Milestone Review Flysheet

Institution	North Carolina State University

Milestone	FRR

Vehicle Properties

Total Length (in)	102
Diameter (in)	5.5
Gross Lift Off Weigh (lb)	32.1
Airframe Material	Fiberglass
Fin Material	Birch Aircraft Plywood
Drag Coeffficient	0.385

Motor Properties

Motor Manufacturer	AeroTech
Motor Designation	L1150R
Max/Average Thrust (lb)	302.6 / 258.3
Total Impulse (lbf-s)	790.6
Mass Before/After Burn (lb)	8.10 / 3.91
Liftoff Thrust (lb)	218.3

Stability Analysis

Center of Pressure (in from nose)	76.3
Center of Gravity (in from nose)	64.3
Static Stability Margin	2.18
Static Stability Margin (off launch rail)	2.25
Thrust-to-Weight Ratio	8.047 : 1
Rail Size and Length (in)	1.5 x 1.5 x 101
Rail Exit Velocity	63

Ascent Analysis

Maximum Veloxity (ft/s)	745
Maximum Mach Number	0.662
Maximum Acceleration (ft/s^2)	300
Target Apogee (From Simulations)	5569
Stable Velocity (ft/s)	63
Distance to Stable Velocity (ft)	3.71

Recovery System Properties

Dogue Parachute

Manufacturer/Model	FruityChutes			
Size	18			
Altitude at Deployment (ft)	5280			
Velocity at Deployment (ft/s)	1.9			
Terminal Velocity (ft/s)	92.9			
Recovery Harness Material	Kevlar			
Harness Size/Thickness (in)	0.5			
Recovery Harness Length (ft)	25			
Harness/Airframe Interfaces	ARRD and U-bolt with quick link			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	3,765			

Recovery System Properties

Main Parachute

Manufacturer/Model	FruityChutes			
Size	48	84		
Altitude at Deployment (ft)	1000	700		
Velocity at Deployment (ft/s)	92.9	75.6		
Terminal Velocity (ft/s)	20.2	14.6		
Recovery Harness Material	Kevlar			
Harness Size/Thickness (in)	0.5			
Recovery Harness Length (ft)	16			
Harness/Airframe Interfaces	U-bolt with quick link			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	60.2	61.6		

Recovery Electonics

Altimeter(s)/Timer(s) (Make/Model)	Perfectflite Stratologger SL100, Stratologger CF, Entacore AIM 3.0
Redundancy Plan	Apogee charges will have a 1 s delay. Main redundant charge will be programmed for 600 ft AGL at 125% primary charge size.
Pad Stay Time (Launch Configuration)	1 hour

Recovery Electonics

Rocket Locators (Make/Model)	Big Red Bee GPS Locator (2)
Transmitting Frequencies	900 MHz on Channel 128
Black Powder Mass Drogue Chute (grams)	2.1
Black Powder Mass Main Chute (grams)	3.3 (top) / 2.2 (bottom)

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Autonomous Ground Support Equipment (MAV Teams Only)	
Capture Mechanism	Overview
	A crafted robotic arm based on a previously purchased robotic arm kit with different servos and gears will move the gripper to a predetermined point above the sample and then the gripper will engage to capture the sample.
Container Mechanism	Overview
	The robotic arm will carefully insert the sample into the pick and pluck foam padded payload bay, attached to the avionics sled bay in the payload compartment. This will secure the sample on three sides. The arm will then close the door to seal the payload bay and a section of foam on the inside wall of the door will fully secure the sample.
Launch Rail Mechanism	Overview
	The launch rail will be raised by a planetary geared steppermotor. While being raised, the rail will be supported by a double ratchet system in case of a loss of power. The gearing ratio between the sector gear and the driver gear will be 8:1.
Igniter Installation Mechanism	Overview
	A stepper motor powered linear actuator will raise the electric match igniter into the rocket on a wooden dowel by rotating a threaded rod which drivese a delrin plate that the dowel rests on.

Payload	
Payload 1	Overview
	The MAV challenge sample. The payload will be made of .75 x 3 inch PVC tubing filled with sand and weigh approximately 4 oz. The payload will be a cylindrical shape with a .75 inch diameter and a 4.75 in length. Ends of the tubing will be secured with domed PVC caps.
Payload 2	Overview

Test Plans, Status, and Results	
Ejection Charge Tests	Ejection charges will be sized for each of the compartments to be separated. Charges will be constructed with black powder in a PVC cap with an E-match secured in the cap using paper wadding and tape. Charge ignition for main and drogue charges are capable of being separately fired at the user's input. Both charges are attached to the wire leads of a switch that fires the charges when activated. If the test is a failure, analysis will be conducted to find the cause of the failure with new tests to follow.
Sub-scale Test Flights	The subscale flight test took place on November 28, 2015. The subscale rocket was overly stable which led to weather cocking and an apogee that was signifcantly lower than expected. Despite that, the drogue successfully deployed at apogee and the main deployed at 700 feet as planned.
Full-scale Test Flights	The full scale flight test took place on February 27, 2016. The full scale rocket performed close to simulations in terms of the apogee achieved once the effect of the airbrakes is taken into account.

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Additional Comments