Preliminary Design Review

RMTS Industries

Overview

- Requirements
- System Description
  - Motor mount
  - Frame
- Fabrication
- Management
- Budget

Requirements

- 1.2.2 Launch Area Clearance
  - The area surrounding the RMTS shall be clear of unrelated equipment, buildings, and flammable materials out to a minimum radius of 50 feet
- 1.2.3 Launch Alarm
  - The RMTS shall incorporate an alarm phase prior to ignition no shorter than 5 seconds to allow for personnel to clear the range
- 1.2.4 Safety Interlock
  - The RMTS shall incorporate a removable safety interlock (key) that is not installed until the range has been cleared
- 1.2.5 Igniter Installation
  - The igniter for the rocket motor shall not be installed until the RMTS is entire set up and the rocket motor is secured within the test stand

Requirements

- 1.2.6 Blast Deflectors
  - Blast deflectors shall be used where necessary to prevent damage/harm to personnel and equipment and to reduce the likelihood of a fire. All blast deflectors shall direct debris in a safe direction
- 2.1 RMTS Size
  - The RMTS design will accommodate National Association of Rocketry (NAR) motor sizes, ranging from Model Rocketry motors through High Power Level I motors (Classification 1/8A – I).

Requirements

- 2.2 RMTS URD
  - The RMTS will be capable of surviving the unplanned rapid deconstruction (URD) of any motor up through HPR Level 1 with minimal damage to components.
- 2.2.1 RMTS Safety Factor
  - Contractor will verify structural integrity and safety of the RMTS design with a factor of safety (SF) of 5x all expected forces for normal operation of all motor sizes. The RMTS will safely contain the explosive force of all motor sizes, keeping operators safe and protecting nearby structures/infrastructure.

Requirements

- 2.3 Performance Envelope
  - The RMTS will support the operation of up to a High Power Rocketry (HPR) Level I motor, including casing/nozzles and instrumentation with thrust according to a normal duration burn (+10%).
- 2.4 Weight and Balance
  - The RMTS will weigh a maximum of 500 lb, including rocket motor adapters, deflection plates (as appropriate) and instrumentation. Individual items or shipping containers must weigh less than 100 lb to allow safe transportation and assembly. Assembly and transportation will not require undue physical exertion or compromise safety in any way.

Requirements

- 2.5 Subsystems
  - The RMTS will incorporate all subsystems and functions necessary to safely accommodate, fire, and test rocket motors throughout the specified motor range. Anticipated subsystems include: base structure, motor holding appliances, thrust measurement, thrust deflection plates (as appropriate), stand-off blast protection, remote ignition, status monitoring, warning lights/sirens, data recording/analysis, and common support tools.
- 2.6 Assembly & Disassembly
  - The Contractor will demonstrate that the RMTS may be assembled within 30 min under temperate weather and temperature conditions from the transported configuration using 1 person, and vice versa. The Contractor will demonstrate that the RMTS may be ‘pre-flighted’ and readied for use (or made safe and ‘post-flighted’) within 30 min from the assembled configuration using 1 person.

Requirements

- 2.7 Weather/Environment
  - The RMTS will be capable of surviving outdoors in the Alaskan environment year-round. This includes temperature, winds, and precipitation variations throughout the year.
- 2.7.1 Precipitation and Temperature Survival
  - The RMTS shall survive severe weather conditions such as rain up to 1 inch/hour or temperatures down to -40F.
- 2.7.2 RMTS Operating Environment
  - The RMTS shall be operated in an environment with minimal to no precipitation.

Requirements

- 2.8 Reliability & Maintainability
  - The RMTS will require minimal maintenance. All components of the RMTS will remain operational for a minimum of 20 years. The Contractor will provide individual component and overall system reliability measures.
- 2.10 Transportability
  - The RMTS system will include the minimum components necessary to test motors at deployed locations: (1) Poker Flat Research Range (PFRR); (2) Kodiak Pacific Spaceport Complex (PSC); (3) Remote locations, such as Oliktok Point, Alaska.

Requirements

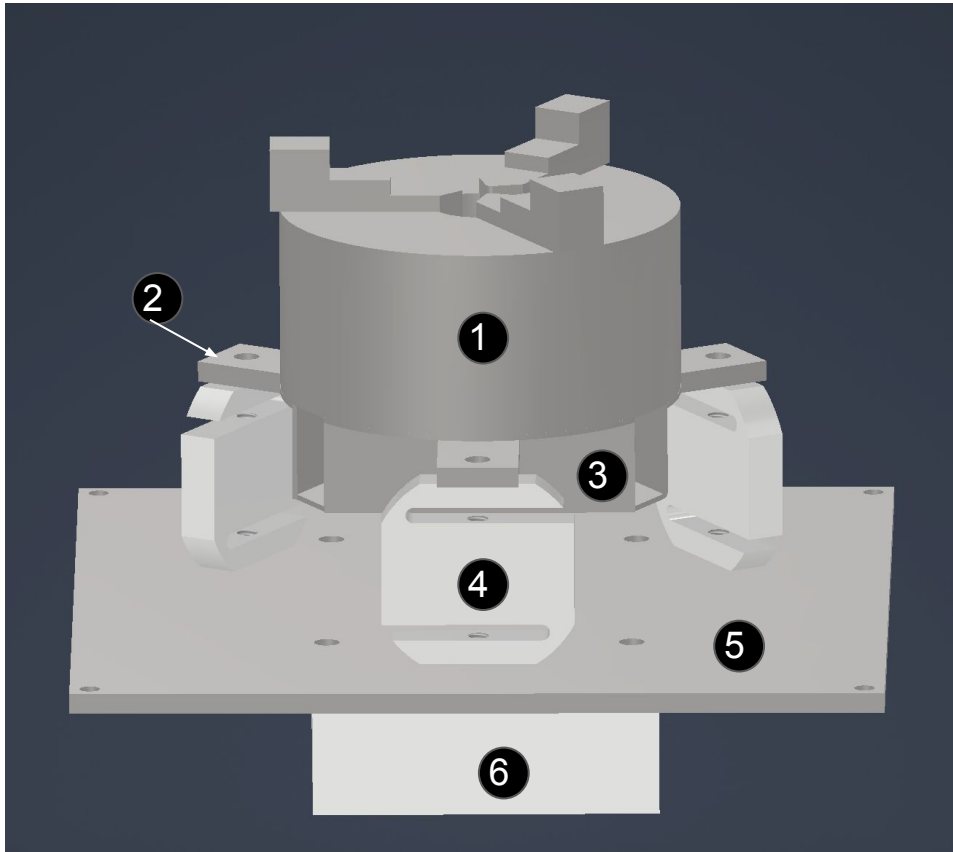
- 2.10.1 Form Factor
  - The RMTS will be designed such that all individual components may be transported using either a 6.5-foot pickup bed with cab-height bed topper, or a 6 x 14 x 6 ft mobile ground control station trailer. The design of the components and securing devices will preclude damage to either the RMTS or the trailer and will not require undue physical exertion. The RMTS will be capable of being transported in a maximum of 7 major items or hardened cases, each weighing no more than 100 lb.

Rocket Motor Mount - Assembly

2 separate versions of this assembly will allow the holding and measurement of A - i class motors.

Components:

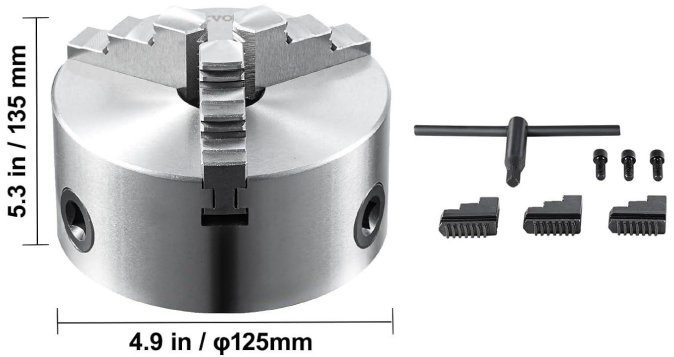
1. Lathe chuck
2. Load cell spacers
3. Ejection catch
4. Load cells
5. Base plate
6. Load cell splitter



Rocket Motor Mount - Lathe Chuck

- Models - 125/160
- Allows mount of rockets from 0mm to 45 mm in diameter
- 3x m8 or m12 mounting holes located on the bottom.
- Currently $115.38 for both on Amazon

VEVOR
TOUGH TOOLS, HALF PRICE

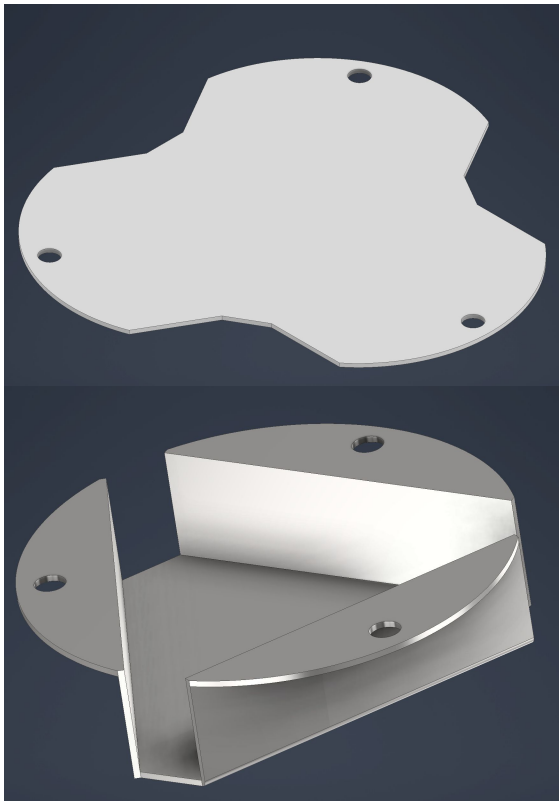


Item Model Number: K11-125	Chuck O.D: 5 in / 125 ± 5 mm
Clamping Range: 0.098-1.57" / 2.5-40 mm	Bore: φ30 mm
External Jaw Clamping Range: 1.78-5"/45-125 mm	
Surface Treatment:＜Ra0.8, Oil Coated	Main Material: HT300
Net Weight: 10.8 lb / 4.9 kg	Product Size: φ125 x 135 mm
Jaws: 3 Jaws	Jaws Material: 20Cr Jaws Hardness: ≥53HRC
Scroll Material: 40Cr	Scroll Hardness: ≥45HRC

https://www.amazon.com/VEVOR-250-0-6-9-84-Clamping-Reversible/dp/B0CG9J49

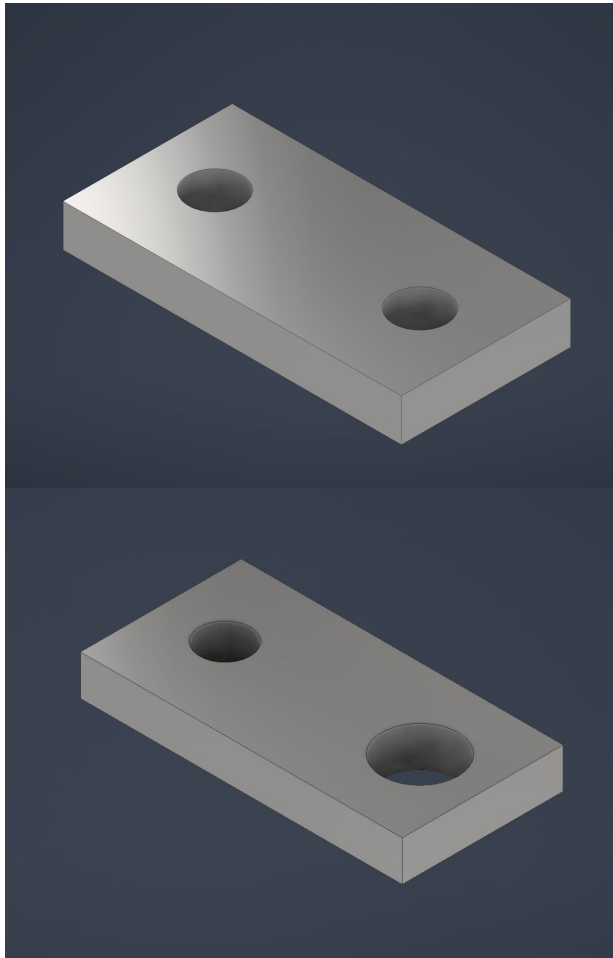
Rocket Motor Mount - Ejection Charge Catch

- Will protect the load cells from the ejection charge of the rocket motor if present
- Will be cut out of sheet metal and bent to shape
- Wide sides give a broad protection to the load cells while the open ends give pressure a pathway to escape.
- Sized to appropriate lathe chuck



Rocket Motor Mount - Load Cell Spacers

- Needed due to only being able to screw into the bottom of the lathe chuck and top of the load cell.
- 2” x 1” x ¼”
- 1 has 2 m8 holes and the other has one m8 and one m12 due to the heavier duty load cells requiring m12.
- Rated to 8224 lbs before yield which gives a 36.67 factor of safety for our rating of 1000 Newtons.



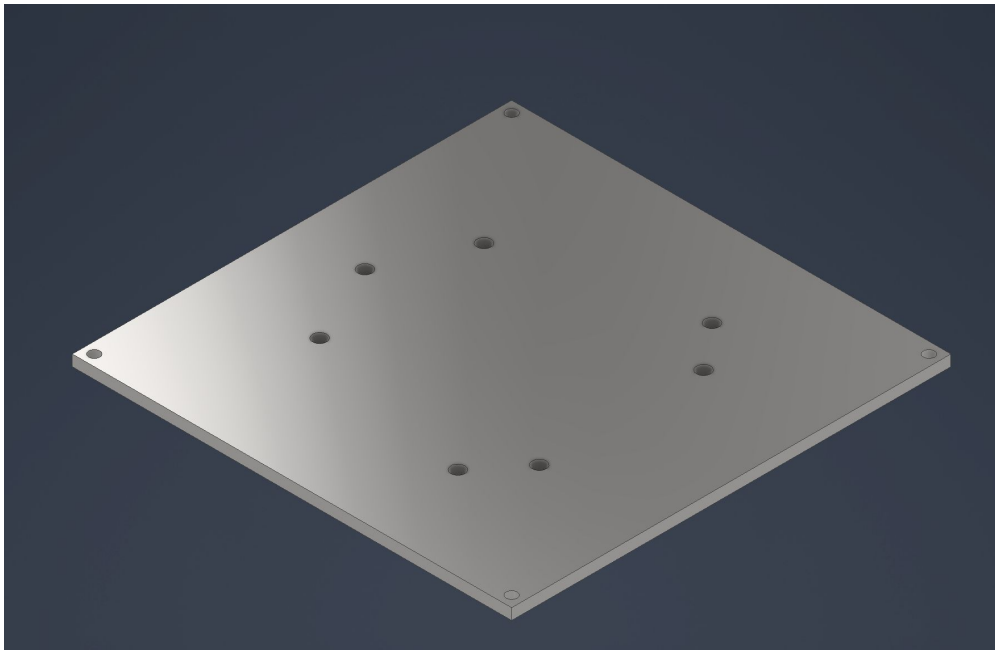
Rocket Motor Mount - Load Cells

- 3x 50kg load cell - 1470 ±0.255(N)
- 3x 10kg load cell - 290 ±0.051(N)
- This combination will allow the measurement of i class rocketry while still allowing accurate measurement of A class.
- Due to laid cells having different dimensions and for ease of changing testing setups it was decided that each load cell group should be attached to its own motor mount in its entirety.

https://www.ato.com/tension-load-cell-s-type-5kg-to-500kg

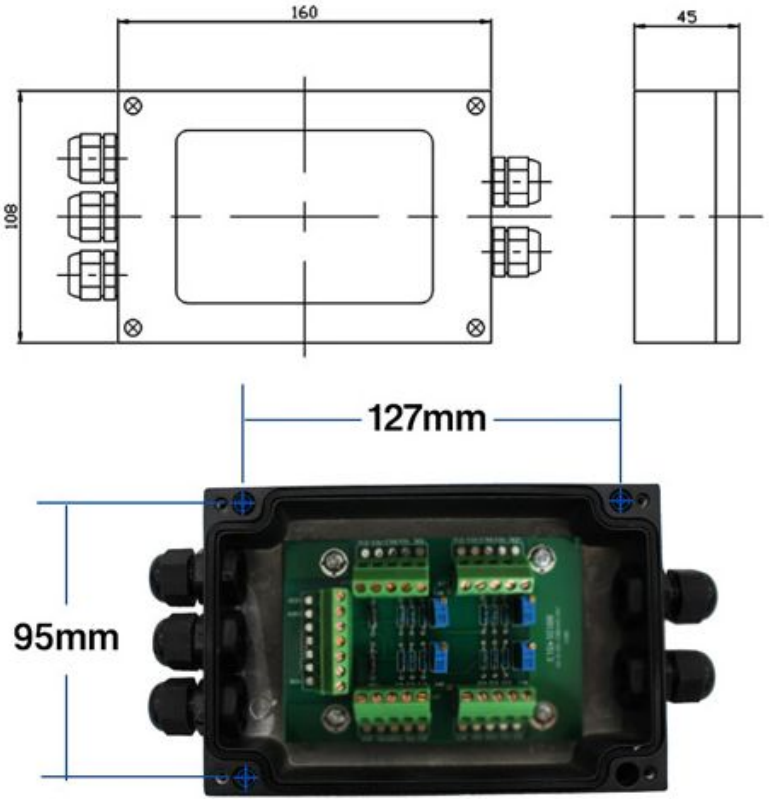
Rocket Motor Mount - Base Plate

- ¼” steel for strength and rigidity
- 463x Factor of Safety
- Not much more than ⅛”
- Attachment point for:
  - Load cells
  - Load cell splitter
  - Frame



Rocket Motor Mount - Load Cell Splitter

- Connects all 3 load cells in parallel
- IP 67
- Allows use of only 1 Amplifier which will be mounted in the electronics box rather than an Amp for each individual load cell
- Will be a fixed part of each motor mount so two will be needed
- $66.67 each



https://www.ato.com/load-cell-junction-box?srsltid=AfmBOorNrkyedBPxgd2_fibsNqd3UhD-r7HHZM9vddCG5cD8hlkITluP

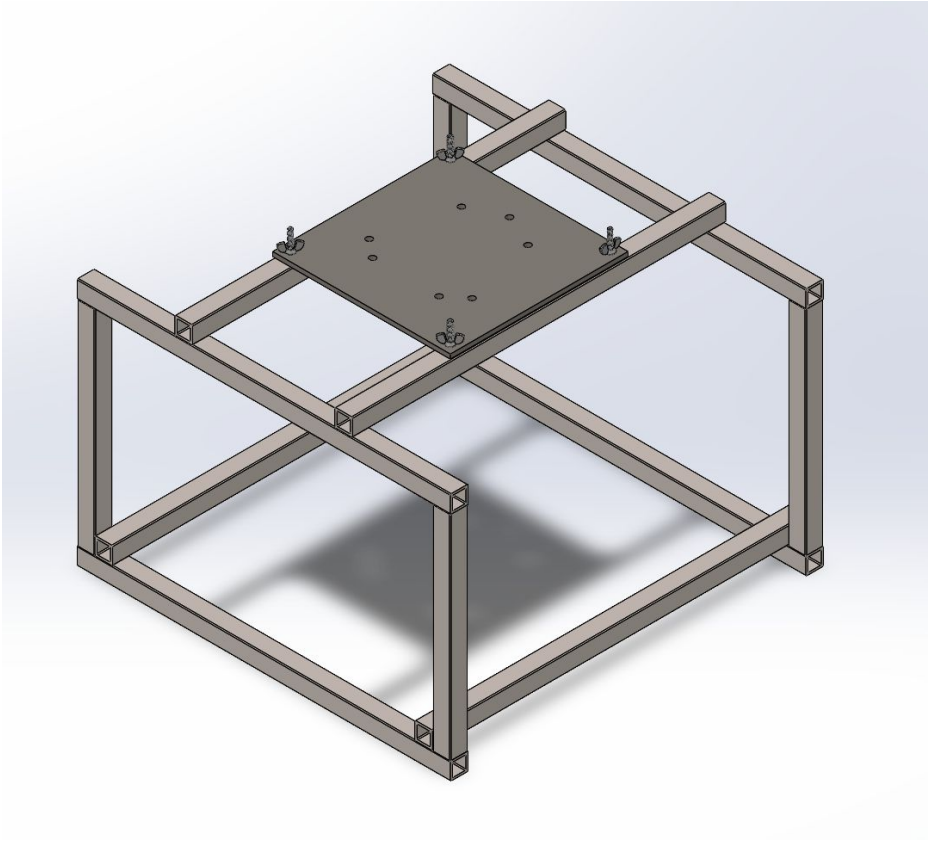
Rocket Motor Mount - Need Fasteners

- 6x M8 screws - 10 kg load cells
- 6x M12 screws - 50 kg load cells
- 8x Mxx screws - load cell splitter
- Lathe chuck comes with need fasteners
- 4x ¼” studs - plate to frame attachment
- 4x ¼” wing nuts
- Blue loctite - don't want to have to constantly tighten things
- One M8 in tension can hold 23.4 kN

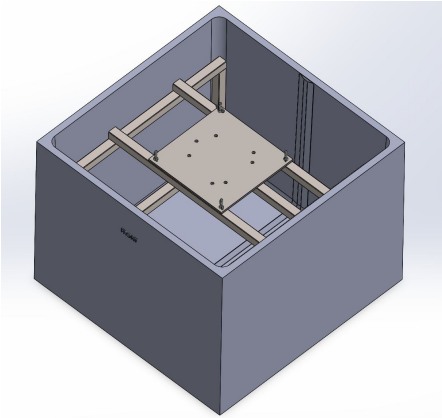
RMTS Frame

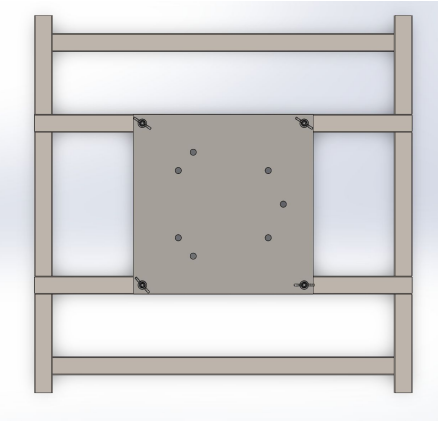
1”x1”x1/8” Square Tube

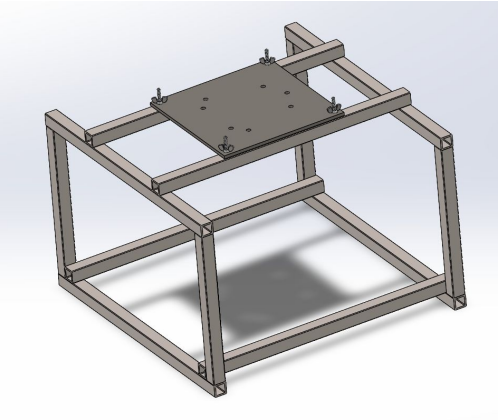
- 8x 21” sections
- 4x 12” sections
- 4x ¼”-20 Welded Studs
- 4x ¼”-20 Wing Nuts
- Welded Joints
- 18’ total steel tube
- Order: 4x 20’ sections cut to 10’ lengths
- ~30 lbs
- 0370 Pelican Case: 41 lbs
- Weight: ~71 lbs < 100 lbs

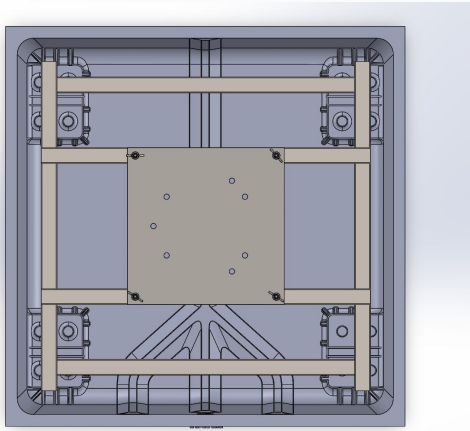


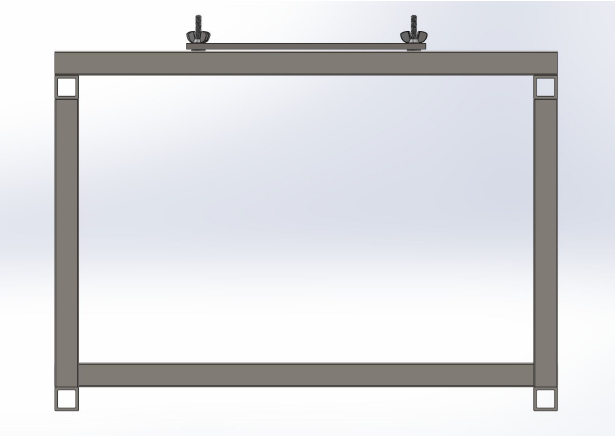
RMTS Frame - In Case & Other Views

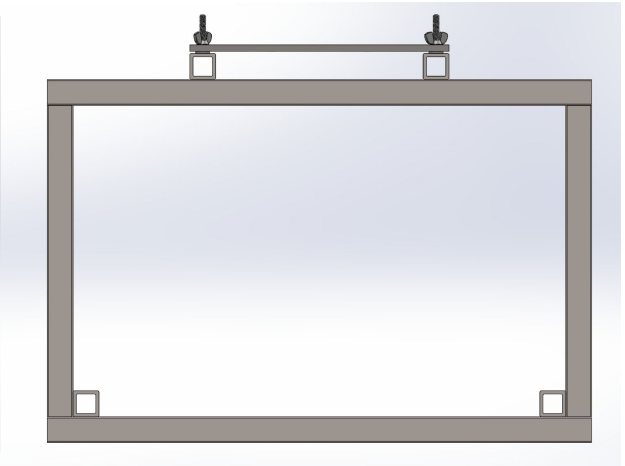






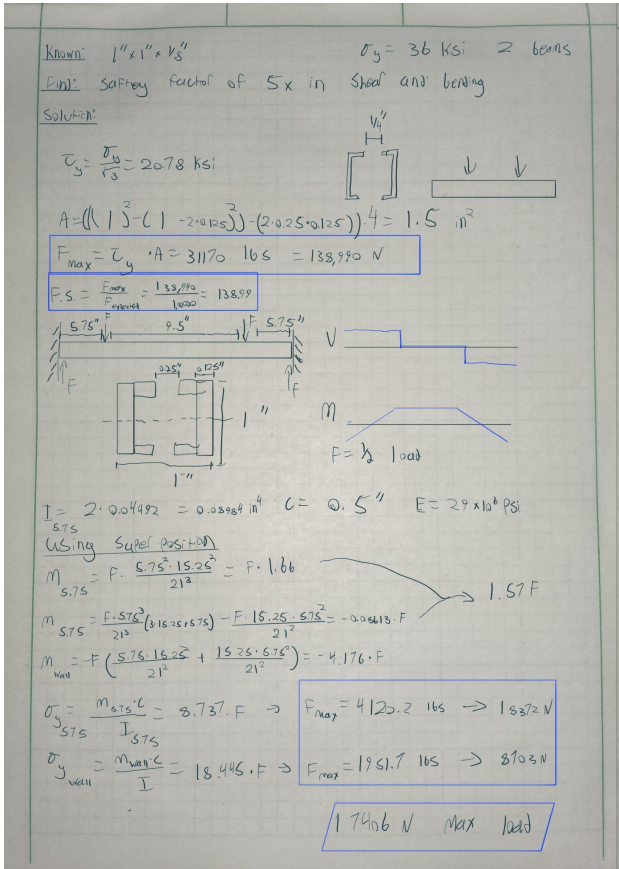






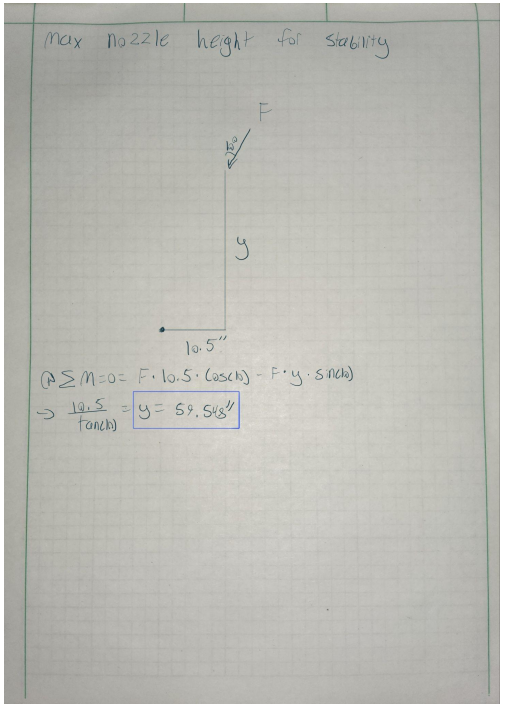
RMTS Frame - Hand Strength Analysis

- 1”x1”x1/8”
- Analysis originally done with thinner stock
- Redesign not needed as a factor of safety of 17x is attained



RMTS Frame - Hand Stability Analysis

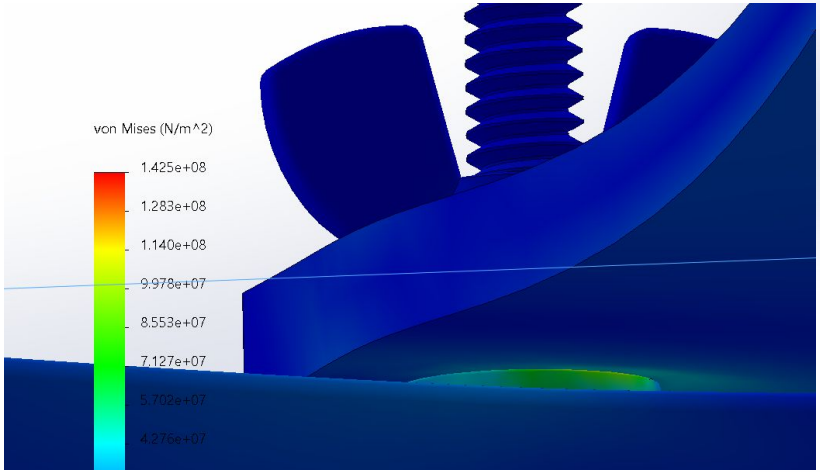
- Max reasonable nozzle to frame distance is 17”
- Frame is currently designed as 12” tall and 21” wide
- Assuming these numbers a max of 20 degree off axis burn is possible while maintaining stability
- Assuming frame has no weight which would help with stability

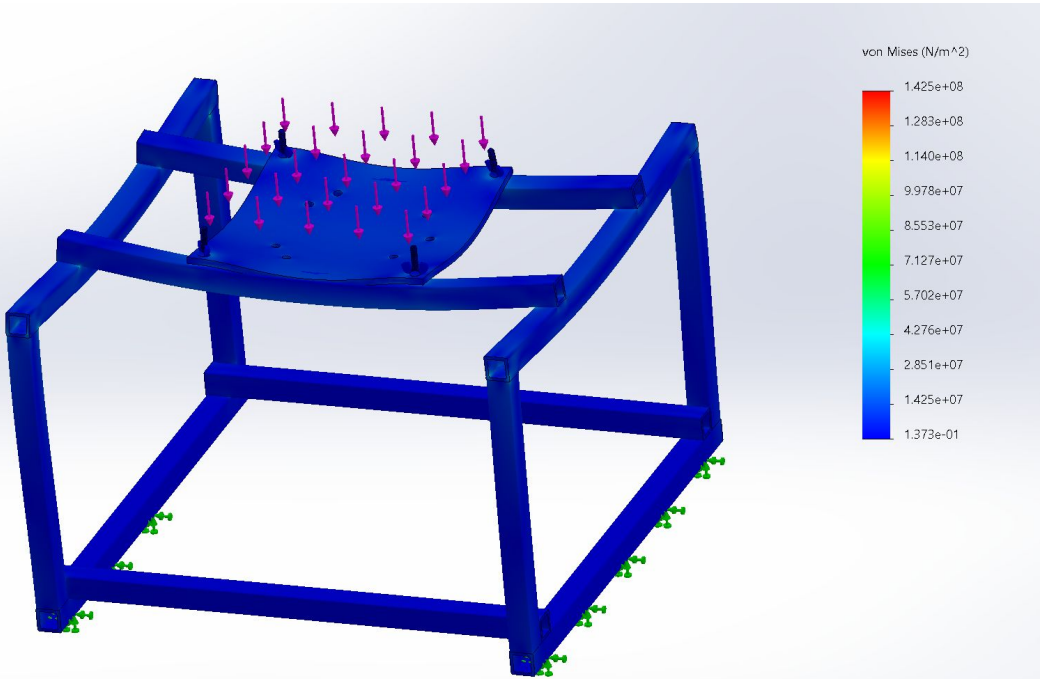


RMTS Frame - FEA Analysis - 1200 N Load - A36 Steel

Stress

- Max: 142.5 MPa (On Bolts) (FS: 4.5)
- Frame: 60 MPa (FS: 11)
- Might change bolts from welded to through hole

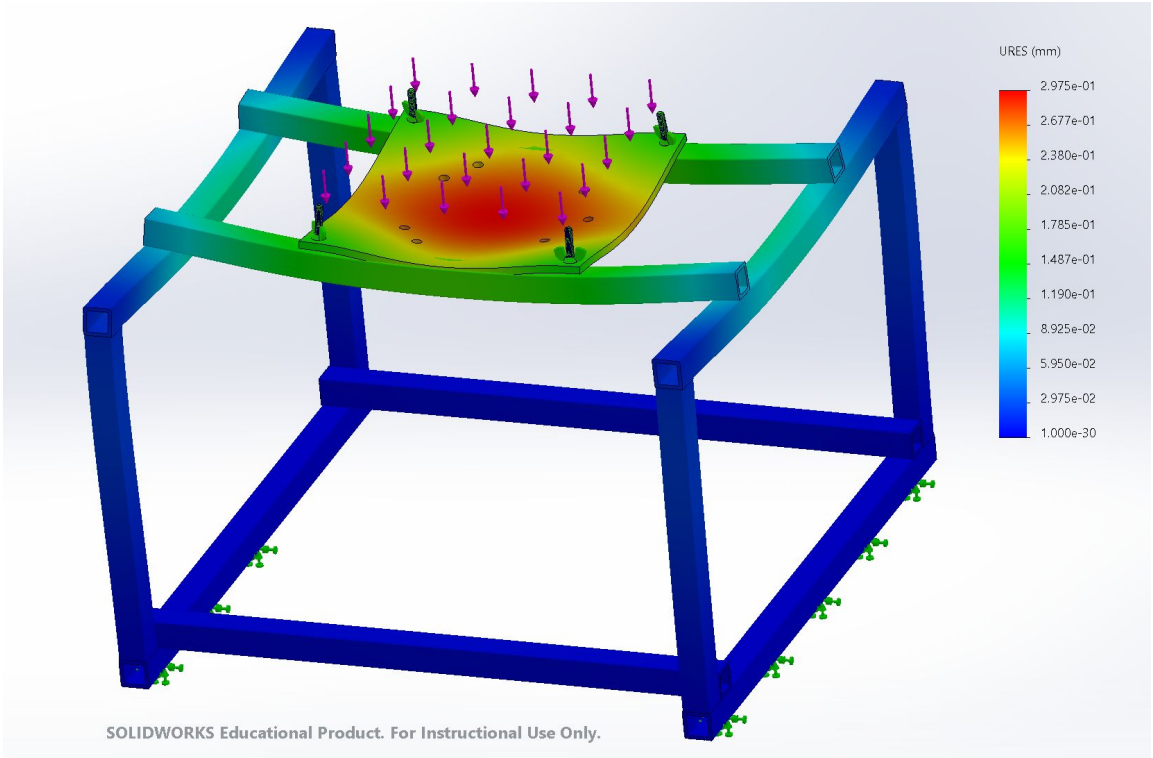




RMTS Frame - FEA Analysis - 1200 N Load - A36 Steel

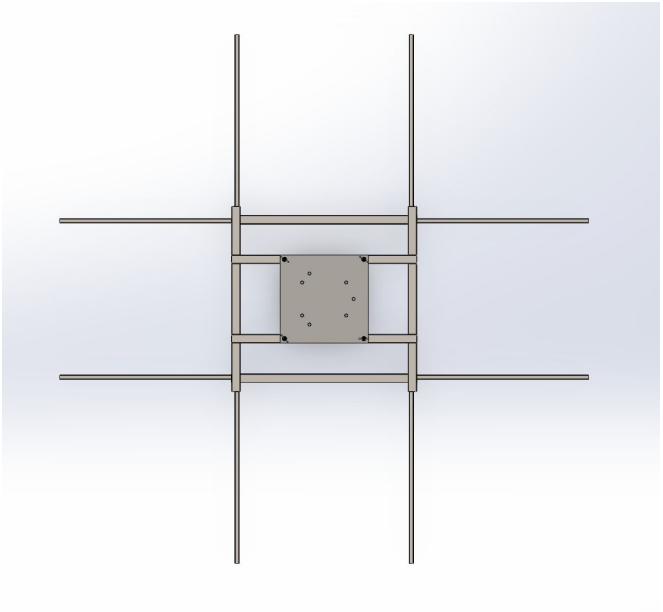
Deflection

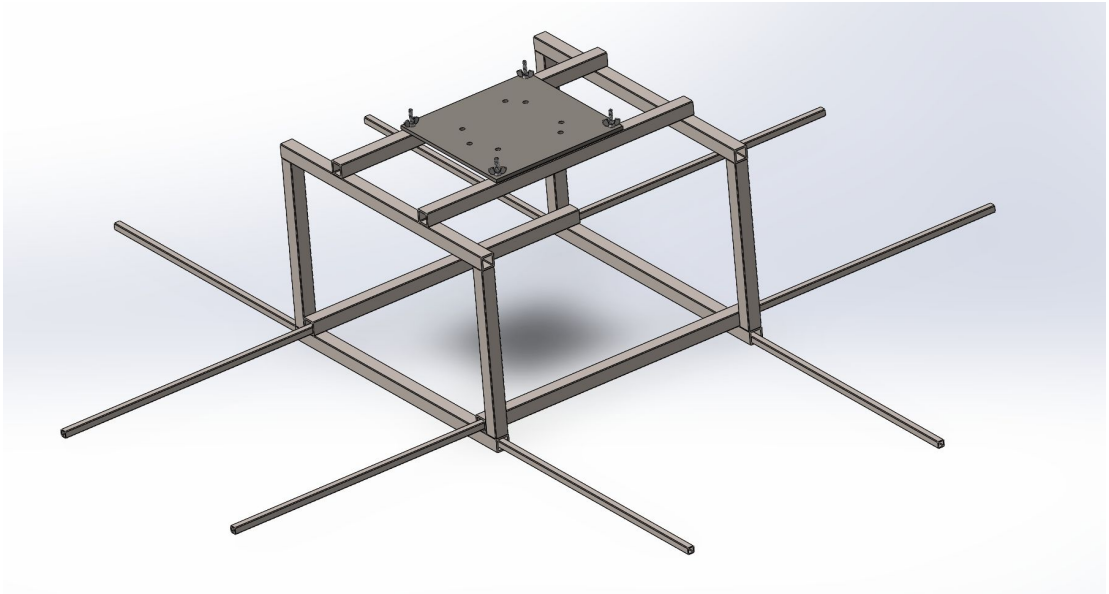
- Max: 0.2975 mm



RMTS Frame - Support if Desired

- 4x: ½”x½”x0.065”x5’ Steel Tubes
- Adds: ~ 14 lbs + $15
- Currently Concept only - No analysis completed yet





Fabrication

The main structure will be manufactured by RMTS Industries. Some machined parts will be customized by suppliers with processing capabilities.

Electronic components will be assembled by RMTS Industries.

It is expected that the necessary materials will be purchased before October 13 and the manufacturing will be completed before October 31.

Test Plan

Each subsystem will test before assembly.

Mechanical components undergo simulation testing using finite element analysis software to verify strength and lifespan.

Electronic components undergo simulation testing using model-based design software to verify design performance and potential anomalies.

Complete simulator testing before November 5th.

Complete formal testing before November 24th.

Management Status

Organizational Structure

Chief Executive Officer (CEO): Josh Jones III

Chief Technology Officer (CTO): Matthew Johnson

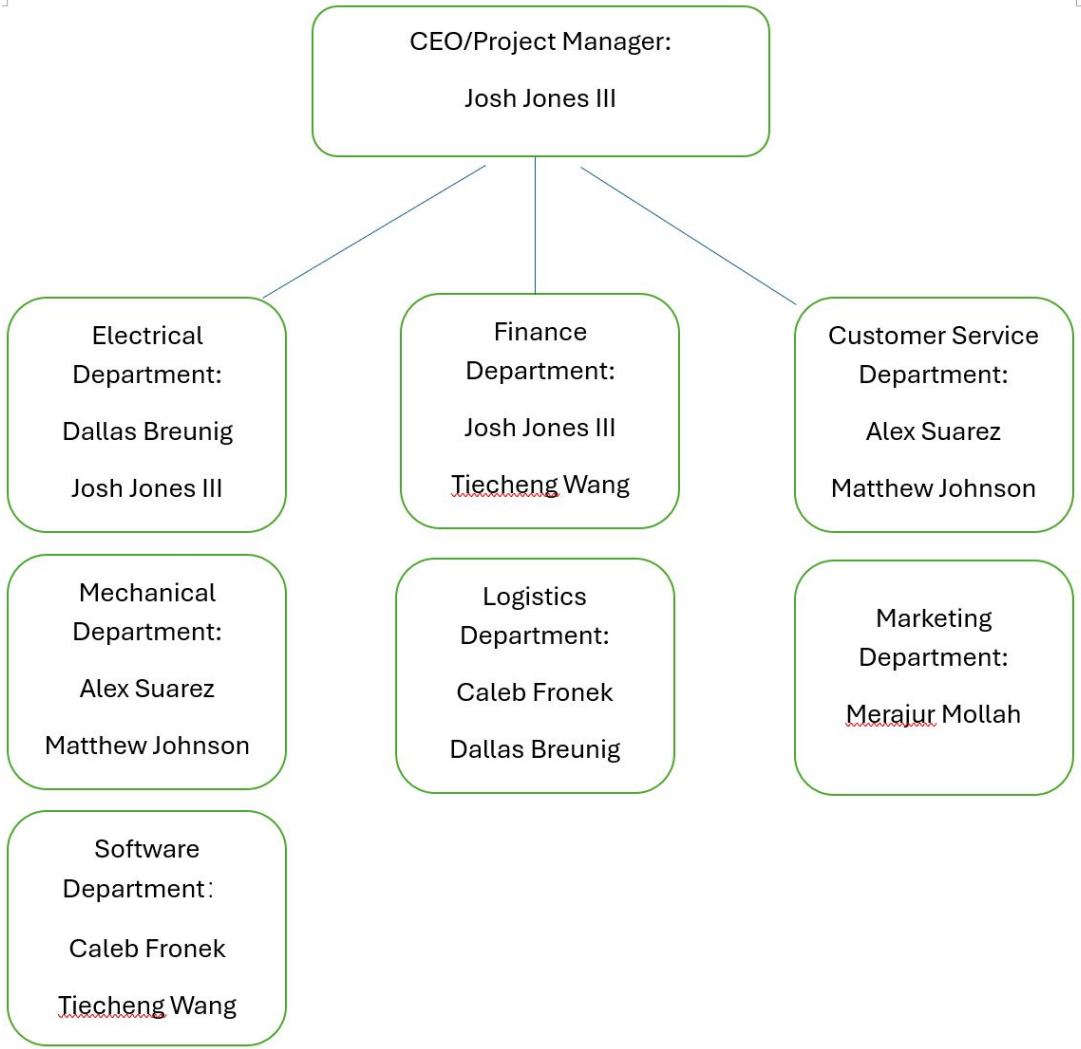
Chief Financial Officer (CFO): Tiecheng Wang

Chief Marketing Officer (CMO): Merajur Mollah

Chief Operations Officer (COO): Dallas Breunig

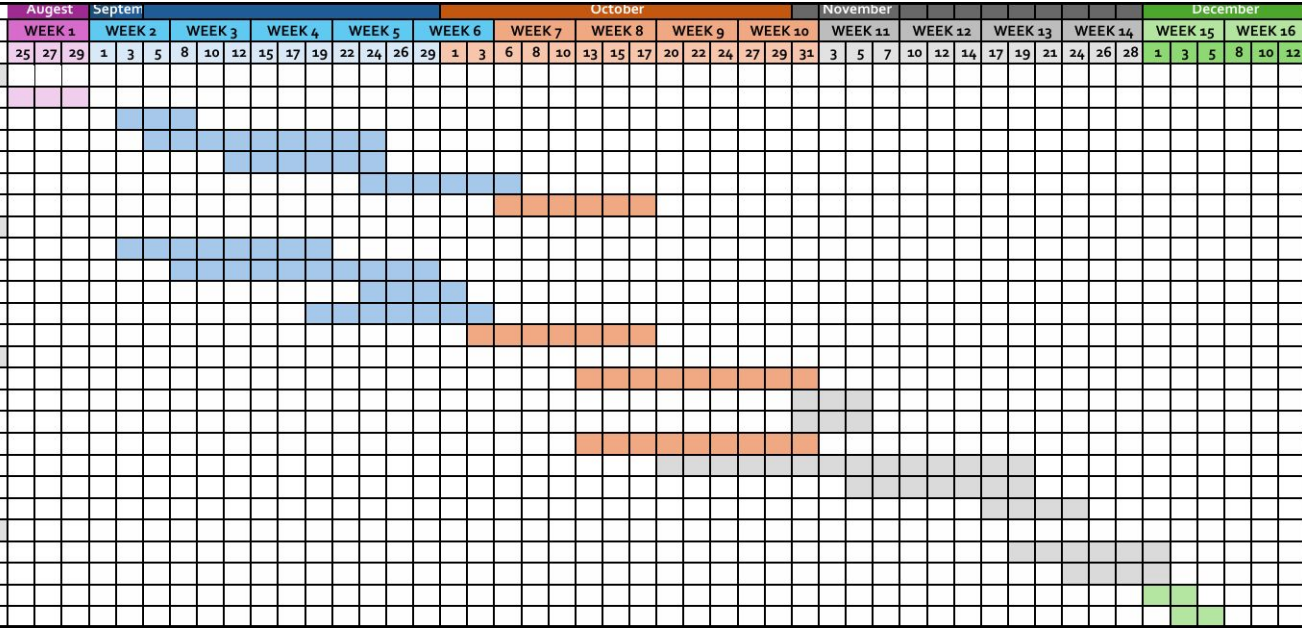
Chief Test Engineer (CTE): Caleb Fronek

Customer Service Executive (CSE)/Safety Officer (SO): Alex Suarez

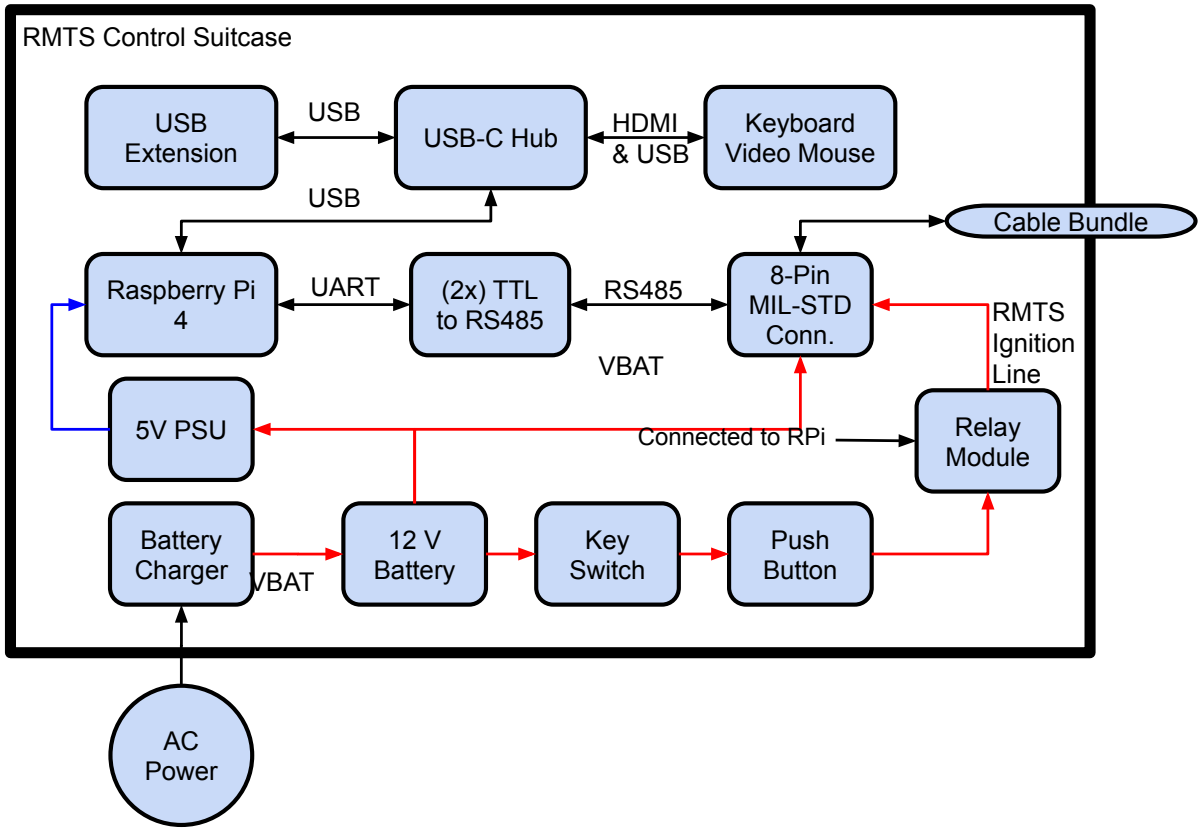

CEO/Project Manager:
Josh Jones III
Electrical Department:
Dallas Breunig
Josh Jones III
Finance Department:
Josh Jones III
Tiecheng Wang
Customer Service Department:
Alex Suarez
Matthew Johnson
Mechanical Department:
Alex Suarez
Matthew Johnson
Logistics Department:
Caleb Fronek
Dallas Breunig
Marketing Department:
Merajur Mollah
Software Department:
Caleb Fronek
Tiecheng Wang

Program Schedule

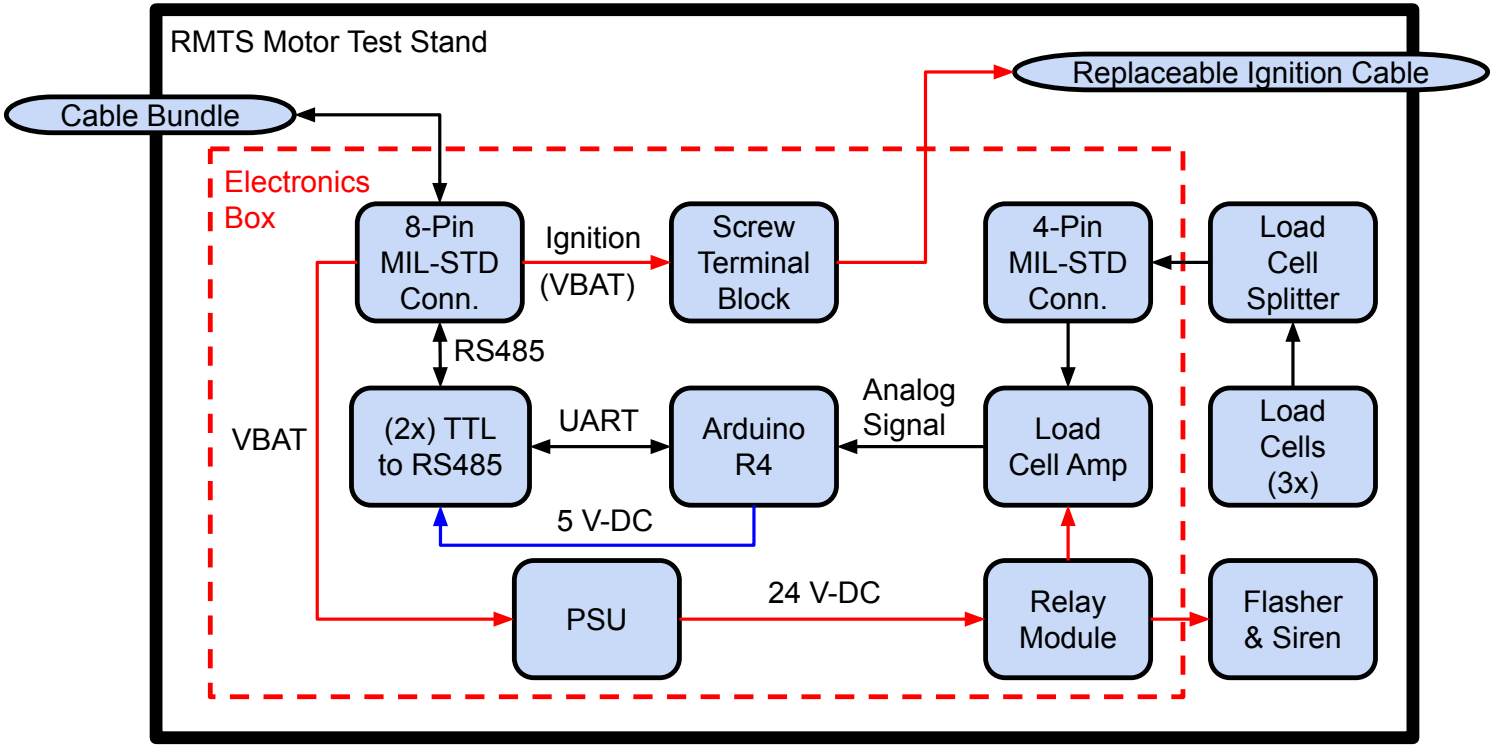
NUMBER	TASK TITLE	START DATE	DUE DATE	DURATION
Phase 1:	Design			
1.1	Statement of Work	8/25/25	8/29/25	4
1.2	Systems Requirements Review	9/3/25	9/8/25	5
1.3	EAP/FMEA	9/5/25	9/24/25	19
1.4	Alternative Systems Review	9/12/25	9/24/25	12
1.5	Preliminary Design Review	9/24/25	10/6/25	12
1.6	Critical Design Review (CDR)	10/6/25	10/17/25	11
Phase2:	Preparation			
2.1	Proposal	9/3/25	9/19/25	16
2.2	EAP/Draft FMEA	9/5/25	9/29/25	24
2.3	RTM	9/24/25	10/1/25	7
2.4	Contract	9/19/25	10/3/25	14
2.5	Draft User's Manual	10/3/25	10/17/25	14
Phase 3:	Build			
3.1	Test Plan	10/13/25	10/31/25	18
3.2	Final FMEA	10/31/25	11/5/25	5
3.3	Simulation Test	10/31/25	11/5/25	5
3.4	Oreder Parts and Build	10/13/25	10/31/25	18
3.5	Prototype Build	10/20/25	11/19/25	29
3.6	Test Readiness Review	11/5/25	11/19/25	14
3.7	Testing Phase & Testing Report	11/19/25	11/24/25	5
Phase 4:	Briefing			
4.1	Final User's Manual	11/19/25	12/1/25	12
4.2	Performance Acceptance Demonstration	11/24/25	12/1/25	7
4.1	Final Briefing Slides & Written Report	12/1/25	12/3/25	2
4.2	Final Briefing	12/3/25	12/5/25	2



System Block Diagrams - Suitcase Diagram



System Block Diagrams - Test Stand Diagram



Electronics Budget

Item	Description	Quantity	Unit Price ($)	Total Price ($)
Load Cell	ATO-LC-S02 10 kg load cell with amplifier	3	$82.59	$247.77
Load Cell	ATO-LC-S02 50 kg load cell with amplifier	3	$82.59	$247.77
Load Cell Amplifier	Load Cell Transmitter, Output 0-5V	1	$81.27	$81.27
Load Cell Splitter	Load Cell Splitter, 3 to 1	2	$66.67	$133.34
Control Board	Raspberry Pi 4 8GB	1	$75.00	$75.00
Control Board	Arduino R4	1	$27.50	$27.50
Flasher/Siren	24 V Flasher with Buzzer	1	$113.00	$113.00
RS485 Driver	TTL to RS485 driver board (x10)	1	$10.39	$10.39
Female Connector	Amphenol PT02E-12-8S	2	$16.51	$33.02
Male Cable Connector	Amphenol PT06E-12-8P(SR)	2	$33.42	$66.84
Battery Converter	12 V Battery Charger (60 A)	1	$123.62	$123.62
Data Cable	CAT6 Ethernet Cable 125 ft	1	$29.99	$29.99
Power Converter	12 V to 24 V Step-up Converter	1	$53.26	$53.26
Key Switch	Keylock Switch SPST 8A 24V-DC	1	$20.14	$20.14
Push Button	Momentary Contact Switch, 10 A-DC	1	$6.99	$6.99
Male Connector	Amphenol MS3102E14S-2P	1	$10.00	$10.00
Female Cable Connector	Amphenol MS3106E14S-2S	2	$23.18	$46.36
USB Extension	Panel mounted USB extension	1	$4.95	$4.95
USB Power Converter	12V/24V DC to 5V 3A USB-C converter	2	$9.99	$19.98
Monitor	Portable monitor	1	$50.99	$50.99
Keyboard + Mouse	Keyboard with integrated touchpad mouse	1	$39.99	$39.99
USB Hub	USB Hub	1	$9.99	$9.99
Battery	ATV 12V SLA or LiFePo4 Battery, 7 Ah	1	$60.00	$60.00
Power Cable	14 AWG Stranded Wire Spool (500 ft)	1	$78.00	$78.00
Relay Module	Dual Relay Module	2	$6.25	$12.50
		Subtotal		$1,602.66

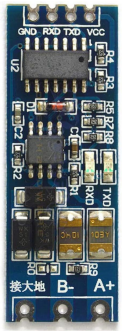
Suitcase Major Power Using Components

Component	Current Draw	Quantity	Total Current Draw
Raspberry Pi 4 8GB	3 A maximum at 5 V DC	1	3 A
TTL to RS485 driver board	Unknown, but similar TI chips can use up to 60 mA at 5 V DC	2	0.12 A
Portable monitor	2 A maximum at 5 V DC	1	2 A
Keyboard with integrated touchpad mouse	Battery powered	1	0 A
Dual Relay Module	20 mA at 5 V DC	1	0.02 A
		Total	5.14 A at 5 V DC (~2.142 A at 12 V DC)

*12V/24V DC to 5V 3A USB-C converter is up 96% efficient

Suitcase Power Using Components

Raspberry Pi 4
(https://www.digikey.com/en/products/detail/raspberry-pi/SC0195-9/12159401)



Bi-Directional TTL/RS485 Converter Module
(https://www.amazon.com/hiBCTR-Bi-Directional-Auto-Direction-Industrial-Automation/dp/B0F543Q89N)

Dopesplay 15.6” Portable Monitor
(https://www.amazon.com/Portable-Ultra-Slim-External-Kickstand-Extender/dp/B0D8JXY8V3)

Arteck Keyboard/Touchpad
(https://www.amazon.com/Portable-Ultra-Slim-External-Kickstand-Extender/dp/B0D8JXY8V3)

TS0010D Dual Relay
(https://www.digikey.com/en/products/detail/sunfounder/TS0010D/18668618)

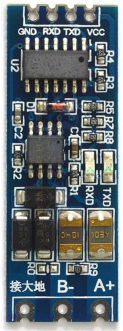
Test Stand Major Power Using Components

Component	Current Draw	Quantity	Total Current Draw
Arduino R4	124 mA at 5 V DC maximum during analog sampling (~52 mA at 12 V DC)	1	0.052 A
TTL to RS485 driver board	Unknown, but similar TI chips can use up to 60 mA at 5 V DC (~25 mA at 12 V DC)	2	0.05 A
Load Cell Amplifier/Transmitter	20 mA at 24 V DC (~40 mA at 12 V DC)	1	0.04 A
Flasher/Siren	75 mA at 24 V DC (~150 mA at 12 V DC)	1	0.15 A
Dual Relay Module	20 mA at 5 V DC (~8.3 mA at 12 V DC)	1	0.0083 A
Ignition	2 A estimated maximum at 12 V DC	N/A	2 A
		Total	2.3003 A at 12 V DC

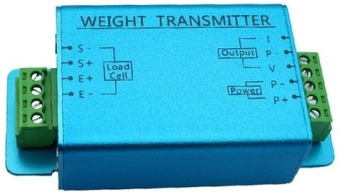
*12 V to 24 V Step-up Converter is up 94% efficient

Test Stand Power Using Components

Arduino R4
(https://www.digikey.com/en/products/detail/arduino/ABX00087/20371539)



Bi-Directional TTL/RS485 Converter Module
(https://www.amazon.com/hiBCTR-Bi-Directional-Auto-Direction-Industrial-Automation/dp/B0F543Q89N)



Load Cell Amplifier/Transmitter
(https://www.ato.com/load-cell-transmitter-output-0-5v-4-20ma)

NE-M1ANB-M Flasher/Siren
(https://www.digikey.com/en/products/detail/patlite-u-s-a/NE-M1ANB-M/27505320)

TS0010D Dual Relay
(https://www.digikey.com/en/products/detail/sunfounder/TS0010D/18668618)

Mechanical Budget

Item	Description	Quantity	Unit Price ($)	Total Price ($)
Steel Tubing	TUBE SQ 1" X 1" X 1/8" X 20'	4	$45.00	$180.00
Deflector plate	Stainless Steel	1	$14.99	$14.99
Rocket Holder	Vevor Lathe Chuck	2	$73.99	$147.98
All machined parts	base plate, ejection catch, and spacers	1	$192.15	$192.15
M8 screws		6	$5.00	$30.00
M12 screws		6	$5.00	$30.00
Blue Loctite	Loctite 242	1	$8.00	$8.00
1/4" steel studs		4	$1.00	$4.00
1/4" wing nuts	4 pack	1	$1.50	$1.50
Paint	Spray on Bedliner Paintcan	1	$15.98	$15.98
Hard Case	Pelican 0370 Protector Case	1	$577.95	$577.95
Hard Case	Koah Weatherproof Hard Case (22"x14"x9")	1	$99.99	$99.99
			Subtotal	$1,302.54

Questions?

Acronyms

AC - Alternating Current

DC - Direct Current

GUI - Graphical User Interface

HDMI - High-Definition Multimedia Interface

MSDS- Material Safety Data Sheet

RMTS - Rocket Motor Test Stand

SOP - Standard Operating Procedure

UAF - University of Alaska Fairbanks

USB-C - Universal Serial Bus-C

Amp - Amplifier

ADC - Analog Digital Converter

FS - Factor of Safety