

# Milestone Review Flysheet 2017-2018

**Institution** Pennsylvania State University

**Milestone** FRR

## Vehicle Properties

Total Length (in)	112
Diameter (in)	5.63
Gross Lift Off Weigh (lb.)	36.3
Airframe Material(s)	Carbon Fiber Wrapped Blue Tube
Fin Material and Thickness (in)	G10 FR4 Fiberglass 3/16
Coupler Length/Shoulder Length(s) (in)	12/6

## Stability Analysis

Center of Pressure (in from nose)	89.98
Center of Gravity (in from nose)	69.98
Static Stability Margin (on pad)	3.6
Static Stability Margin (at rail exit)	2.6
Thrust-to-Weight Ratio	8.56
Rail Size/Type and Length (in)	1515 / 120 in
Rail Exit Velocity (ft/s)	71.5

## Recovery System Properties

### Drogue Parachute

Manufacturer/Model	Fruity Chutes Elliptical		
Size/Diameter (in or ft)	12" Diameter		
Altitude at Deployment (ft)	5280		
Velocity at Deployment (ft/s)	-		
Terminal Velocity (ft/s)	105		
Recovery Harness Material	Kevlar		
Recovery Harness Size/Thickness (in)	0.5		
Recovery Harness Length (ft)	40		
Harness/Airframe Interfaces	3/8" Steel U-Bolt		
Kinetic Energy of Each Section (Ft-lbs)	Nose/Payload	Avionics Bay	Booster
	1784	987.6	2284

## Recovery Electronics

Altimeter(s)/Timer(s) (Make/Model)	Stratologger Cf
Redundancy Plan and Backup Deployment Settings	Single level redundancy for drogue and main event
Pad Stay Time (Launch Configuration)	2 hours

## Motor Properties

Motor Brand/Designation	Aerotech/ L1390
Max/Average Thrust (lb.)	371/309
Total Impulse (lbf-s)	887
Mass Before/After Burn (lb.)	137 oz/ 67 oz
Liftoff Thrust (lb.)	1375
Motor Retention Method	Plywood centering rings

## Ascent Analysis

Maximum Velocity (ft/s)	684
Maximum Mach Number	0.61
Maximum Acceleration (ft/s^2)	303
Predicted Apogee (From Sim.) (ft)	5347

## Recovery System Properties

### Main Parachute

Manufacturer/Model	Fruity Chute Iris Ultra Compact		
Size/Diameter (in or ft)	84" Diameter		
Altitude at Deployment (ft)	700		
Velocity at Deployment (ft/s)	105		
Terminal Velocity (ft/s)	18		
Recovery Harness Material	Kevlar		
Recovery Harness Size/Thickness (in)	0.5		
Recovery Harness Length (ft)	30		
Harness/Airframe Interfaces	3/8" Steel U-Bolt		
Kinetic Energy of Each Section (Ft-lbs)	Nose/Payload	Avionics Bay	Booster
	47.54	26.4	60.91

## Recovery Electronics

Rocket Locators (Make/Model)	Americaloc GL300W	
Transmitting Frequencies (all vehicle and payload)	Cell Phone Service (AT&T): 850 mHz	
Ejection System Energetics (ex. Black Powder)	Black Powder	
Energetics Mass - Drogue Chute (grams)	Primary	1.5
	Backup	2.5
Energetics Mass - Main Chute (grams)	Primary	2
	Backup	3
Energetics Masses - Other (grams) - If Applicable	Primary	25g CO2 cartridge
	Backup	N/A

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### Payload

Payload	
Payload 1 (official payload)	Overview
	The payload challenge chosen this year is build a remotely deployable autonomous rover. The rover will be deployed from the launch vehicle and then autonomously move at least 5 feet away from all parts of the rocket. After the rover has reached its destination, it will deploy a set of foldable solar panels.
Payload 2 (non-scored payload)	Overview
	N/A

### Test Plans, Status, and Results

Ejection Charge Tests	The ejection charges will be tested before all flights. The charges used will be sufficiently large to ensure deployment of the corresponding parachute without causing damage to the body tube. To complete the ground test, the ejection charges must be loaded and the initiators must be connected to a 40 ft wire extender. Then, the rocket must be assembled and the shear pins must be installed. From a safe distance, a 9V battery can be connected to the wire extender. (Safety note: make sure that everyone is a safe distance away from the rocket and that no one is standing in line with the nose cone or booster section of the rocket.) This will cause the charge to detonate and should separate the rocket. If the rocket does not separate, then the amount of black powder will need to be increased on that section. If the the ejection charge test for the drogue parachute charge also separates the main parachute section, then the amount of black powder in the drogue parachute section will need to be decreased. (Safety note: If any charges do not detonate, then only the lead and safety officer can approach the rocket with the utmost care to disarm the rocket.) This procedure was performed prior to the fullscale test launch to verify the chosen black powder charges of 1.5 and 2 grams. The test was successful and those size echarges were then used for fullscale test flight which performed as expected.
Sub-scale Test Flights	We launched on a Cesaroni J280 and acheived an apogee of 3733 ft. During descent, parachute deployment appeared to be nominal and the rocket touched down at a safe impact velocty. Upon landing, the airframe and major components of the rocket were inspected and no physical damage was observed.
Full-scale Test Flights	A fullscale test flight was performed on February 18th. Weather conditions on the day of launch were very favorable. The air temperature was 47° F, the wind was averaging 7 mph primarily from the West, and there was little to no cloud cover. The fullscale rocket launched with the compeition motor, an Aerotech L1390 and achieved an apogee of 5472 ft. All systems of the rocket performed as expected including downbody camera footage, airframe structural components, ejection charges, and rover retention during flight. During main deployment, the booster coupler experienced some zippering which is planned to be mitiagted through the addition of fireballs to the recovery harness.