Milestone Review Flysheet 2021-2022

Institution	North Carolina State University

Milestone	Preliminary Design Review

Vehicle Properties	
Total Length (in)	109.25
Diameter (in)	6
Gross Lift Off Weigh (lb)	40.9
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	Aircraft Birch Plywood, 0.25
Coupler Length(s)/Shoulder Length(s) (in)	6

Motor Properties	
Motor Brand/Designation	Aerotech L1390G
Max/Average Thrust (lb)	365/309
Total Impulse (lbf-s)	887.8
Mass Before/After Burn (oz)	136.8/69.6
Liftoff Thrust (N)	1416.5
Motor Retention Method	Retainer screw, engine block, centering rings

Stability Analysis	
Center of Pressure (in. from nose)	76.2
Center of Gravity (in. from nose)	62.6
Static Stability Margin (on pad)	2.21
Static Stability Margin (at rail exit)	2.7
Thrust-to-Weight Ratio	7.64
Rail Size/Type and Length (in)	1515, 144
Rail Exit Velocity (ft/s)	72.56

Ascent Analysis	
Maximum Velocity (ft/s)	614
Maximum Mach Number	0.56
Maximum Acceleration (ft/s^2)	300
Target Apogee (ft)	4400
Predicted Apogee (From Sim.) (ft)	4406

Recovery System Properties - Overall	
Total Descent Time (s)	85.3
Total Drift in 20 mph winds (ft)	2501.9

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)		
Energetics Mass - Drogue Chute (grams)	Primary	1.3
	Backup	1.8
Energetics Mass - Main Chute (grams)	Primary	3.1
	Backup	3.6
Energetics Mass - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	PerfectFlite StratoLogger CF
Secondary Altimeter Make/Model	PerfectFlite StratoLogger CF
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	EggFinder GPS TX/RX
Additional Locators (if applicable)	BRB900 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 - Drogue Parachute				
Manufacturer/Model			Fruity Chutes 24-inch Compact Elliptical	
Size or Diameter (in or ft)			24 in	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee + 1 second	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			83.2	
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)			40	
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
	808	789.7	1344.9	N/A

Recovery System Properties - Main Parachute				
Manufacturer/Model			Fruity Chutes 96-inch Iris Ultra Compact	
Size or Diameter (in or ft)			96 in	
Main Altimeter Deployment Setting (ft)			600	
Backup Altimeter Deployment Setting (ft)			575	
Velocity at Deployment (ft/s)			83.2	
Terminal Velocity (ft/s)			17.1	
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)			40	
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
	34	33.2	56.6	N/A

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Payload

	Overview
Payload 1 (official payload)	In Baseline Solution 1 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. In Baseline Solution 2 a lander will jettison from the launch vehicle to take pictures for image recognition. The lander is contained in the Upper Payload Bay facing downward. It is kept in place by shear pins and an electronic rotary latch. At apogee the rotary latch unlocks and only the shear pins are keeping the lander in place. At 600 feet AGL the main parachute deploys and pulls the lander out of the launch vehicle. When the lander is pulled out of the launch vehicle the spring loaded legs will trigger and position themself. Once RSO approval is given, the ground station will send a signal to the ARRD to separate the lander from the main parachute system. After landing the chute will be released by two electronic rotary latches, the gimbal system will center the camera and pictures will be taken. Image recognition will occur on the lander to identify its exact location and IMU data will be used to determine the distance from the launch vehicle. The launch vehicle location will be calculated from this information and transmitted to the launch vehicle. Using information from Baseline 1 and Baseline 2 a final location will be calculated and transmitted back to the ground station.

	Overview
Payload 2 (non-scored payload)	N/A

Test Plans, Status, and Results

Ejection Charge Tests	Ejection testing is scheduled for 11/17/2021. 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 is scheduled for the weekend of 11/20/2021. This test flight will confirm launch vehicle design choices and will highlight flaws in the system. This flight validates recovery systems and tests 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 flight is scheduled for February 19th, 2022. This flight will validate that the launch vehicle meets team derived and system requirements. This flight satisfies handbook requirement NASA 2.18.1.

Payload Demonstration Flights	The payload demonstration flight is scheduled for February 19th, 2022. This flight will validate that the payload meets the team derived and system requirements. This flight will also demonstrate functionality of both payload systems. This flight satisfies handbook requirement NASA 2.18.2.

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Transmitter #1			
Location of transmitter:	AV Bay		
Purpose of transmitter:	Launch Vehicle Tracking Device		
Brand	BigRedBee	RF Output Power (mW)	250 mW
Model	BRB900	Specific Frequency used by team (MHz)	900 MHz
Handshake or frequency hopping? (explain)	Fixed frequency, ID 8		
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:	Payload Lander		
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 8		
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:	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 #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:			

Milestone Review Flysheet 2021-2022

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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