Milestone Review Flysheet 2021-2022

Institution	North Carolina State University

Milestone	Flight Readiness Review

Vehicle Properties	
Total Length (in)	109
Diameter (in)	6
Gross Lift Off Weigh (lb)	45.48
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	Aircraft Birch Plywood, 0.5
Coupler Length(s)/Shoulder Length(s) (in)	6

Motor Properties	
Motor Brand/Designation	Aerotech L850W
Max/Average Thrust (lb)	420/191
Total Impulse (lbf-s)	819.7
Mass Before/After Burn (oz)	132/74
Liftoff Thrust (N)	1001
Motor Retention Method	Retainer screw, engine block, centering rings

Stability Analysis	
Center of Pressure (in. from nose)	80.14
Center of Gravity (in. from nose)	66.7
Static Stability Margin (on pad)	2.18
Static Stability Margin (at rail exit)	2.25
Thrust-to-Weight Ratio	5.1
Rail Size/Type and Length (in)	1515, 144
Rail Exit Velocity (ft/s)	58

Ascent Analysis	
Maximum Velocity (ft/s)	452
Maximum Mach Number	0.4
Maximum Acceleration (ft/s^2)	198
Target Apogee (ft)	4400
Predicted Apogee (From Sim.) (ft)	3676

Recovery System Properties - Upper Section Drogue Parachute	
Manufacturer/Model	Fruity Chutes 18-inch Compact Elliptical
Size or Diameter (in or ft)	18 in
Main Altimeter Deployment Setting	Apogee
Backup Altimeter Deployment Setting	Apogee + 1 second
Velocity at Deployment (ft/s)	0
Terminal Velocity (ft/s)	83.9

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	Missile Works RRC3
Secondary Altimeter #1 Make/Model	PerfectFlite StratoLogger CF
Secondary Altimeter #2 Make/Model	PerfectFlite StratoLogger CF
Other Recovery Electronic	Jolly Logic Chute Release (x4)
Rocket Locator (Make/Model)	BRB900 TX/RX
Additional Locators (if applicable)	EggFinder GPS TX/RX
Transmitting Frequencies (all - vehicle and payload)	433 MHz, 900 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Altimeters are fully independent. Each altimeter has its own set of batteres, switches, e-matches and powder charges
Pad Stay Time (Launch Configuration)	2.9

Recovery System Properties - Upper Section Overall	
Total Descent Time (s)	78.3
Total Drift in 20 mph winds (ft)	2297.9

Recovery System Properties - Fin Can Overall	
Total Descent Time (s)	82.6
Total Drift in 20 mph winds (ft)	2422.5

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)		3F Black Powder
Energetics Mass - Drogue Chute (grams) (Fin Can Seperation)	Primary	4.4
	Backup	4.9
Energetics Mass - Main Chute (grams) (Upper Section Seperation)	Primary	5
	Backup	5.5
Energetics Mass - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

Recovery System Properties - Upper Section Main Parachute	
Manufacturer/Model	Fruity Chutes 60-inch Iris Ultra Compact
Size or Diameter (in or ft)	60 in
Main Jolly Logic Deployment Setting (ft)	700
Backup Jolly Logic Deployment Setting (ft)	700
Velocity at Deployment (ft/s)	83.9
Terminal Velocity (ft/s)	20.5

Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			36 (shared with main)	
Harness/Airframe Interfaces		Quick Links connected to bowline knots that are connected to the U-bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	1322.5	983.6	N/A	N/A

Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			36 (shared with drogue)	
Harness/Airframe Interfaces		Quick Links connected to bowline knots that are connected to the U-bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	78.7	58.5	N/A	N/A

Recovery System Properties - Fin Can Drogue Parachute				
Manufacturer/Model			Fruity Chutes 15-inch Compact Elliptical	
Size or Diameter (in or ft)			15 in	
Main Altimeter Deployment Setting			Apogee + 1 second	
Backup Altimeter Deployment Setting			Apogee + 2 second	
Velocity at Deployment (ft/s)			32.2	
Terminal Velocity (ft/s)			82.5	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			10 (shared with main)	
Harness/Airframe Interfaces		Quick Links connected to bowline knots that are connected to the U-bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	N/A	N/A	1591.5	N/A

Recovery System Properties - Fin Can Main Parachute				
Manufacturer/Model			Fruity Chutes 60-inch Iris Ultra Compact	
Size or Diameter (in or ft)			60 in	
Main Jolly Logic Deployment Setting (ft)			600	
Backup Jolly Logic Deployment Setting (ft)			600	
Velocity at Deployment (ft/s)			82.5	
Terminal Velocity (ft/s)			16.43	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			10 (shared with drogue)	
Harness/Airframe Interfaces		Quick Links connected to bowline knots that are connected to the U-bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	N/A	N/A	63.1	N/A

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Payload	
Payload 1 (official payload)	Overview
	Ariel Photographing and Positioning Apparatus (APPA)
	There will be two cameras mounted on the side of the launch vehicle. The cameras will take images both on ascent and descent. Image recognition will be used on notable landmarks in the pictures taken to locate the launch vehicle. This will happen continuously until image recognition fails to work and then IMUs will be used to track the rest of the descent. Using information from the IMU and the cameras, a final location will be calculated and transmitted back to the ground station.

Test Plans, Status, and Results	
Ejection Charge Tests	Ejection testing occured on 2/17/2021. This test will ensure that altimeters used in-flight are functioning nominally and that black powder charges calculated previously have enough force to separate launch vehicle sections. The calculated amount of black powder will be manually ignited in the launch vehicle to confirm proper section separation. If the black powder charges fail to separate the sections, the size of the charges will be increased and the test will be repeated until proper section separation is observed.
Sub-scale Test Flights	The sub-scale test flight ocurred on 11/20/2021. This test flight confirmed launch vehicle design choices and highlighted flaws in the system. This flight validated recovery systems and tested feasibility of different payload design options. The flight will test the feasibility of different configurations of ribbon cable for the purposes of connecting lower payload bay electronics to the Jetson Nano board for image processing.
Vehicle Demonstration Flights	The vehicle demonstration fligh occurred on February 19th, 2022. The launch vehicle and upper section recovery system functioned as designed but the recovery system for the fin can did not which does not fully satisy requirement 2.19.1. The main parachute was knotted, this is discussed further in the FRR. The launch vehicle reached an apogee of 3294 ft AGL. The static stability margin was 2.2 exceeding the 2.0 requirement. The vehicle demonstration flight carried both MOMO and APPA. There were some issuses with collecting data and theres are noted and discussed in the FRR document.
Payload Demonstration Flights	The payload demonstration flight is scheduled for March 26, 2022. This flight will validate that the payload meets the team derived and system requirements. This flight will also demonstrate functionality of the payload systems. It will also re-validate the recovery system for the fin can. This flight satisfies handbook requirement NASA 2.19.2.

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Transmitter #1			
Location of transmitter:	AV Bay		
Purpose of transmitter:	Launch Vehicle Tracking Device		
Brand	BigRedBee	RF Output Power (mW)	250mW
Model	BRB900	Specific Frequency used by team (MHz)	900 MHz
Handshake or frequency hopping? (explain)	Broadcasts on 900 MHz spread spectrum		
Distance to closest e-match or altimeter (in)	1		
Description of shielding plan:	Sheet of aluminum foil between tracker and recovery electronics on AV sled		

Transmitter #2			
Location of transmitter:	Fin Can		
Purpose of transmitter:	Payload Lander Tracker		
Brand	Eggtimer Rocketry	RF Output Power (mW)	100 mW
Model	Eggfinder GPS Tracking System	Specific Frequency used by team (MHz)	921 MHz
Handshake or frequency hopping? (explain)	Fixed frequency, ID 9		
Distance to closest e-match or altimeter (in)	1		
Description of shielding plan:	Sheet of aluminum foil between tracker and payload electronics		

Transmitter #3			
Location of transmitter:	Fin Can		
Purpose of transmitter:	Communicate Location Estimate from Payload to Ground Station		
Brand	REYAX	RF Output Power (mW)	~ 142 mW
Model	RYLR896	Specific Frequency used by team (MHz)	915 MHz
Handshake or frequency hopping? (explain)	Fixed Frequency, Network ID 10 (LoRa Technique)		
Distance to closest e-match or altimeter (in)	1		
Description of shielding plan:	Sheet of aluminium foil between transmitter and payload electronics		

Transmitter #4			
Location of transmitter:	N/A		
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description of shielding plan:			

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Transmitter #5			
Location of transmitter:	N/A		
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description of shielding plan:			

Transmitter #6			
Location of transmitter:	N/A		
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description of shielding plan:			

Additional Comments