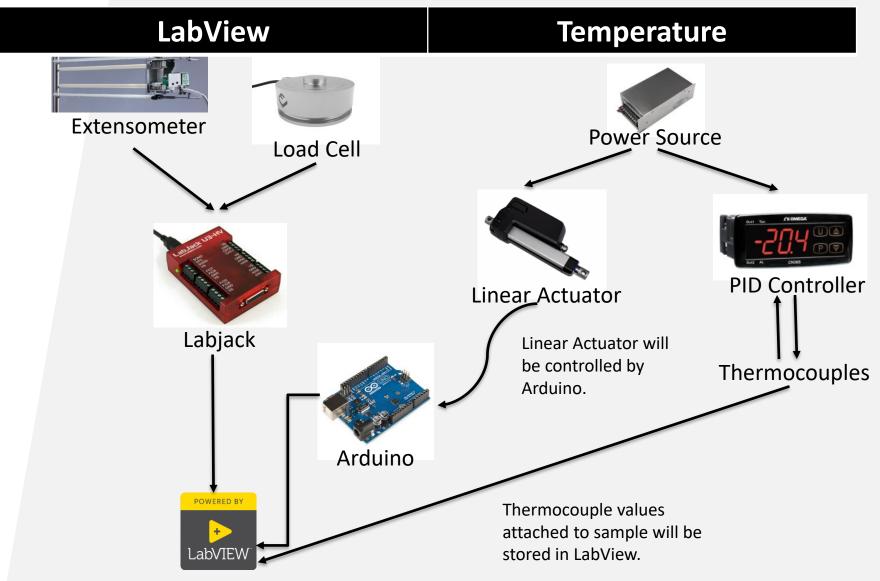




INSTRUMENTATION

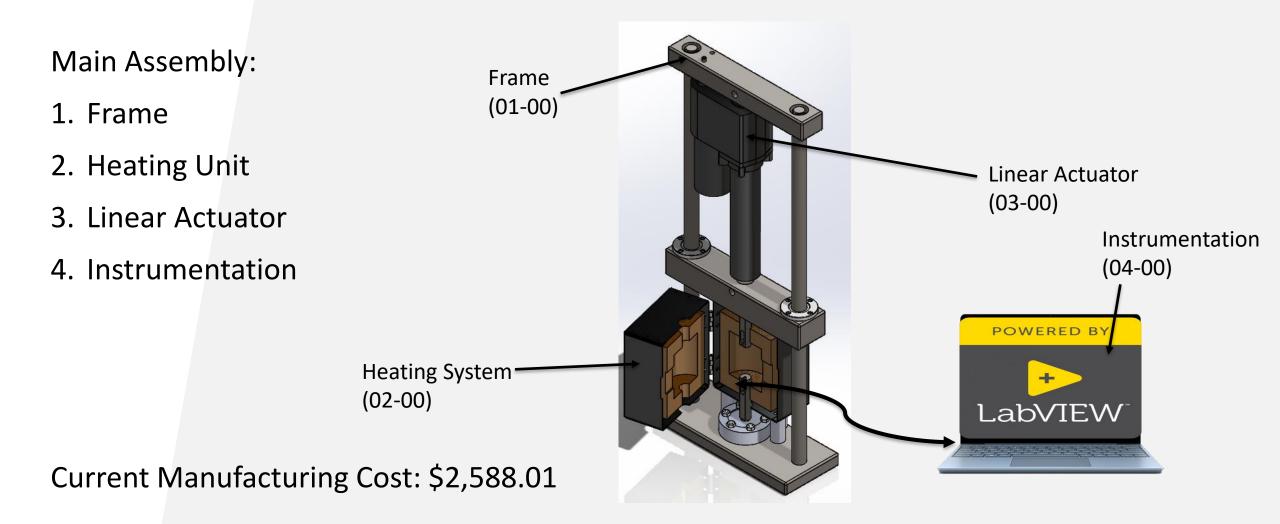


Two Interfaces



MANUFACTURING/BOM PLAN





POTENTIAL RISKS

- The weight of the steel = Con: High shipping cost, Pro: Assembled TTS will have a low Center of Gravity
- Assembly in glovebox: Will test assembly and disassembly
- Still need connection for load cell, LabView coding for DAQ, motor and heater control
 - Programming difficulties due to irregular connection types that do not mesh with readily available DAQ devices. May need to obtain an intermediary conditioning device to connect the load cell to the LabView UI
- External temperature of the heating system and components.

SUMMARY OF DVP

Test TTS assembly/Disassembly to fit with in an 8in hole.

Test force from linear actuator to test functionality up to 1500lbs.

Validate requirement of wire for the heat temp is up to 700C

Measure Temperature of the outside shell is below 50C

Test TTS on test specimen up to 700C

Test functionality of Instrumentation (Input gives the correct Output)



BUDGET:



Capstone Project Budget	Template	e - Fall/S	pring								Capstone Project Budget			pring								
Project:	Fits Like a (Glove										Fits Like a										
Last Updated											Last Updated	2/17/2021										
		1		Ye	ar				It	em	Expense Items	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Item Total		
Expense Items	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr		otal	Instrumentation	Sept	OCC	NOV	DEC	1911	reb	IVIdi	Арі	\$ 613		
											LabJack						\$144.52					
Equipment/Tools:											MegaMoto Plus						\$ 66.31					
									s	-	PID Controller						<u> </u>	\$141.88				
											Extensometer							Ş -				
Travel:											Thermocouples Power Supply						\$119.30	\$ 41.20				
Transportation							\$200.00		\$	200	Misc					\$100.00	\$119.50					
									s	-	Heating Unit					<i>Q</i> 200.00				\$ 185	F	Expenses
									Ť		Nichrome Wire						\$ 21.37					
Supplies / Parts / Services:											Castable Refractory Cement				\$ 90.72							
Frame									¢ 1	L,964	3D printing filament		\$ 32.00									
				6443 PF						1,504	Support Legs							\$ -				
Steel Shipping & Tax				\$113.75							Sheet Metal Shell						\$ 22.32					
Guide rods				\$ 97.61							Ceramic Wool Shop Usage (est. Hrs):						\$ 19.07			Hause	\$ 2,963 \$	Subtatal
Top Plate				\$167.98							Mill					20	20	20		60	\$ 2,905 3	ubtotai
Bottom Plate				\$ 39.15							Drill Presses					15	15	15		45		
Ball Bearings				\$127.82							Lathe					10				10		
Grips				\$ 13.91																0		
Cross Head Plate				\$ 42.37																0		
Linear Actuator				\$465.00																0		
Load Cell				\$821.45													Grad		nt Support		including fri	nge
Wiring						\$ 24.00													Overhead		504 - 6 - 11	
Fasteners					\$ 50.96													University	Overhead	-	5% of all exp	
Test Material							s -												Totals	\$ 4,161		\$ 839 Excess

Capstone Project Schedule																						
Fits Like a Glove							•		Snapshot #3									Design	Expo			
																		Ū				
	2021																					
	Jan				Feb							Mar			Apr			May				
Task Description	1/15	1/22	1/26	1/29	2/5	2/12	2/19	2/26	3/5	3/9	3/12	3/19	3/26	4/2	4/9	4/16	4/23	4/30	5/7	5/14	5/21	5/28
Product Requirements Document																						
Research Operational Parameters																						
Rough Draft Bill of Materials																						
Design Solution to Challenges/Problem																						
Preliminary CAD Modeling																						
Concept Design Review																						
Preliminary Coding Skeleton																						
First Round Prototyping (POC) (ABS)																						
Review and Revise CAD																						
Review and Revise Coding																						
Machine Custom Parts from BOM																						
Final CAD Review																						
Second Round Coding Revew																						
Final Assembly of Parts																						
Final Coding Review																						
Prototype Testing																						
Choose Final Testing Materials																						
Final Product Review																						
Testing Final Product																						
Product Validation							[
Deliver/Report Final Project to Client																						







THANK YOU!

QUESTIONS?