



University of North Dakota



2015 NASA Student Launch

Frozen Fury Rocket Team

Presented by Sofiane Chaieb

North Dakota Space Grant Annual Meeting
May 4, 2015

NASA Student Launch & Centennial Challenges



An 8 month commitment to design, construct, and launch a high-powered rocket with an operational autonomous ground support equipment.

Maxi-MAV Prize



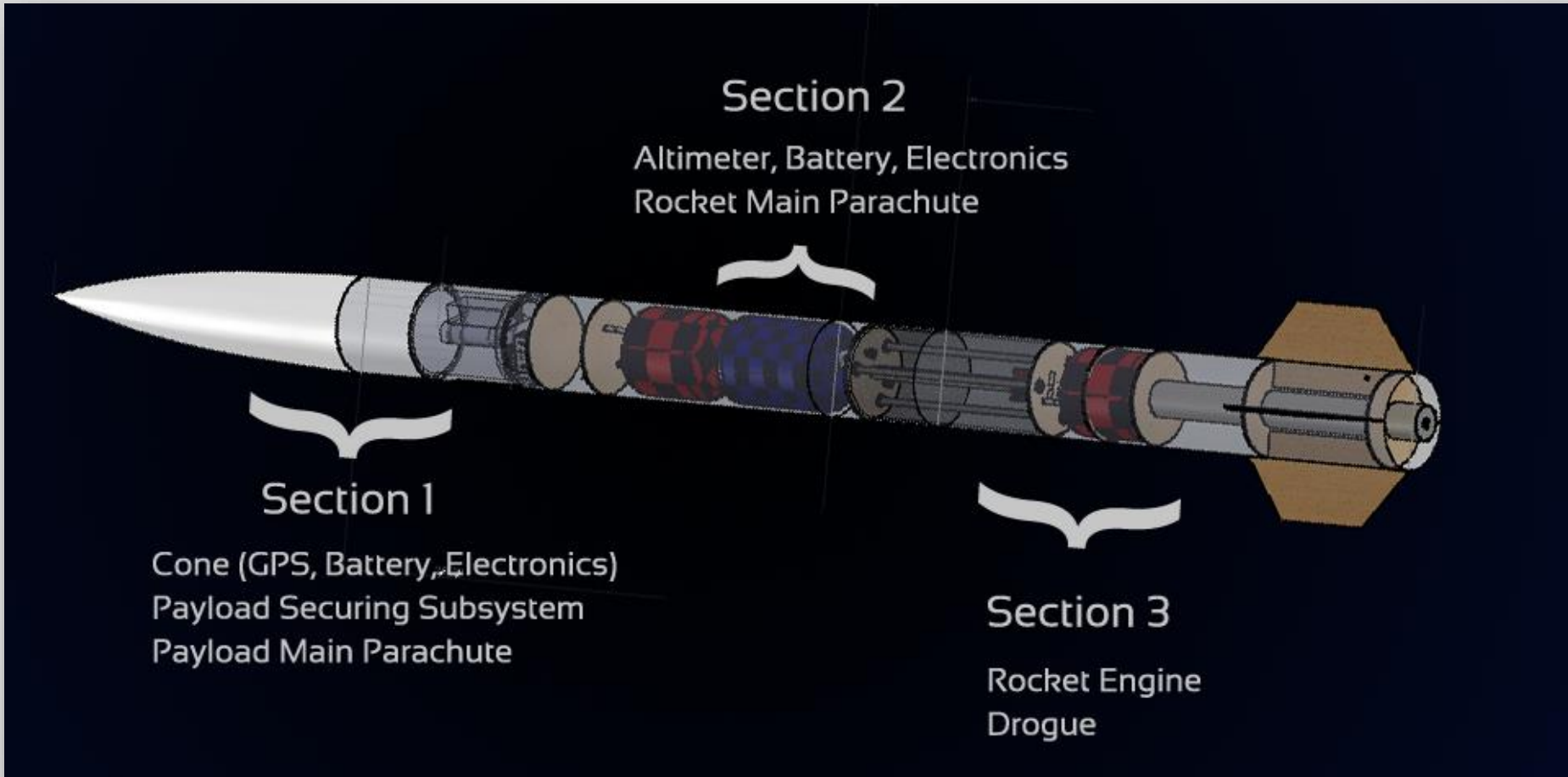
“Robotically capturing simulated Mars soil samples, loading the samples into a rocket, launching the high-powered rocket to 3,000 feet, and ejecting and returning the soil sample to Earth”

UND Frozen Fury Rocket Team



Credits: NASA TV

Launch Vehicle Design



Section 2

Altimeter, Battery, Electronics
Rocket Main Parachute

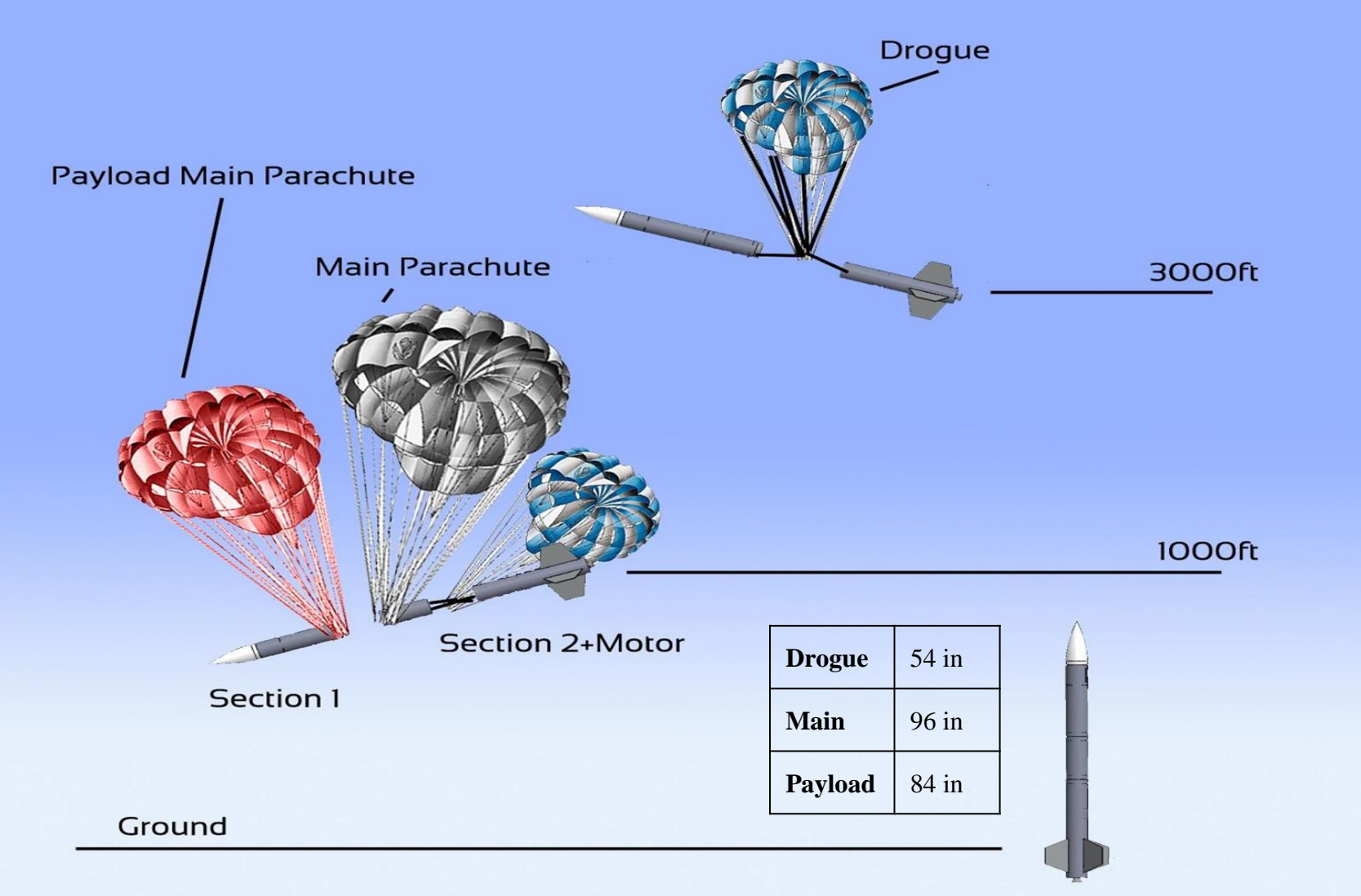
Section 1

Cone (GPS, Battery, Electronics)
Payload Securing Subsystem
Payload Main Parachute

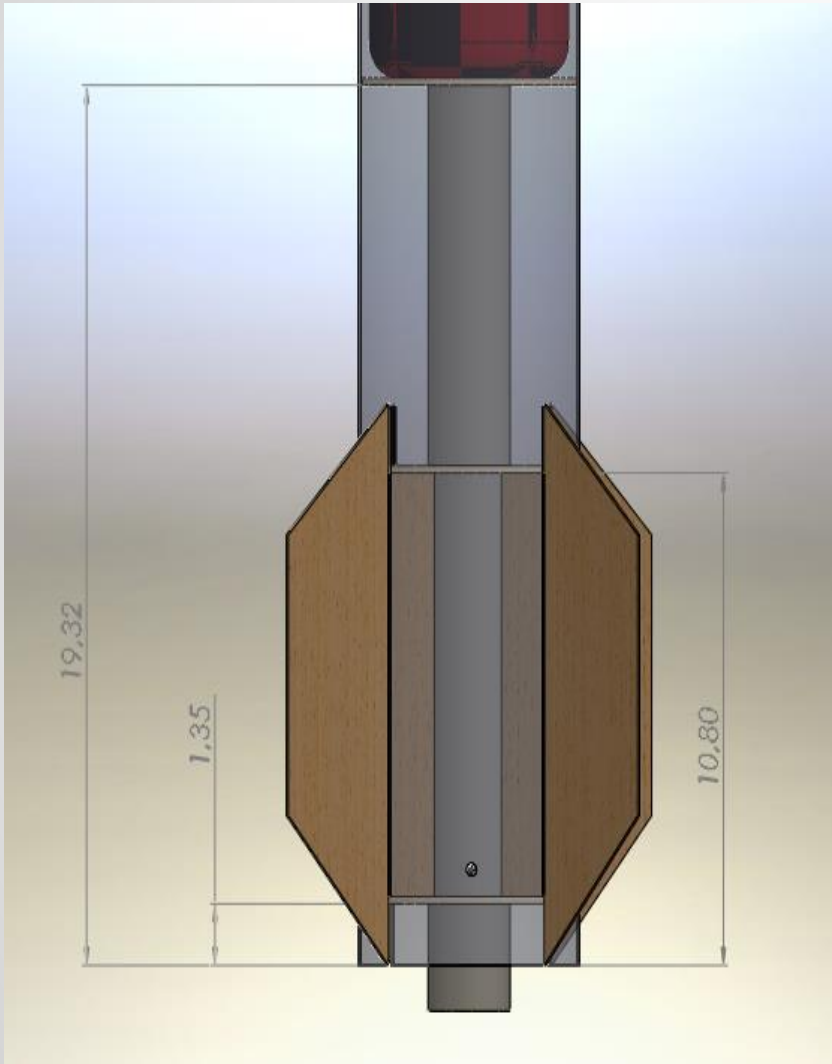
Section 3

Rocket Engine
Drogue

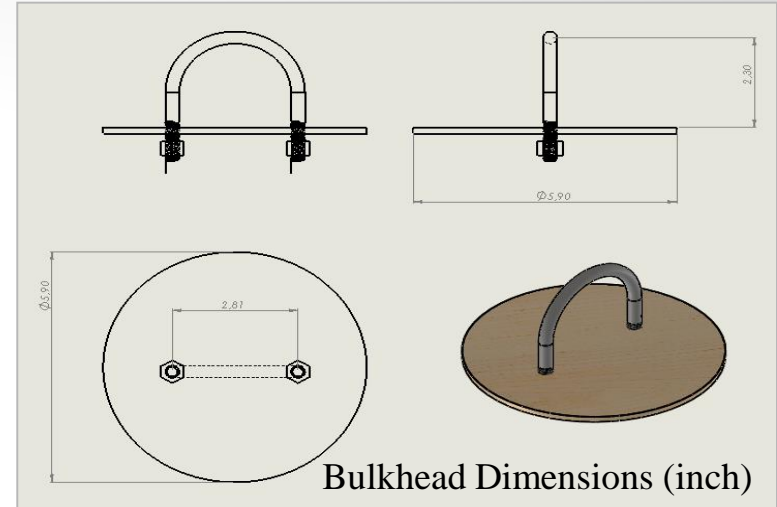
Launch and Recovery



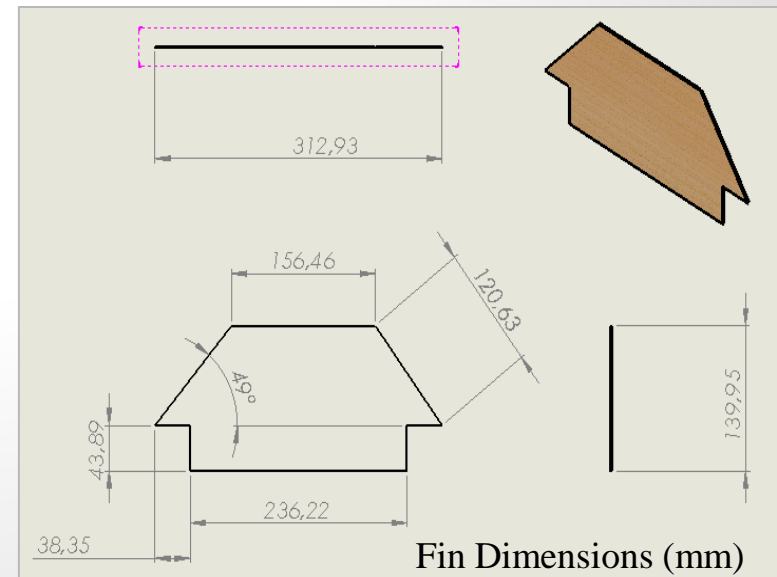
Launch Vehicle Design



Location of Centering Rings (inches)

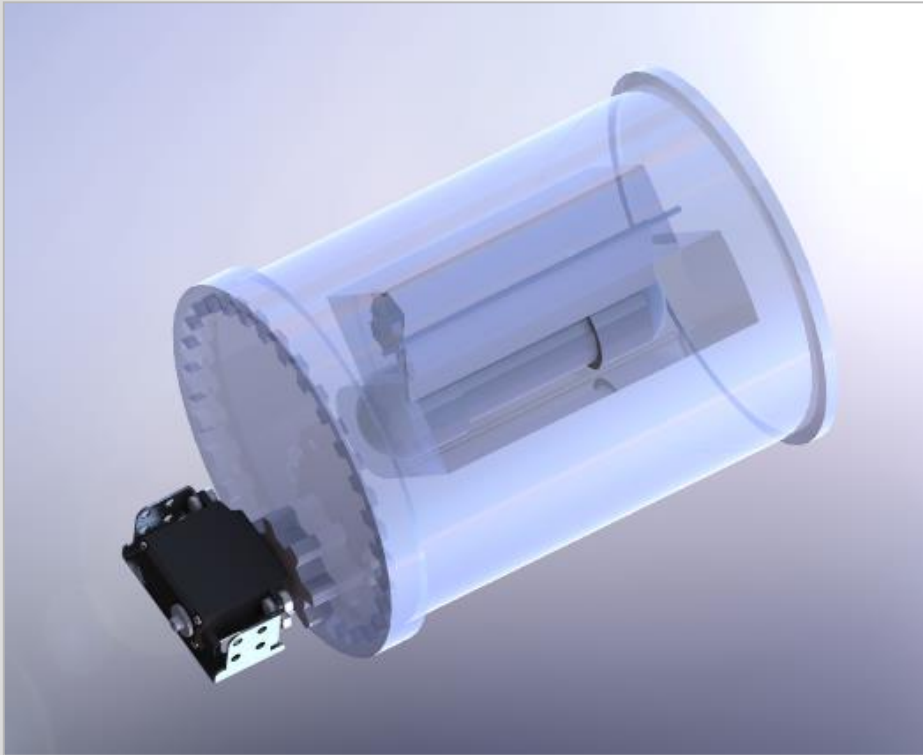


Bulkhead Dimensions (inch)

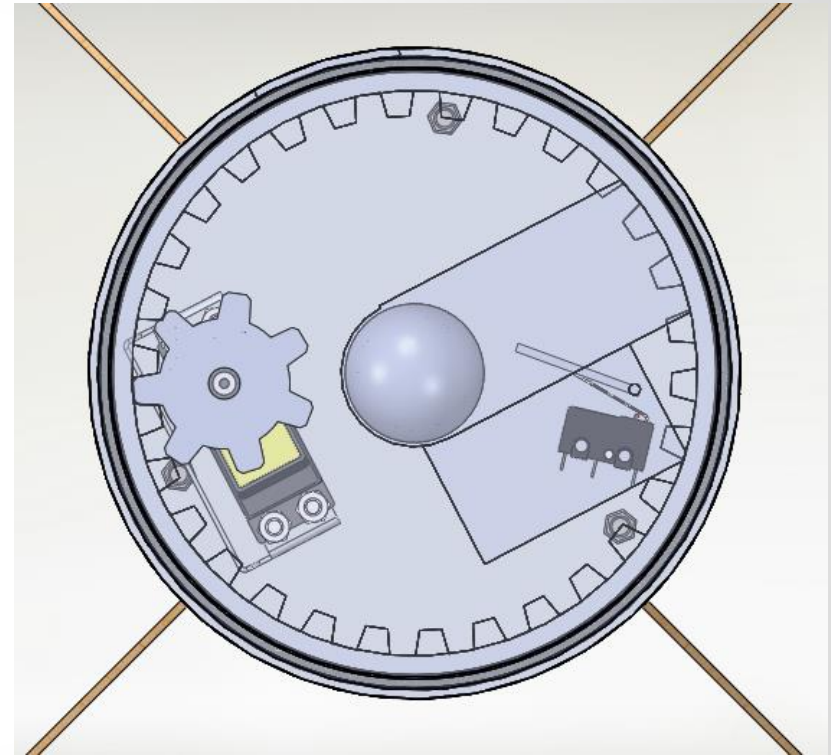


Fin Dimensions (mm)

Payload securing Design

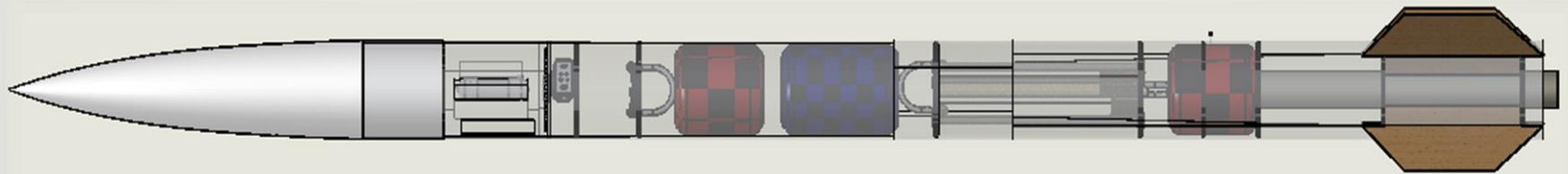
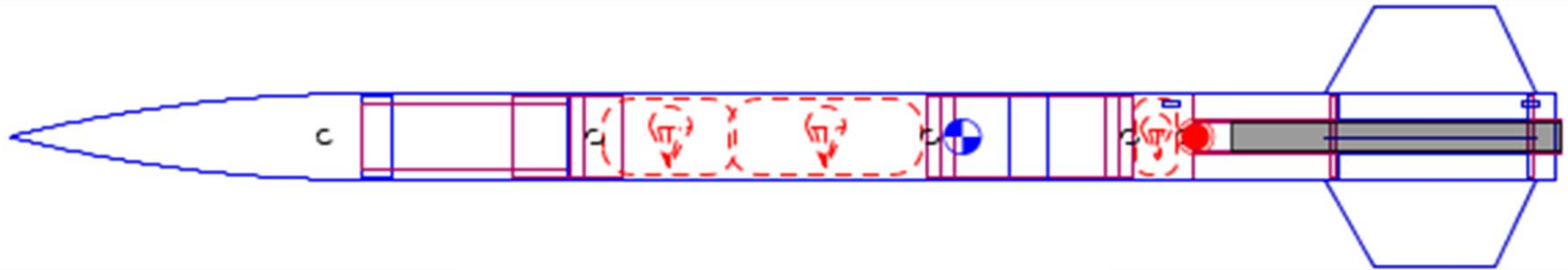


Payload Compartment 3-D View



Payload Compartment Rear View

Launch Vehicle Simulation



Length: 106 inches

Diameter: 6.116 inches

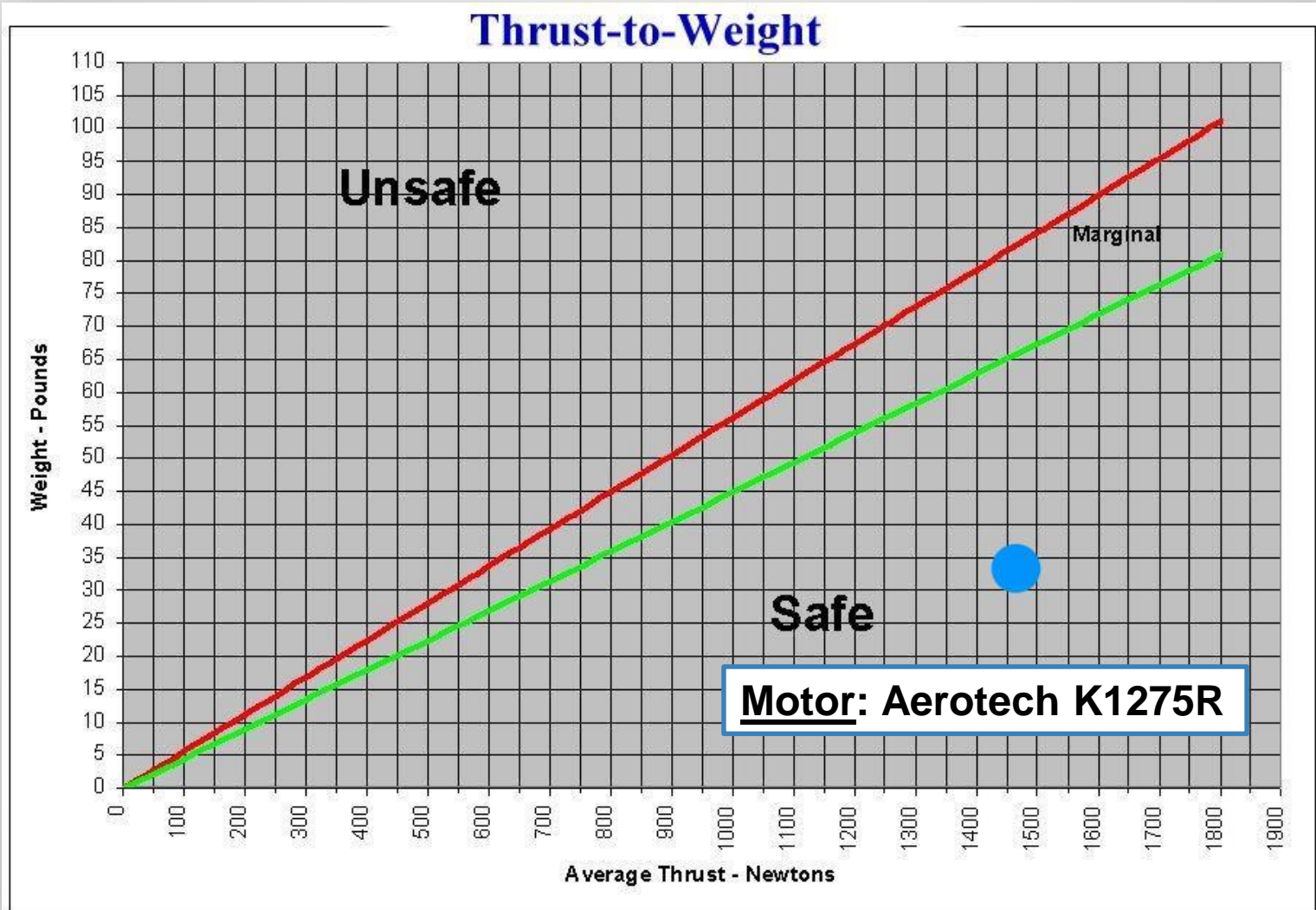
Mass: 29.2 lbs

Center of Gravity: 64,897 inches

Center of Pressure: 80.77 inches

Safety Margin: 2.6

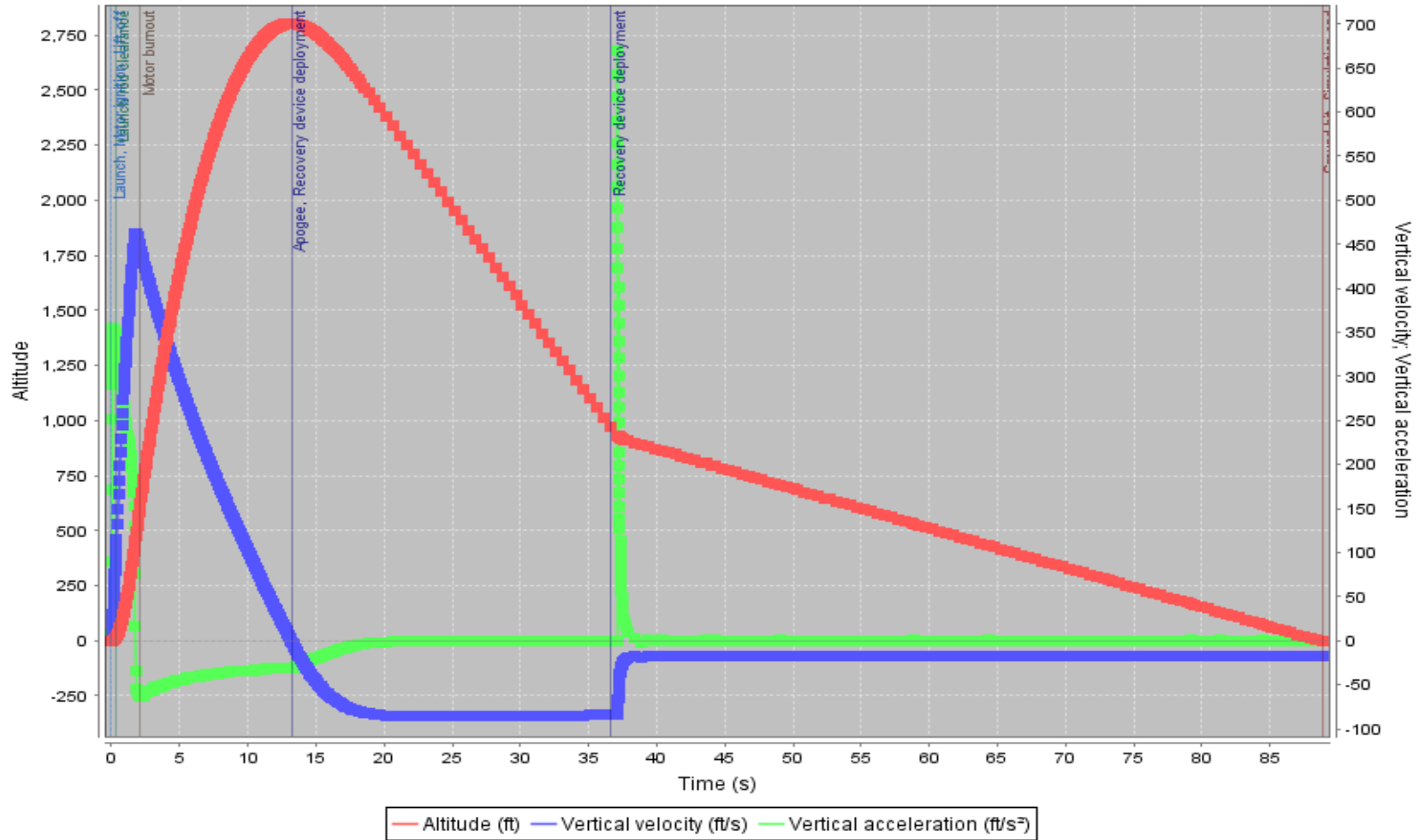
Thrust-to-Weight Ratio (stability off rod)



Thrust to weight ratio 9.85:1

Flight Analysis

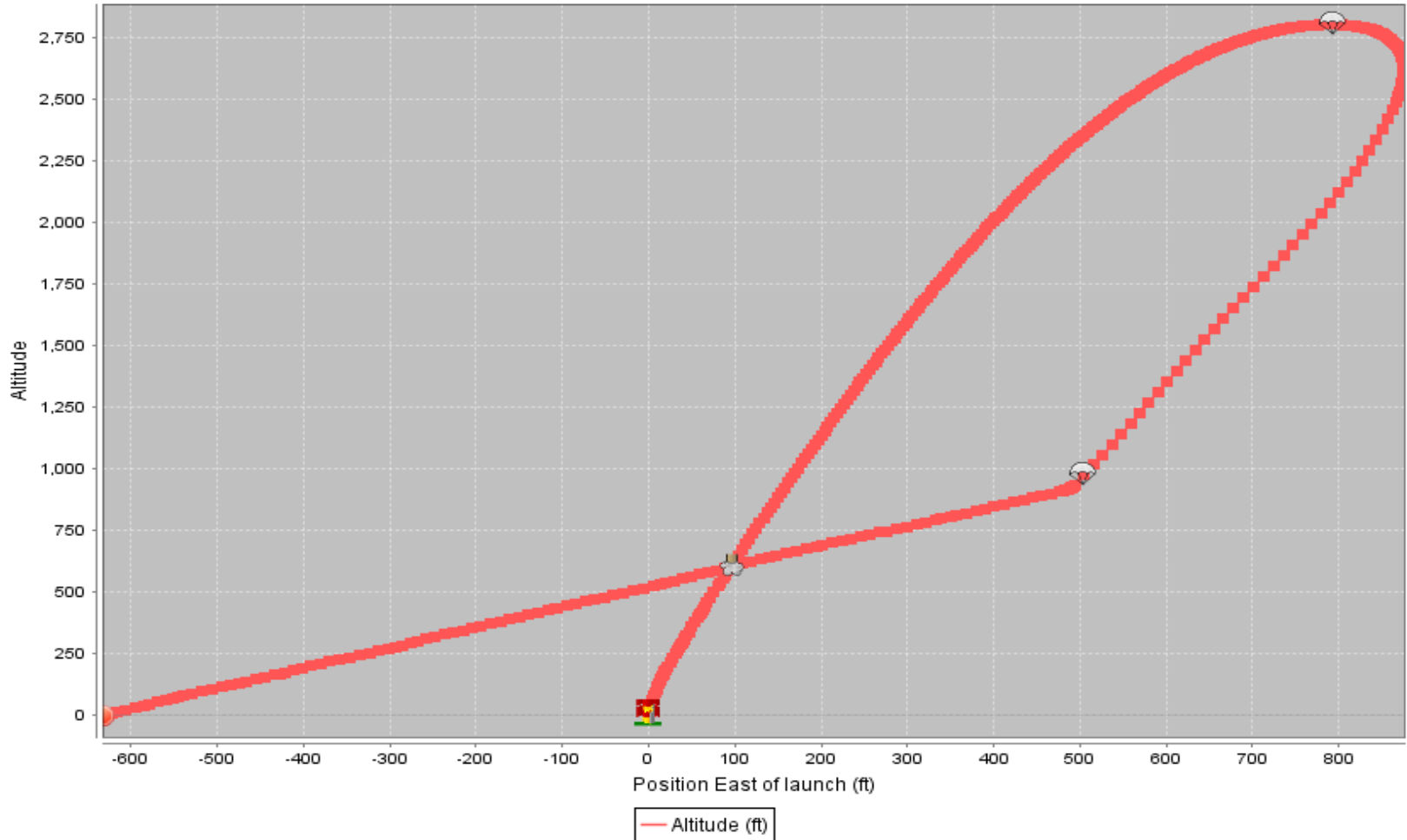
Simulation 11
Vertical motion vs. time



Total motion vs. Time

Drift Analysis at 5 mph

Simulation 11
Flight side profile



Launch Vehicle Construction



Full Launch Vehicle

LV Construction – Step 1



Airframe – carbon fiber

- Superior strength to weight ratio
- Ease of workability



Carbon fiber tubes reception from China (after cutting)



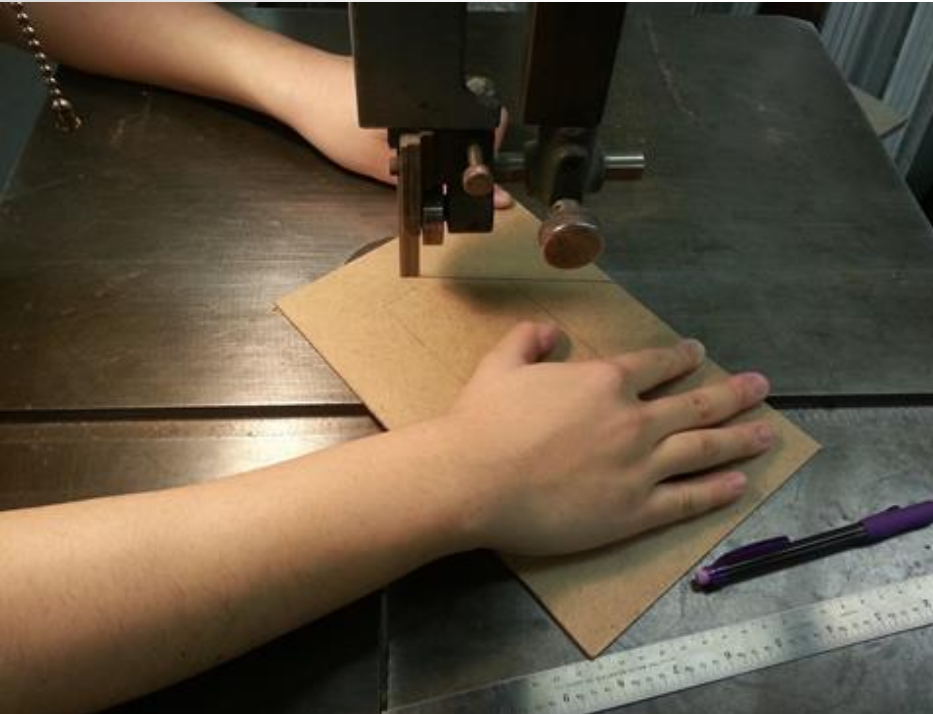
Couplers construction

LV Construction – Step 2



Fins – birch plywood epoxyed

The epoxy gives it a more rigid, strong, and lightweight structure



Construction of the fins



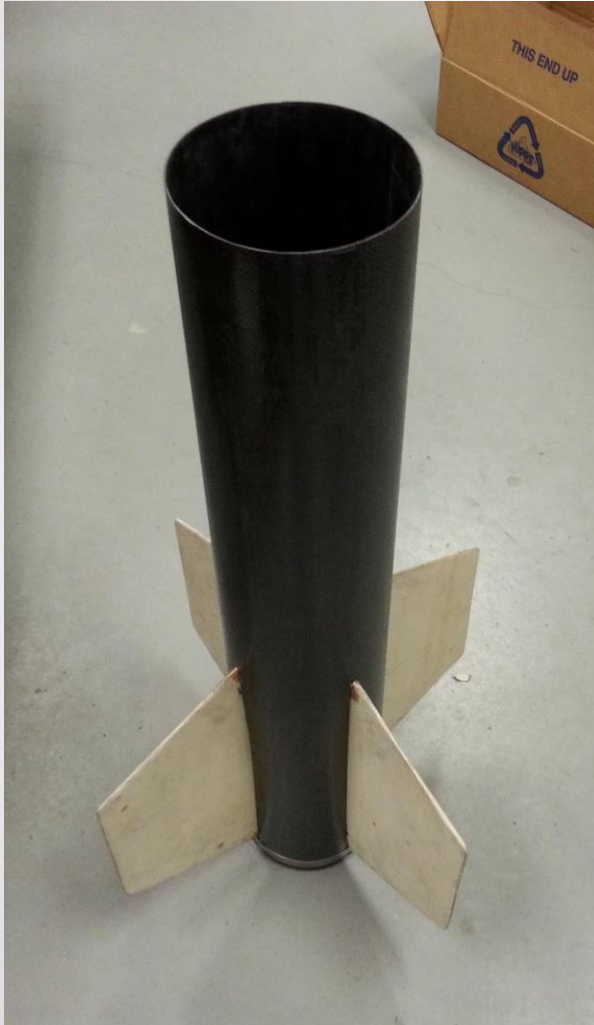
Epoxying of the fins

LV Construction – Step 3



Fin Can and Motor Mount

LV Construction – Step 4

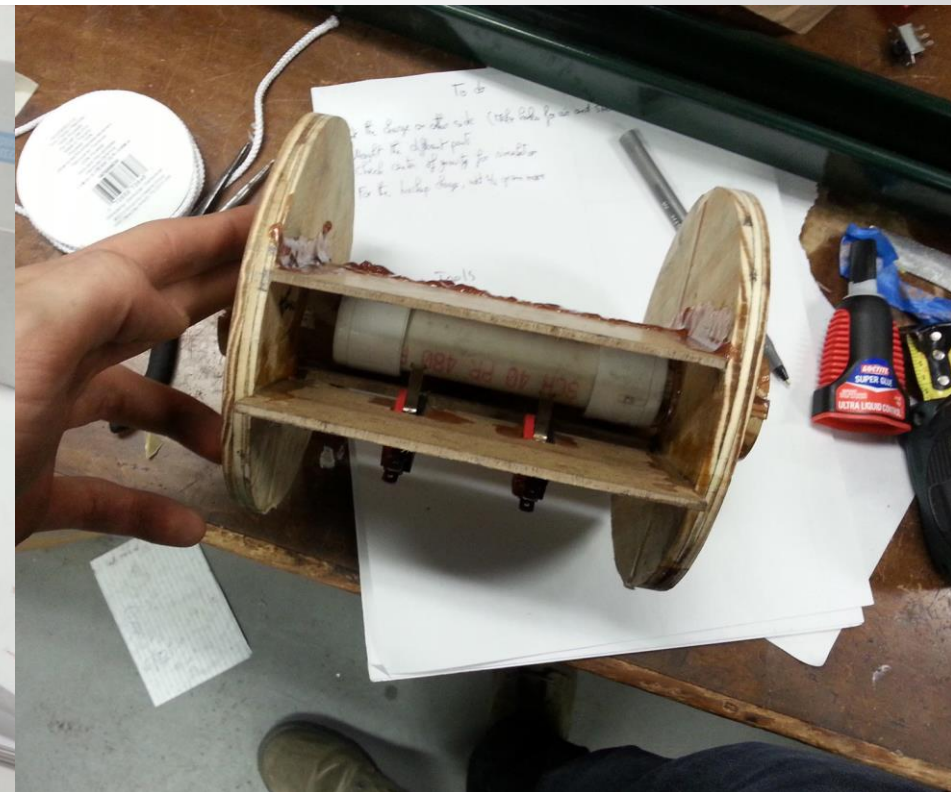
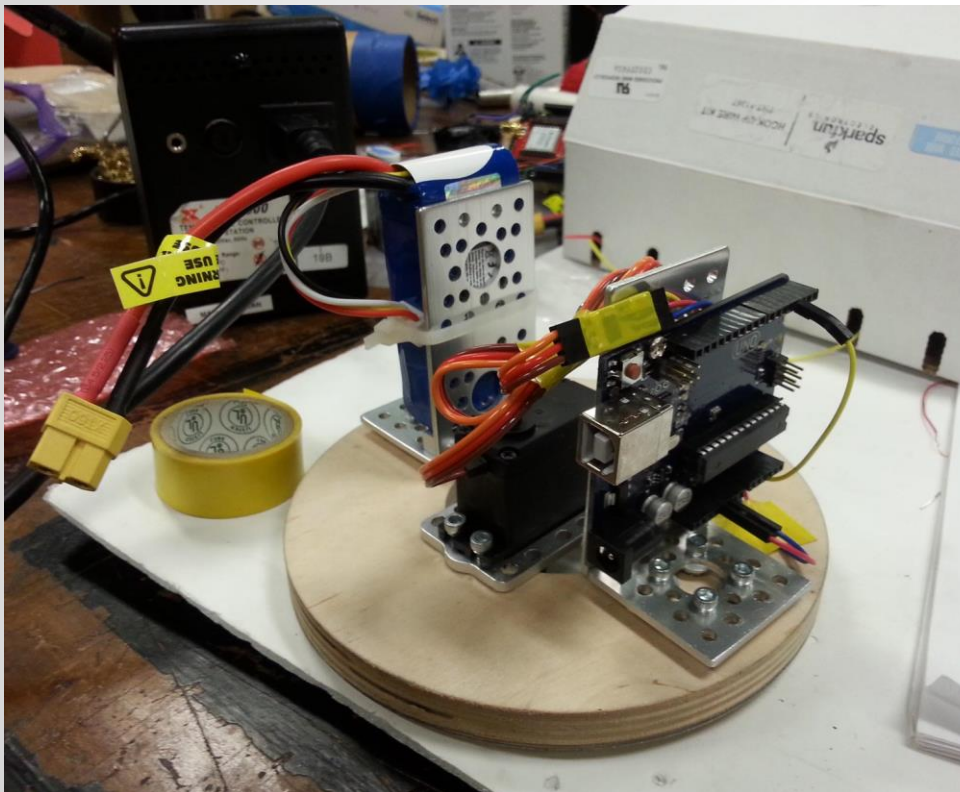


Motor Stage



Nose Cone

LV Construction – Step 5



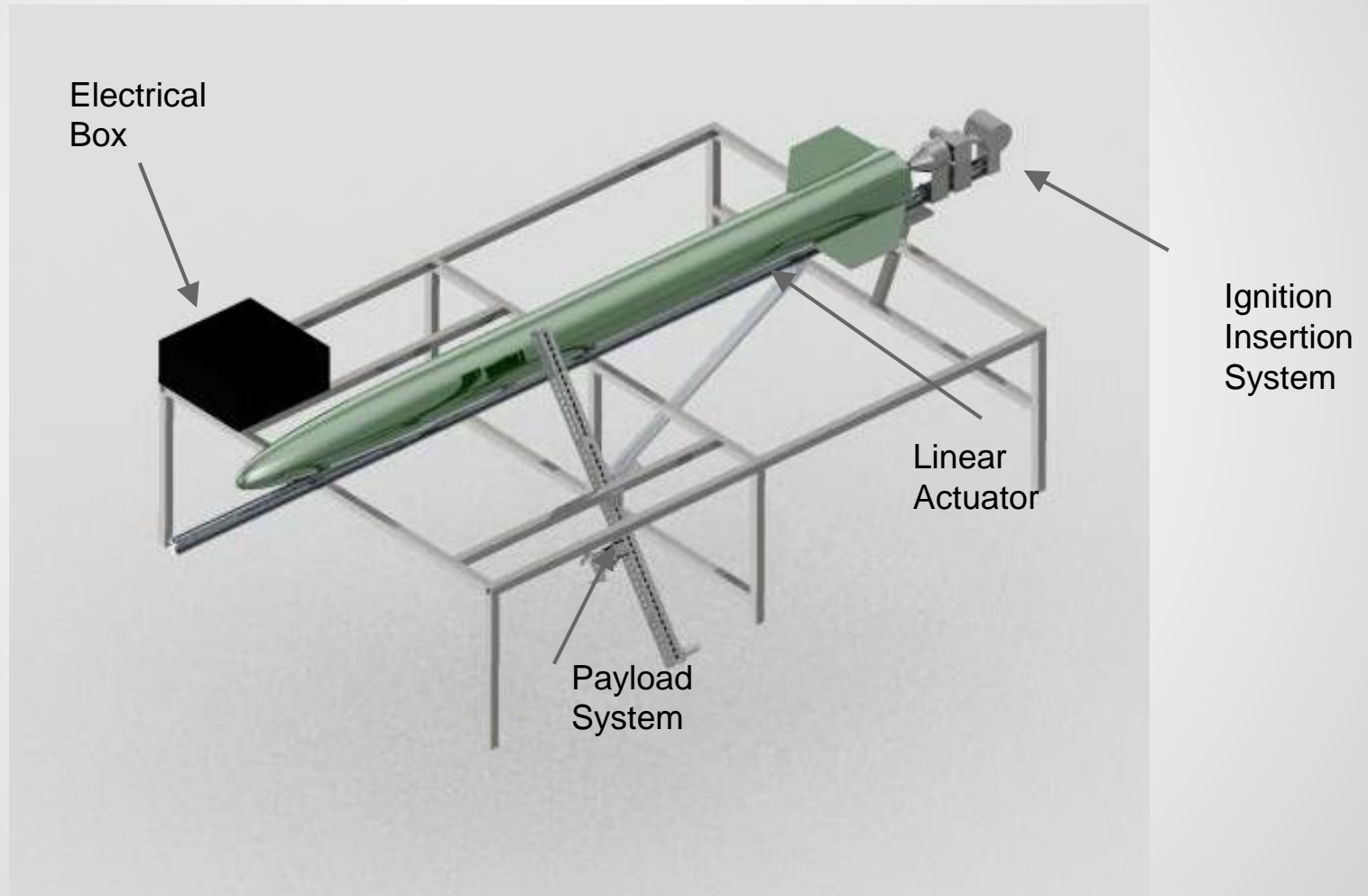
*Mounting of battery (1800mAh),
servo motor and Arduino UNO*

Payload Compartment

Launch Vehicle complete



Autonomous Ground Support Equipment Design



Rocket in Horizontal Position

AGSE Design



Nearly Completed AGSE

Frame



Placing the actuator mount.

Rocket Lifter



Igniter Insertion System

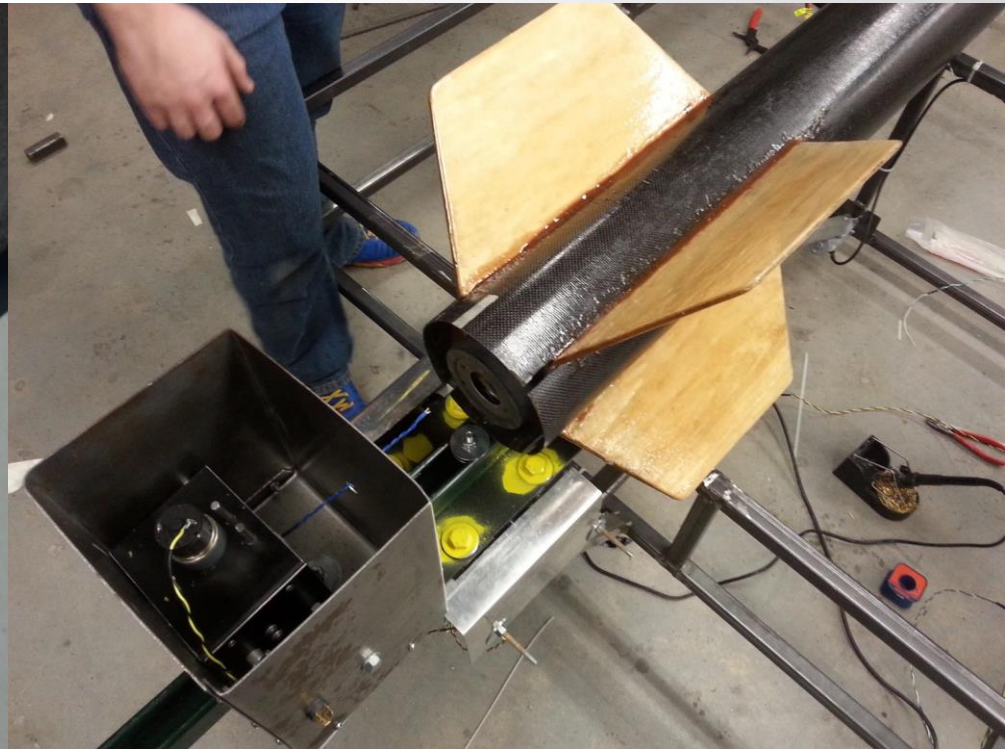


Side view of the ignition system

Igniter Insertion System

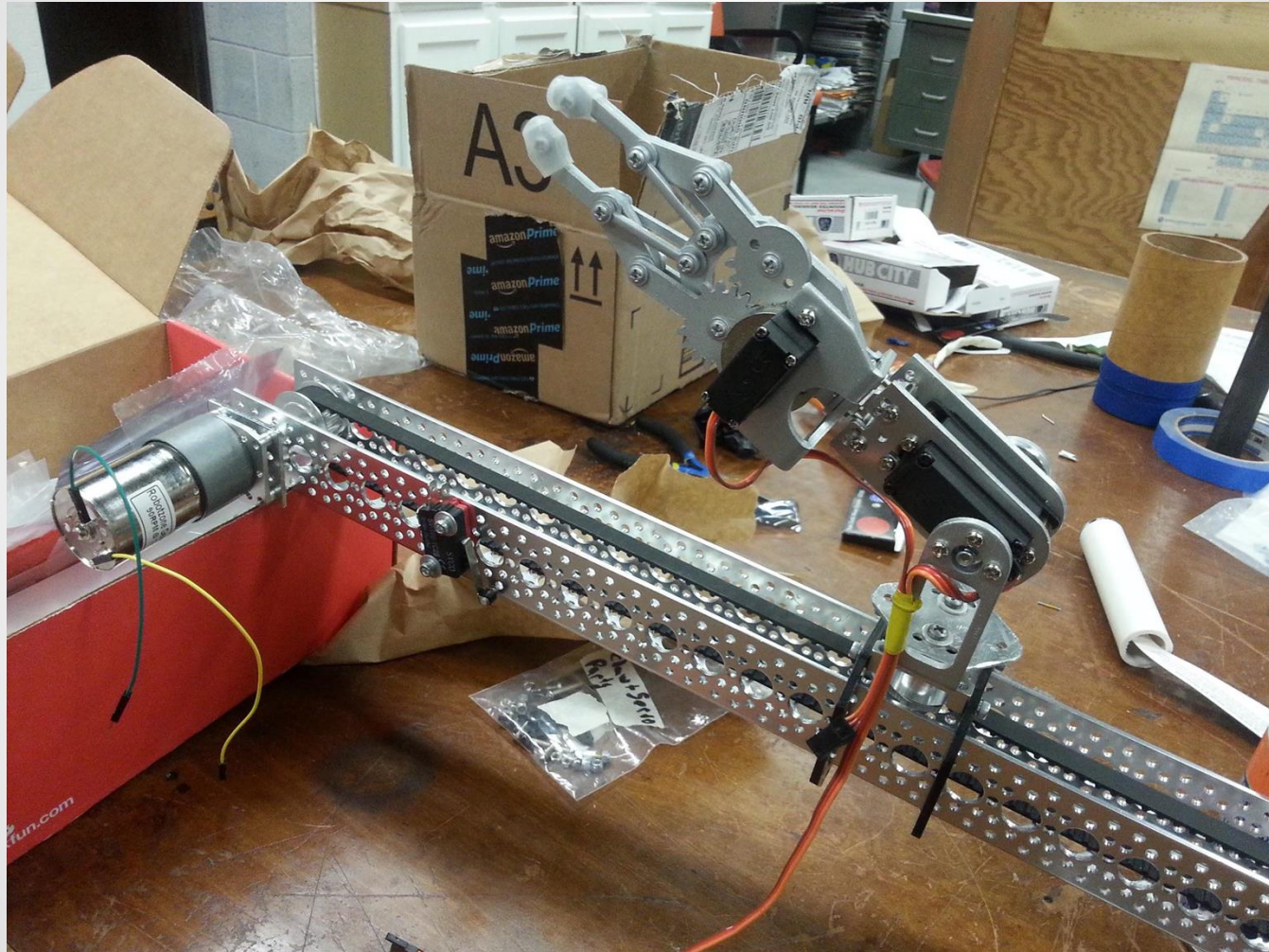


Ignition insertion device assembled



Ignition wire (blue) coming out of the protective case

Belt/Slider Rail



Payload acquisition assembly

Test Launches



Two Half scale and Two Full scale launches have been performed



D-Day in Alabama



D-Day in Alabama



D-Day in Alabama



3,109 ft



Questions?

https://www.youtube.com/watch?feature=player_detailpage&v=LrokpKTisvE#t=37