Motor Design Review

Solid Design Team

Scott Olivares, Esteban Mena, Tarique Perera, Nick Wood, and Jack Krienen

Design Objective

Avoid:

Goal:

Design Review

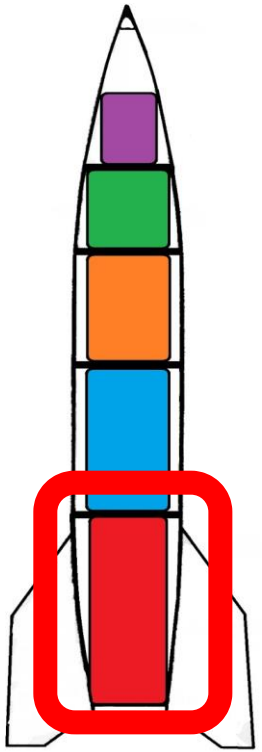
Payload

Drogue Chute

Payload/Avionics

Main Chute

Motor and Casing



Motor

- Propellant Selection:
  - HTPB with AP and Al
    - Non-detonable
    - Non-toxic
    - Medium cost
    - Good experience
    - Stable combustion
    - Good physical properties
    - Good burn rate

https://www.youtube.com/watch?v=I4wuotjgIqY

Motor

- Motor Selection:
  - Aerotech L2200G-P “Mojave Green”
    - High Peak Thrust
    - Quick Burn Time
    - High Total Impulse

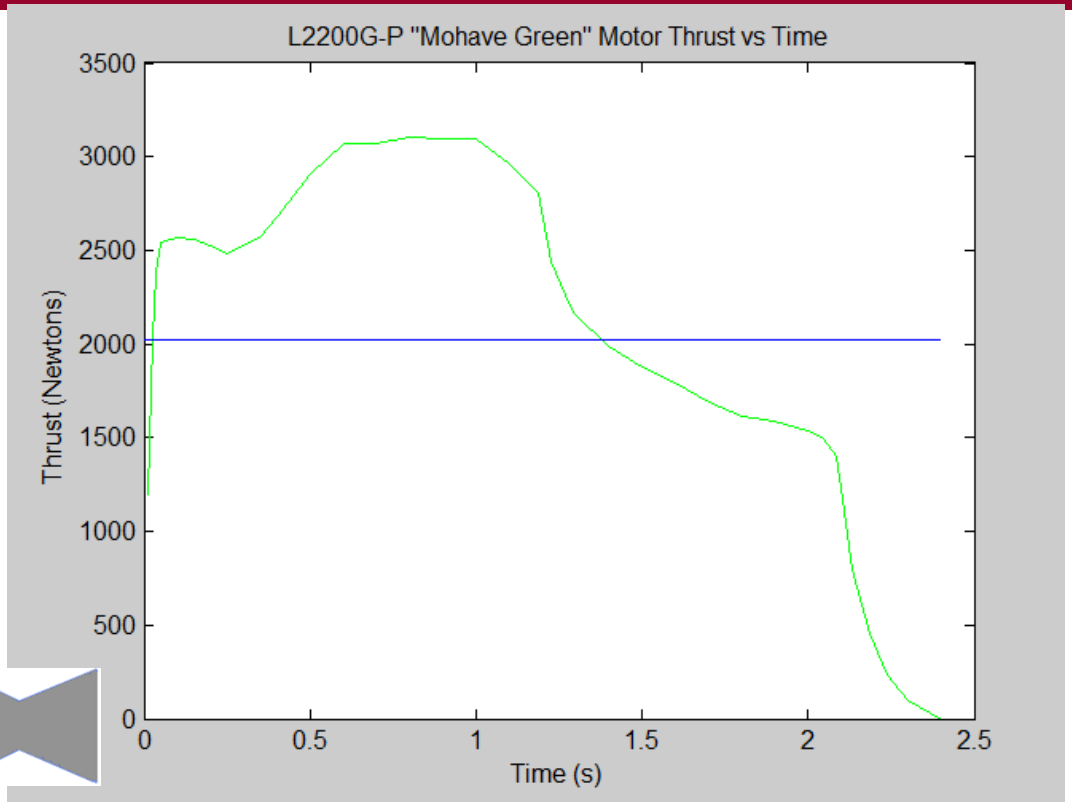
http://www.aerotech-rocketry.com/products.aspx

Motor Calculations

Assumptions:

- Mass of rocket: 16.78 kg ≅ 37 lb
- Mass of propellant: 2.518 kg ≅ 5.54 lb
- All propellant is burned up

Motor Performance

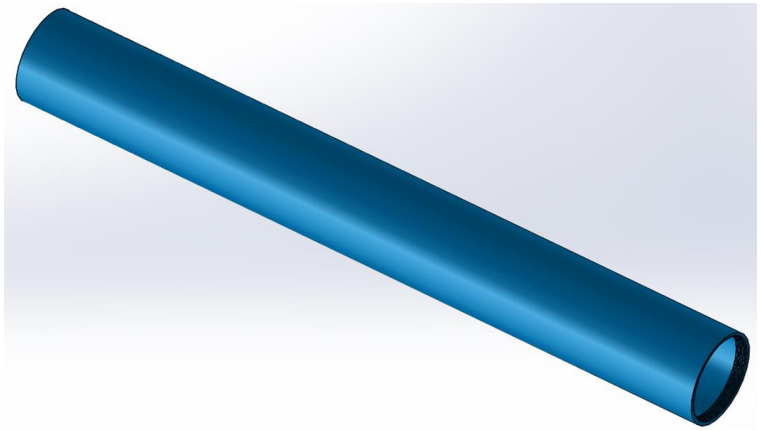


Motor Performance

- Burn time: 2.4s
- Total Impulse: 5097.6 N-s
- Specific Impulse: 206.4 s
- Average Thrust: 2020.7 N
- Peak Thrust: 3101.8 N
- Mass Ratio: 0.85
- Impulse-to-weight ratio: 30.97
- Thrust-to-weight ratio: 12.28
- Effective exhaust velocity: 2024.4 m/s

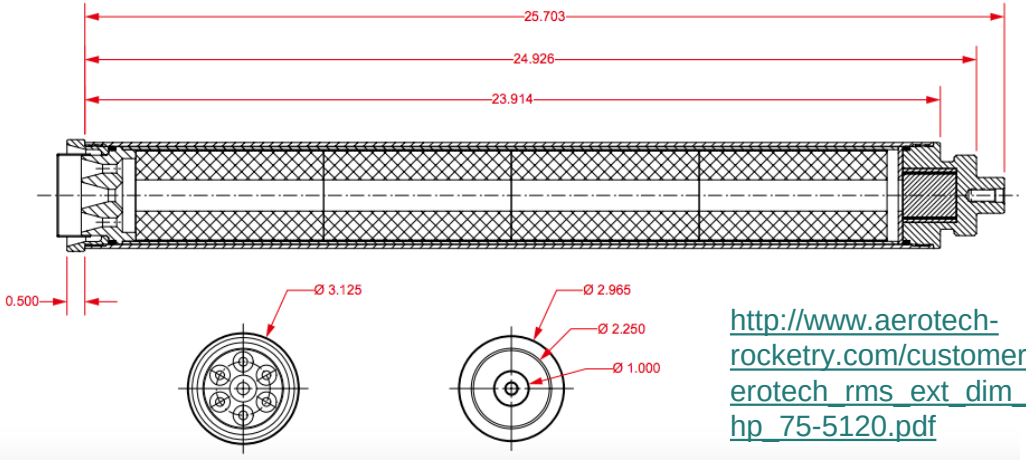
Casing

- Motor Case Material Selection:
  - Aluminum
    - Provides good strength-to-weight ratio
    - Lightest metal
    - Isotropic (properties are same in all directions)
    - Cost effective



Casing

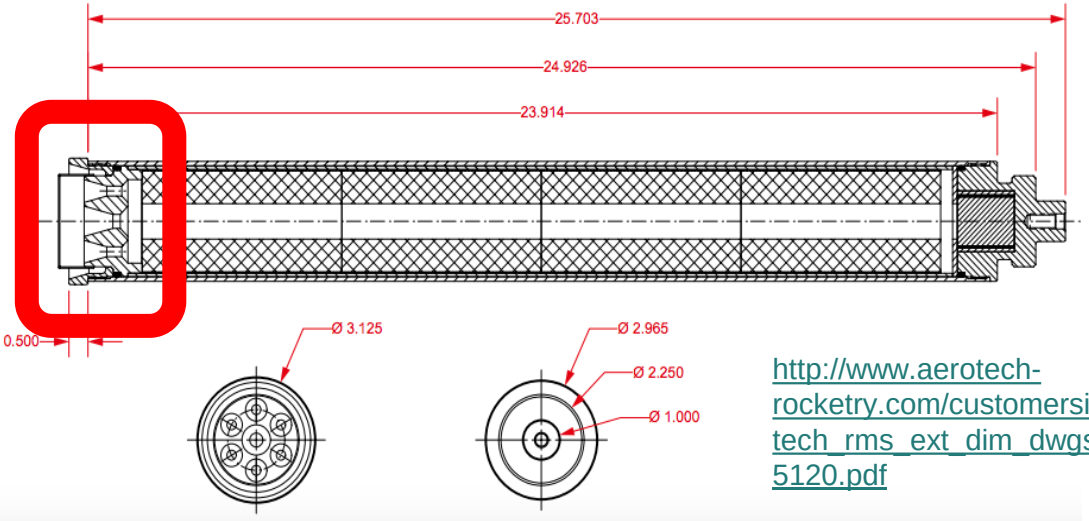
- Motor Case Design:
  - Based on RMS 75/5120



http://www.aerotech-rocketry.com/customersite/resource_library/aerotech_rms_ext_dim_dwgs/75mm_hp_rms/hp_75-5120.pdf

Nozzle

Nozzle Design



http://www.aerotech-rocketry.com/customersite/resource_library/aerotech_rms_ext_dim_dwgs/75mm_hp_rms/hp_75-5120.pdf

Igniter

- First Fire Starter for High Power Motors
  - H-size +
  - Requires 12 volt launch controller
- Ordered 6 packs of 3
  - Testing
  - Sharing

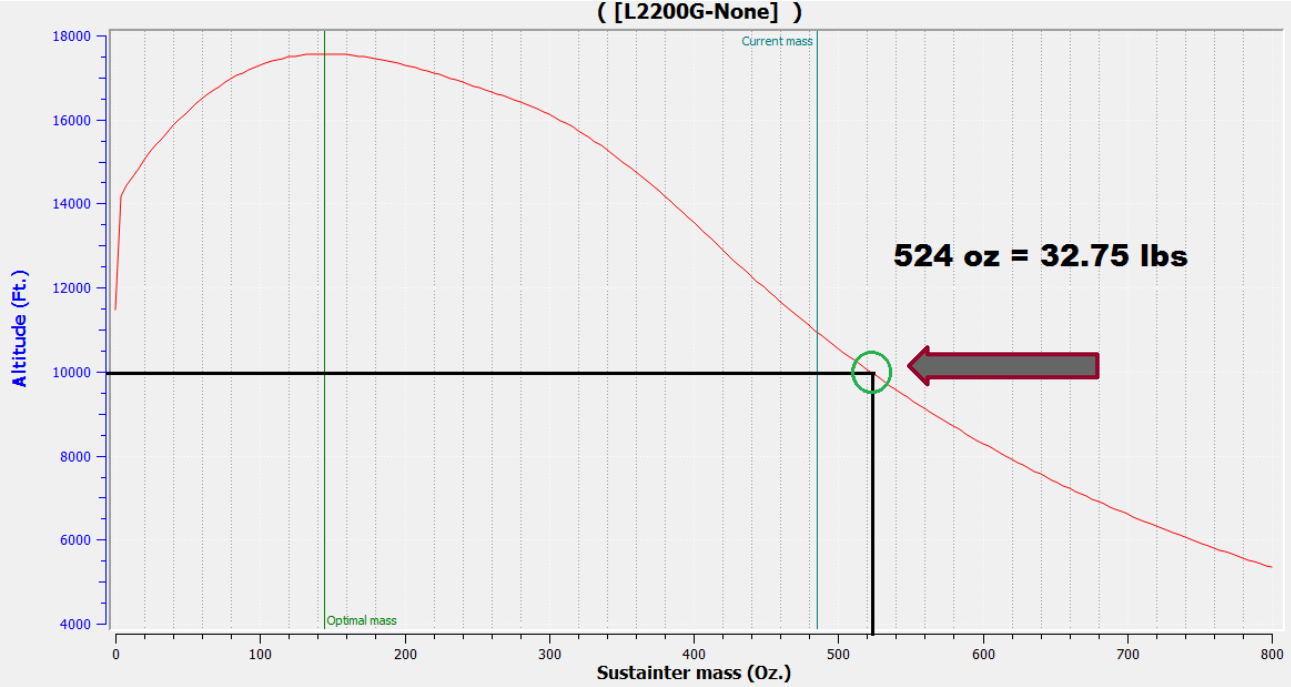
http://www.apogeerockets.com/Rocket_Motors/AeroTech_Accessories/First_Fire_Igniter

Fuselage

- Need to determine optimal weight
  - Propellant weight = 5.54 lbs
  - Case weight = 4-5 lbs
  - Payload weight = 10 lbs
  - Everything else = ??
- Use simulations to determine weight of “everything else”
- Design parts using these parameters

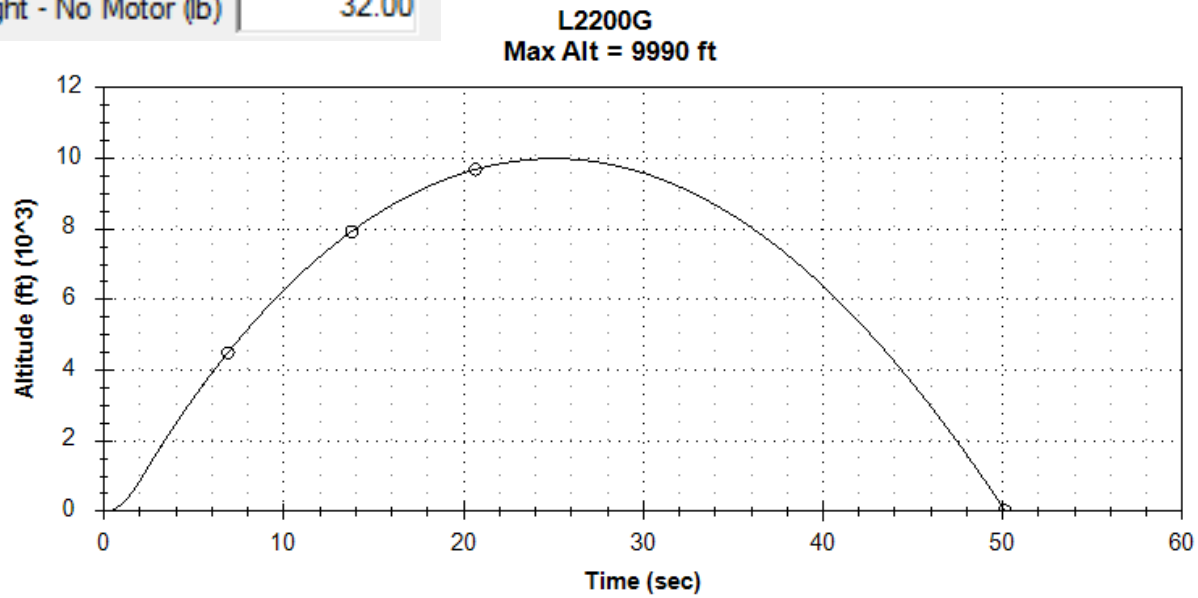
Optimal Weight

Rocksim:

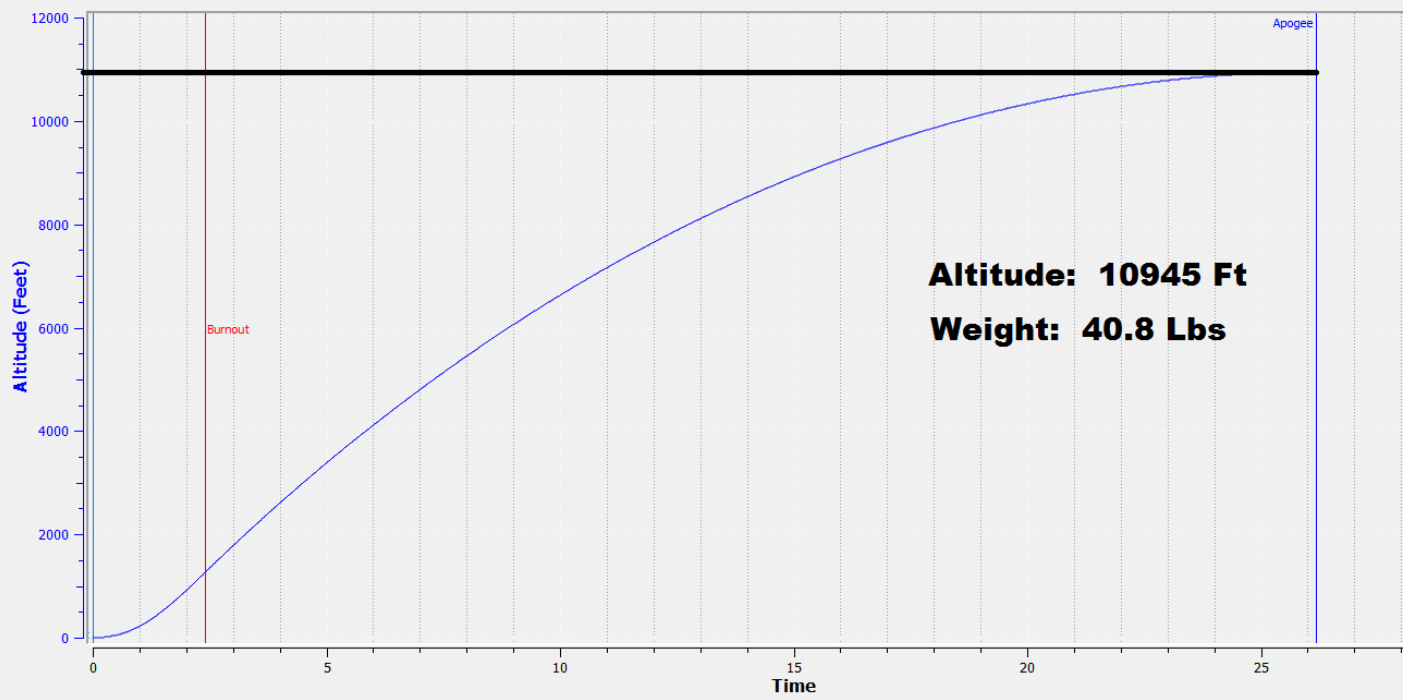


Simulations - RASAero

Motor Selection	L2200G (AT)	Liftoff Weight (lb)	42.47
		Weight - No Motor (lb)	32.00



Simulations - Rocksim



Current Model

- Fuselage
  - 1020 Steel
  - Length: 48 inches
  - ID: 3 inches
  - OD: 3.25 inches
- Nose Cone
  - Length: 8 inches
  - Ogive radius: 15 inches
- Fins
  - Root chord: 8 inches
  - Semi span: 4 inches
  - Tip chord: 3 inches
  - Leading edge: 6.4 inches

Building Materials

Income		Type	# of	Cost	Budget
Class budget Solid Team		base rate	1	$3,000.00	$3,000.00
Income Total					$3,000.00
Expenses		Type	# of	Cost	Budget
Motor Items	**Catalog #**				
AeroTech L2200G-P	12220P	Motor	4	$199.99	$799.96
First Fire Initiatiors for H and Above	89894	Pack of 3	6	$11.89	$71.34
Harardous Materials Shipping fee	n/a		1	$28.50	$28.50
Motor Case Items					
75mm Forward Closure	60160	Forward seal	1	$85.58	$85.58
75mm Aft closure	60169	Closure	1	$65.98	$65.98
Aluminum Tubing for Motor Case OD 3" and ID 2.75"		24"pipe	1	$15.15	$15.15
Fuselage Items					
Steel Tubing OD 3-1/4" and ID 3.01		48" Pipe	1	$50.02	$50.02
Aluminum Nose Cone A 3-1/4"		by inch	12	$3.85	$46.20
Aluminum Nose Cone B 3-1/4"		by inch	8	$3.85	$30.80
Expenses Total					$1,162.73
Net Total					**$1,837.27**

Building Materials

Catalog #	Description:	Quantity	Unit	Price	TOTAL
12220P	Aerotech L2200G-P Mojave Green	4.00	Motor	$199.99	$799.96
89894	First Fire Initiators for H and Above 3-Pack	6.00	Pack	$11.89	$71.34
	Hazardous Materials Shipping Charge	1.00		$28.50	$28.50
				TOTAL	$899.80

Shipping:	Next Day		Two Day		Three Day		
	Ground	x	Least		Electronic Delivery		

3 Team Plan?

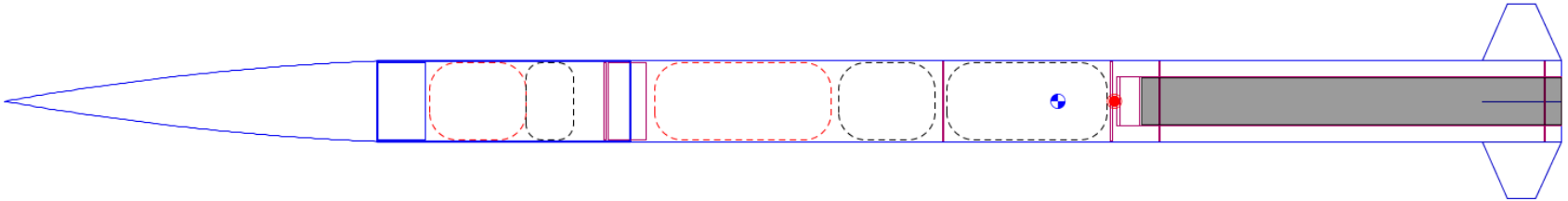
- Recovery Systems and Aerodynamics: Solid Design Team
- Electronics for Combustion: Hybrid and Fluids Design Teams

Aerodynamics And Recovery

- Work on a common platform
  - Payload and Recovery System Placement
  - Similarly sized main and drogue chutes
  - Electronics for chute deployment and altitude recording

Common Rocket Fuselage Design

- 5in Diameter
- 96in Length
- 30lbs (with the solid motor)



Next Steps

- Motor case
  - Order aluminum piping
  - Turn/bore to correct diameters
  - Thread
  - Completed by 04/01/2015
- Nose cone & Fins
  - Optimize design using aerodynamics
  - Select method for fin attachment
  - Completed by 04/15/2015
- Fuselage
  - Optimize design
  - Order piping
  - Completed by 04/15/2015
- Recovery Electronics
  - Parachute and Shock Cord Sizing
  - 3 Team Plan Dependant
  - Completed by 04/17/2015

Thank You!

Questions?