Milestone Review Flysheet 2017-2018

Institution	University of Notre Dame	Milestone	CDR

Vehicle Properties	
Total Length (in)	128
Diameter (in)	7.675 (fore), 5.54 (aft)
Gross Lift Off Weight (lb.)	48.3
Airframe Material(s)	Carbon fiber, fiberglass
Fin Material and Thickness (in)	Carbon fiber, 0.125 thick
Coupler Length/Shoulder Length(s) (in)	19

Motor Properties	
Motor Brand/Designation	Cesaroni L1395-BS
Max/Average Thrust (lb.)	Max: 400.1, Avg: 313.8
Total Impulse (lbf-s)	1100.5
Mass Before/After Burn (lb.)	37.5
Liftoff Thrust (lb.)	400.1
Motor Retention Method	Glue on motor retainter screw on cap

Stability Analysis	
Center of Pressure (in from nose)	101
Center of Gravity (in from nose)	79.83
Static Stability Margin (on pad)	2.71
Static Stability Margin (at rail exit)	2.71
Thrust-to-Weight Ratio	8.28
Rail Size/Type and Length (in)	15 wide, 144 long
Rail Exit Velocity (ft/s)	58.8

Ascent Analysis	
Maximum Velocity (ft/s)	631
Maximum Mach Number	0.57
Maximum Acceleration (ft/s^2)	236
Predicted Apogee (From Sim.) (ft)	5508

Recovery System Properties – Drogue Parachute

Manufacturer/Model	*FruityChutes/* Iris Ultra-compact Spherical			
Size/Diameter (in or ft)	24 in.			
Altitude at Deployment (ft)	5280			
Velocity at Deployment (ft/s)	5			
Terminal Velocity (ft/s)	75			
Recovery Harness Material	Nylon			
Recovery Harness Size/Thickness (in)	0.5			
Recovery Harness Length (ft)	40			
Harness/Airframe Interfaces	Screw-locking Quicklinks secured to eyebolts			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	1162	878	2045	N/A

Recovery System Properties – Main Parachute

Manufacturer/Model	FruityChutes/Iris Ultra-compact Spherical			
Size/Diameter (in or ft)	144 in.			
Altitude at Deployment (ft)	600			
Velocity at Deployment (ft/s)	75			
Terminal Velocity (ft/s)	12.57			
Recovery Harness Material	Nylon			
Recovery Harness Size/Thickness (in)	0.5			
Recovery Harness Length (ft)	40			
Harness/Airframe Interfaces	Screw-locking Quicklinks secured to eyebolts			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	28.08	28.17	38.73	N/A

Recovery Electronics

Altimeter(s)/Timer(s) (Make/Model)	Featherweight/*Raven3*
Redundancy Plan and Backup Deployment Settings	Triple redundant systems. Primary drogue: apogee. Secondary drogue: apogee +1 sec. Tertiary drogue: apogee +2 sec. Primary main: 650 ft AGL. Secondary main: 600 ft AGL. Tertiary main: 550 ft AGL
Pad Stay Time (Launch Configuration)	5 hours

Recovery Electronics

Rocket Locators (Make/Model)	Rocket locators found in Air Braking Payload, not Recovery	
Transmitting Frequencies (all - vehicle and payload)	***Required by CDR***	
Ejection System Energetics (ex. Black Powder)	Black Powder	
Energetics Mass - Drogue Chute (grams)	Primary	4
	Backup 1	4
	Backup 2	4
Energetics Mass - Main Chute (grams)	Primary	5
	Backup 1	5
	Backup 2	5
Energetics Masses - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

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Payload

Payload 1 (official payload)	Overview The deployable rover will contain an autonomously driven rover that is deployed via a ground station upon safe landing. The rover will detect the sections of the rocket and any other obstacles via a LiDAR sensor. The rover will drive at least five feet away from the rocket and deploy two sets of folded solar panels. The solar panels will be actuated via a servomotor. During the flight of the rocket, the rover will be secured to prevent any motion that could alter the flight path of the rocket.
Payload 2 (non-scored payload)	Overview The purpose of the air braking system is to assist the rocket in reaching its primary goal of an apogee of 5280 ft. To achieve this a control code will use data from sensors to measure altitude and velocity and project a flight path for the rocket. Then, a PID controller will determine the amount of drag force needed to alter the flight of the rocket to an ideal flight path with an apogee of 5280 ft. The controller will then activate a servo motor, which will be connected to a crank-slider mechanism. This mechanism will extend four drag tabs out of the rocket into the airflow, which will be the control surfaces that will induce the drag necessary to reach the target apogee. This system will activate after motor burnout and will run continuously until the rocket reaches apogee.

Test Plans, Status, and Results

Ejection Charge Tests	Ground testing before full-scale launch on February 10th, 2018 Optimize black powder/shear pin combination
Sub-scale Test Flights	Two launches on December 2nd, 2017. First launch with no scaled Air Braking System in order to obtain altitude measurements to compare with computer simulations. The second launch had a scaled, 3D printed Air Braking System in order to compare with the control flight. The experimental flight verified that the Air Braking Tabs have a significant impact on the apogee of the rocket, as it was diminished by approximately 60 feet under the same conditions.
Full-scale Test Flights	Two test launches scheduled for February 10th, 2018. The first launch will be a control flight with a non-active Air Braking System. The Deployable Rover Payload will be simulated by ballast in the forward section of the rocket. The second launch will be with an activated Air Braking System in order to measure its impact on the vehicles flight. The Deployable Rover Payload will also be active during this flight in order to test its capabailites upon successful landing.

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Additional Comments