33% BUILD UPDATE

NAU ROCKET PROPULSION TEAM #3

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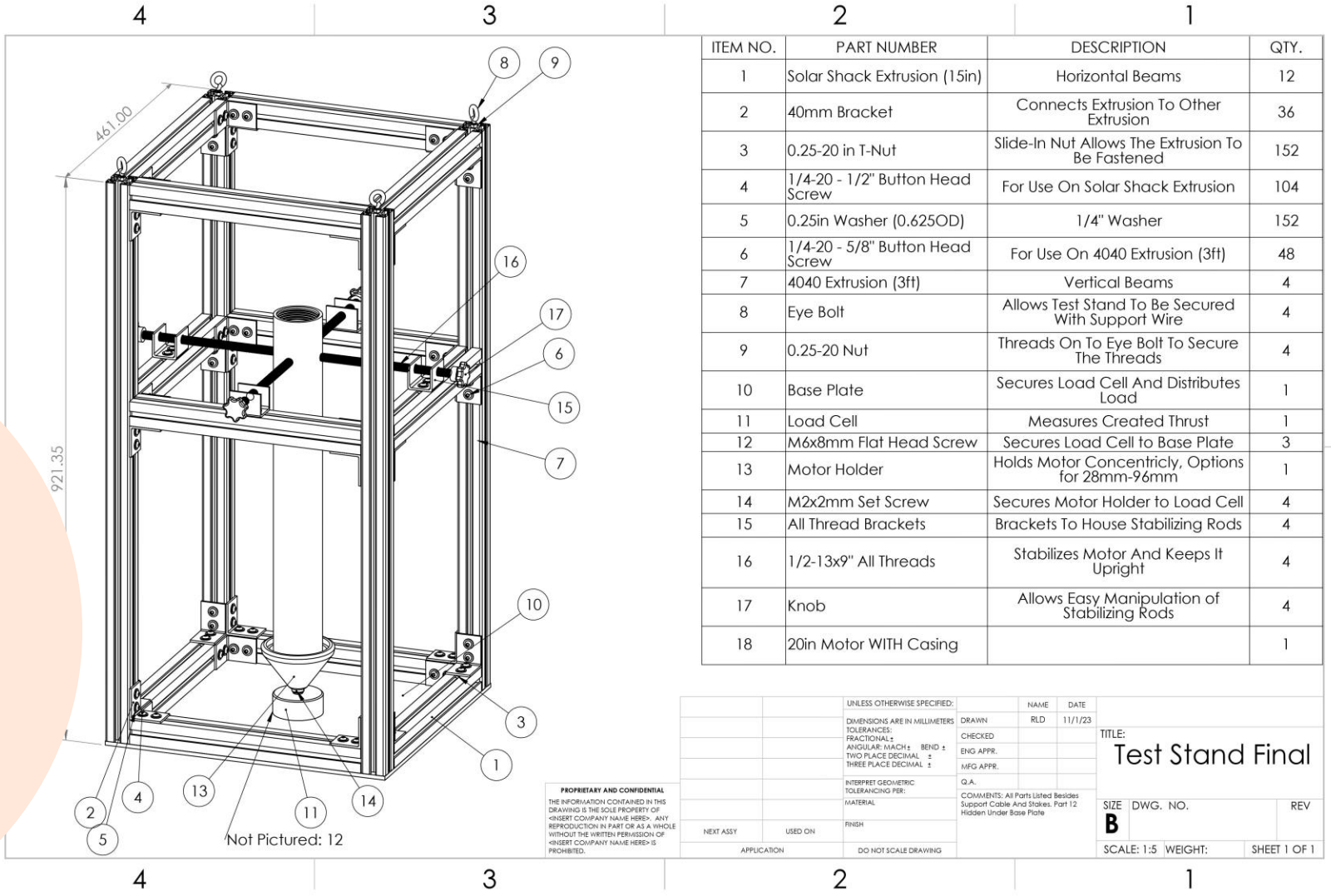
SUMMARY OF PROJECT

- Build a propulsion system for a high-power, level 2 rocket
  - Design the motor to fit the 3-meter-tall carbon fiber rocket body built by the NAU Rocket Club
  - Develop a unique Ammonium Perchlorate Composite Propellant (APCP) formula
  - Cannot exceed an M-Class motor (>2180 N*s Impulse)

- Design and build a rocket test stand to gather data on rocket motors efficiency
  - Work with EE team to input thrust and impulse data

- Have at least two motor testing's small scale 38 and 54 mm
- Design and build a motor casing for final 75 mm
- Build a final 75mm diameter rocket motor to launch in Phoenix March 23rd or 24th, 2024

TEST STAND



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Solar Shack Extrusion (15in)	Horizontal Beams	12
2	40mm Bracket	Connects Extrusion To Other Extrusion	36
3	0.25-20 in T-Nut	Slide-In Nut Allows The Extrusion To Be Fastened	152
4	1/4-20 - 1/2" Button Head Screw	For Use On Solar Shack Extrusion	104
5	0.25in Washer (0.625OD)	1/4" Washer	152
6	1/4-20 - 5/8" Button Head Screw	For Use On 4040 Extrusion (3ft)	48
7	4040 Extrusion (3ft)	Vertical Beams	4
8	Eye Bolt	Allows Test Stand To Be Secured With Support Wire	4
9	0.25-20 Nut	Threads On To Eye Bolt To Secure The Threads	4
10	Base Plate	Secures Load Cell And Distributes Load	1
11	Load Cell	Measures Created Thrust	1
12	M6x8mm Flat Head Screw	Secures Load Cell to Base Plate	3
13	Motor Holder	Holds Motor Concentricly, Options for 28mm-96mm	1
14	M2x2mm Set Screw	Secures Motor Holder to Load Cell	4
15	All Thread Brackets	Brackets To House Stabilizing Rods	4
16	1/2-13x9" All Threads	Stabilizes Motor And Keeps It Upright	4
17	Knob	Allows Easy Manipulation of Stabilizing Rods	4
18	20in Motor WITH Casing		1

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION | DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	RLD	11/1/23
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

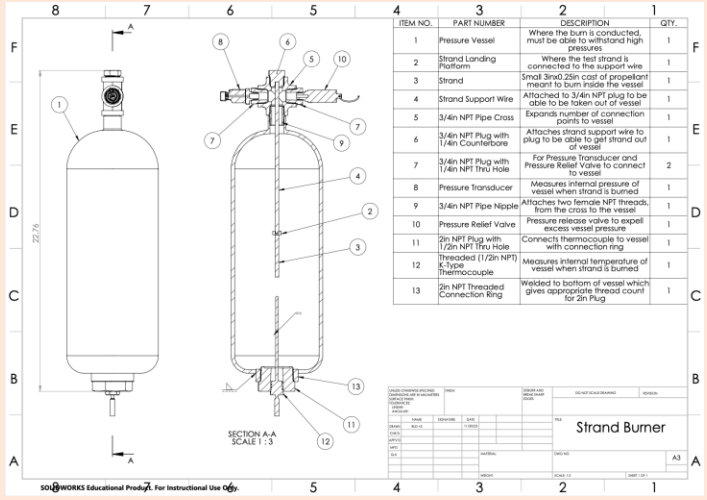
COMMENTS: All Parts Listed Besides Support Cable And Stakes. Part 12 Hidden Under Base Plate

TITLE: Test Stand Final

SIZE B | DWG. NO. | REV

SCALE: 1:5 | WEIGHT: | SHEET 1 OF 1

PRESSURE VESSEL STRAND BURNER



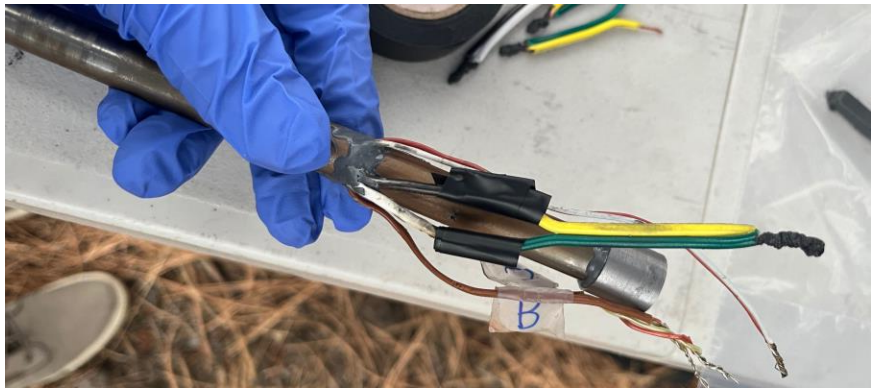
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Pressure Vessel	Where the burn is conducted, must be able to withstand high pressures	1
2	Strand Landing Platform	Where the test strand is connected to the support wire	1
3	Strand	Small 3in×0.25in cast of propellant meant to burn inside the vessel	1
4	Strand Support Wire	Attached to 3/4in NPT plug to be able to be taken out of vessel	1
5	3/4in NPT Pipe Cross	Expands number of connection points to vessel	1
6	3/4in NPT Plug with 1/4in Counterbore	Attaches strand support wire to plug to be able to get strand out of vessel	1
7	3/4in NPT Plug with 1/4in NPT Thru Hole	For Pressure Transducer and Pressure Relief Valve to connect to vessel	2
8	Pressure Transducer	Measures internal pressure of vessel when strand is burned	1
9	3/4in NPT Pipe Nipple	Attaches two female NPT threads, from the cross to the vessel	1
10	Pressure Relief Valve	Pressure release valve to expell excess vessel pressure	1
11	2in NPT Plug with 1/2in NPT Thru Hole	Connects thermocouple to vessel with connection ring	1
12	Threaded (1/2in NPT) K-Type Thermocouple	Measures internal temperature of vessel when strand is burned	1
13	2in NPT Threaded Connection Ring	Welded to bottom of vessel which gives appropriate thread count for 2in Plug	1

SECTION A-A
SCALE 1 : 3

Strand Burner

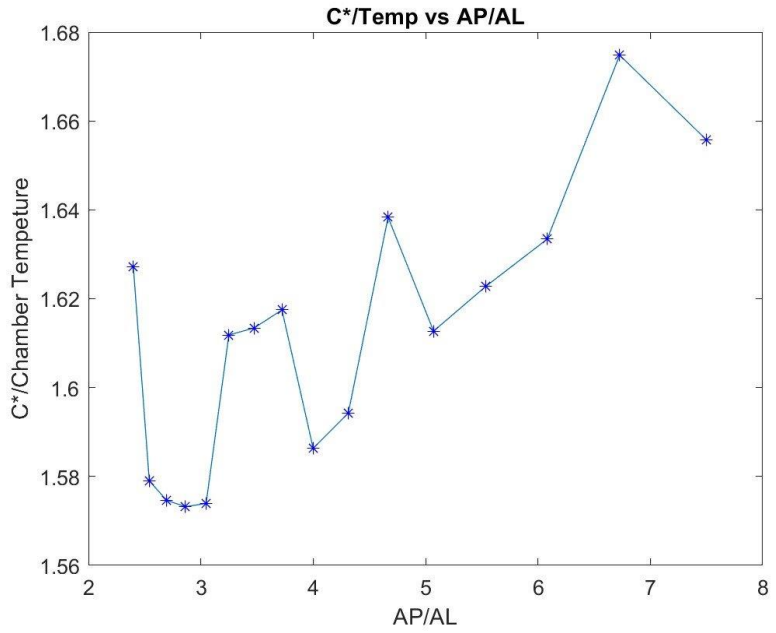
SOLIDWORKS Educational Product. For Instructional Use Only.

STRAND BURNER TESTING



PROPELLANT FORMULAS

- 74% AP
- 11% AL
- C*= 5134.267 ft/s
- Chamber Temperature = 3065.608 K
- AP/AL= 6.7273



PROPELLANT FORMULAS

Batch Sheet

Rocket Capstone Batch V2.2

Makes: 2 Strands in the custom mold, 0.25 in x 4 in

Chemical	Amount Planed(g)	Amount Used (g)
R45	4.62	
DOA	0.52	
Silicon Liquid	2 drop	
Aluminum	2.6	
Lamp Black	0.06	
AP Large	8.75	
AP Small	8.75	
MDI Curative	0.68	
Total	25.98	

Notes:

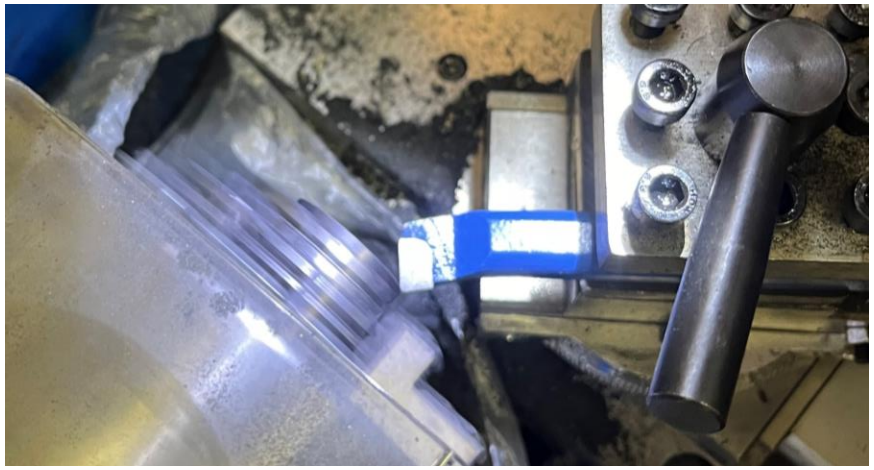
Made by adjusting the rations in the modified V2 batch sheet -the Silicon liquid amount is guessed -AP amount is divided equally between large and small -keep all else constant adjust the ratio of AP to AL -2.25% DOA of total mass based on research paper in link below -87.1% for remaining mass is R45, 0% of remaining mass is DOA, 12.9% of remaining mass as in V1

https://pubs.aip.org/aip/acp/article-abstract/2366/1/040009/675922/Preliminary-results-of-DOA-plasticizer-effect-on?redirectedFrom=fulltext

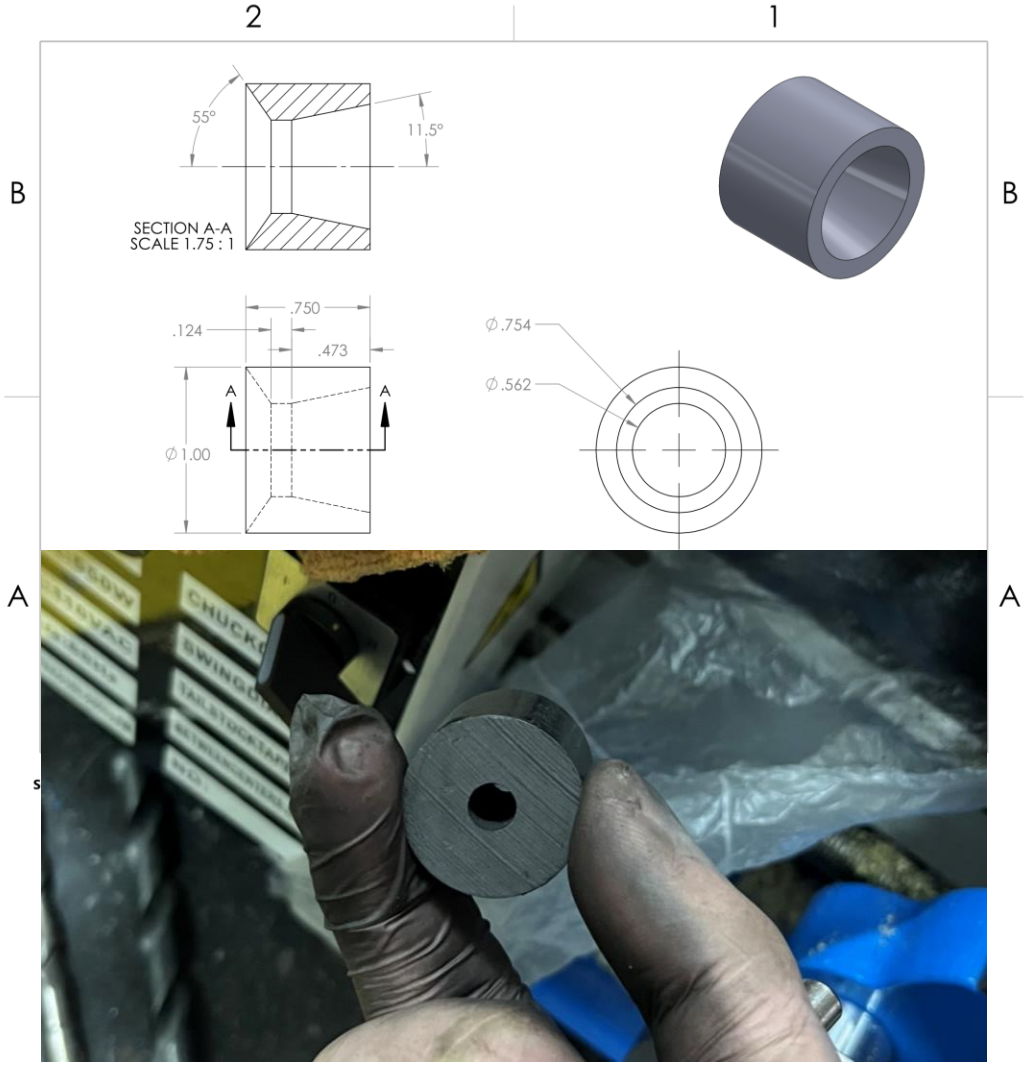
https://www.rocketmotorparts.com/details/p1577809_7835874.aspx

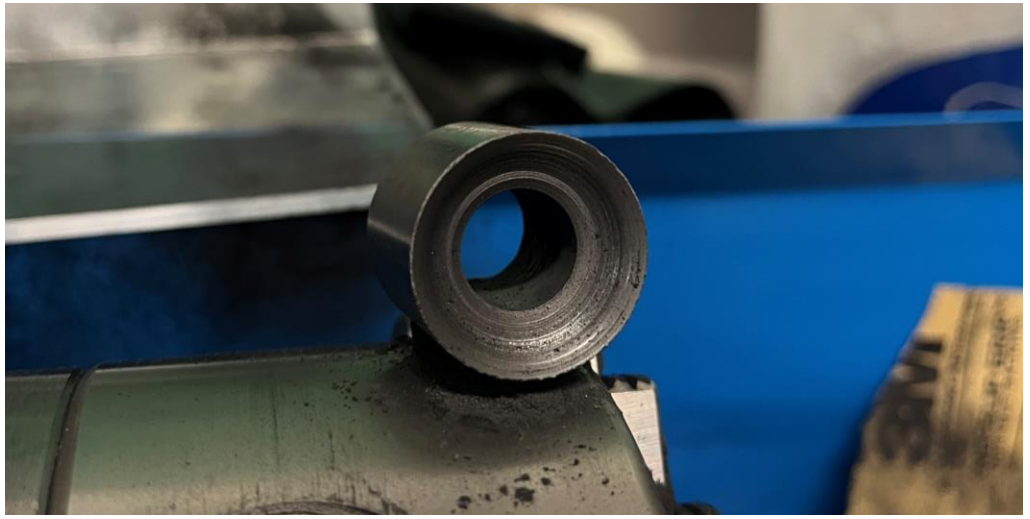
PROPELLANT FORMULATION

NOZZLE MANUFACTURE



NOZZLE MANUFACTURE





MOTOR CASING PURCHASED PARTS