Milestone Review Flysheet 2023-2024

Institution	North Carolina State University	Milestone	Preliminary Design Review

Vehicle Properties

Total Length (in)	105
Diameter (in)	6.07
Aspect Ratio	17.3
Gross Lift Off Weight (lb)	45.2
Ballast Amount (lb) / Material / Location	0, N/A, CG
Launch Vehicle Burn Out Weight (lb)	41.1
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	G10 Fiberglass, 1/8
Coupler Length(s)/Shoulder Length(s) (in)	6, 4.5, and 3

Motor Properties

Motor Brand/Designation	AeroTech L1520T
Max/Average Thrust (lb)	352.45
Total Impulse (lbf-s)	835.16
Mass Before/After Burn (oz)	128.64/65.28
Liftoff Thrust (N)	347.41
Motor Retention Method	Motor Retainer, Centering Rings, Thrust Plate

Stability Analysis

Center of Pressure (in. from nose)	77.913
Center of Gravity (in. from nose)	64.966
Static Stability Margin (on pad)	2.1
Static Stability Margin (at rail exit)	2.13
Thrust-to-Weight Ratio	8.27
Rail Size/Type and Length (in)	1515, 144
Rail Exit Velocity (ft/s)	71.3

Ascent Analysis

Maximum Velocity (ft/s)	559.5
Maximum Mach Number	0.4971
Maximum Acceleration (ft/s^2)	260.33
Target Apogee (ft)	4050
Predicted Apogee (From Sim.) (ft)	4037.2

Recovery System Properties - Overall

Total Descent Time (s)	81.98
Total Drift in 20 mph winds (ft)	2404.76

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		#FFF Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2.01
	Backup	2.51
Energetics Mass - Main Chute (grams)	Primary	0.7
	Backup	1.2
Energetics Mass - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	MissleWorks RRC3
Secondary Altimeter Make/Model	Eggtimer Quasar
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Eggtimer Quasar
Additional Locators (if applicable)	Big Red Bee 900
Transmitting Frequencies (all - vehicle and payload)	420.25 MHz
	900 MHz
Describe Redundancy Plan (batteries, switches, etc.)	The Quasar tracker and duel deploy altimeter will have its own battery, and the RRC3 pirimatry altimeter will have its own battery. Each altiemter has its own e-matches, mechanical arming switch, and ejection charges.
Pad Stay Time (Launch Configuration)	2.9 Hr

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Fruity Chutes Classic 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)			113.1	
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)			17	
Harness/Airframe Interfaces		Quick links will be attached to bowline knots in the shockcord. The quick links will be attached to U-bolts on the bulkheads		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	1323.93	2129.8	2777.78	N/A

Recovery System Properties - Main Parachute

Manufacturer/Model			Fruity Chutes Compact Elliptical; Fruity Chutes Classic Elliptical	
Size or Diameter (in or ft)			84 in ; 48 in	
Main Altimeter Deployment Setting			800 ft	
Backup Altimeter Deployment Setting			750 ft	
Velocity at Deployment (ft/s)			113.1	
Terminal Velocity (ft/s)			15.85 ; 18.49	
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)			8 ; 8	
Harness/Airframe Interfaces		Quick links will be attached to bowline knots in the shockcord. The quick links will be attached to U-bolts on the bulkheads		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	38.97	41.83	54.56	N/A

Milestone Review Flysheet 2023-2024

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Payload	
Payload 1 (official payload)	Overview The payload on board this year's launch vehicle is the STEMnauts Atmosphere Independent Lander, or SAIL. The goal of this payload is to safely transport four non-living passengers, known as STEMnauts, from the launch vehicle to the ground without the use of a parachute. This will be achieved by using a contra-rotating set of rotor blades powered by an electric motor. Once separated from the launch vehicle, the rotor blades as well as a set of landing legs will unfold and the SAIL will be descending under a parachute. Once RSO permission is given, an RF controlled latch will release the SAIL, sending it into free fall. At this point, the motor will start spinning the rotor blades, generating lift to slow down the SAIL. The rotor blades will continue to operate based on pre-derived lfit curves until landing.
Payload 2 (non-scored payload)	Overview N/A

Test Plans, Status, and Results	
Ejection Charge Tests	Ejection testing is scheduled for November 16th, 2023. Ejection testing will ensure that all altimeters are functioning correctly and that the charges have been sized correctly. Black powder will be loaded into the launch-day-appropriate sections. A manual switch will be used to activate the charges. The e-matches will be connected to a 9V battery, and upon a completed circuit, the charges will detonate. If the sections fail to separate, the ejection charge size has been underestimated. If the sections separate with too much force, the ejection charge size has been overestimated. Upon either case, the ejction charge size will be increased or reduced by 0.2 g respectively and the test will be repeated until separation is deemed successful.
Sub-scale Test Flights	The sub-scale test flight is scheduled for November 18th, 2023. During the flight, all subsystem launch vehicle designs will be tested and analyzed individually to prove their feasibility on the full-scale launch vehicle. The flight will also test the leading payload ejection method using a simulated payload mass under a parachute.
Vehicle Demonstration Flights	The Vehicle Demonstration Flight window is February 1st through February 29th, 2024. This flight will determine if all team derived and NASA requirements have been met by the launch vehicle subsystems. This will satisfy NASA SLI Requirement 2.19.1.
Payload Demonstration Flights	The Payload Demonstration Flight window is February 1st through March 31st, 2024. This flight will determine if all team derived and NASA requirements have been met by the payload subsytem. This will satisfy the NASA SLI Requirement 2.19.2.

Milestone Review Flysheet 2023-2024

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Transmitter #1			
Location of transmitter:	Avionics Bay		
Purpose of transmitter:	Launch Vehicle Tracking Device		
Brand	Eggtimer Rocketry	RF Output Power (mW)	100 mW
Model	Quasar	Specific Frequency used by team (MHz)	420.25 MHz
Handshake or frequency hopping? (explain)	Fixed Frequency, ID 8		
Distance to closest e-match or altimeter (in)	1 in		
Description of shielding plan:	There will be a sheet of aluminum foil added between the tracker and other recovery electronics on the sled.		

Transmitter #2			
Location of transmitter:	Nose Cone Sled		
Purpose of transmitter:	Nose Cone 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)	100 in		
Description of shielding plan:	There will be a sheet of aluminum foil added around the tracker to shield from payload electronics in nose cone.		

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 2022-2023

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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

Note: The Recovery System Properties - Main Parachute section of this flysheet includes both the main parachute and the parachute connected to the nose cone. The format of the entries in that section is as follows: Main parachute entry; Nose cone parachute entry.