Milestone Review Flysheet 2020-2021

Institution	North Carolina State University

Milestone	PDR

Vehicle Properties

Total Length (in)	106.25
Diameter (in)	6.17
Gross Lift Off Weigh (lb)	45.4
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	Aircraft Birch Plywood, 0.25
Coupler Length(s)/Shoulder Length(s) (in)	All 6 inches

Motor Properties

Motor Brand/Designation	Aerotech L1520T-PS
Max/Average Thrust (lb)	396.875/352.47
Total Impulse (lbf-s)	835.41
Mass Before/After Burn (oz)	128.79/63.39
Liftoff Thrust (N)	1545.4
Motor Retention Method	Retainer screw, engine block, centering rings

Stability Analysis

Center of Pressure (in. from nose)	78.29
Center of Gravity (in. from nose)	64.48
Static Stability Margin (on pad)	2.2
Static Stability Margin (at rail exit)	2.38
Thrust-to-Weight Ratio	7.94
Rail Size/Type and Length (in)	1515 - 144 in
Rail Exit Velocity (ft/s)	73.75

Ascent Analysis

Maximum Velocity (ft/s)	548.66
Maximum Mach Number	0.488
Maximum Acceleration (ft/s^2)	542.56
Target Apogee (ft)	4473
Predicted Apogee (From Sim.) (ft)	4473

Recovery System Properties - Overall

Total Descent Time (s)	84.7
Total Drift in 20 mph winds (ft)	2484.5

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		4f Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	1
	Backup	1.5
Energetics Mass - Main Chute (grams)	Primary	3.2
	Backup	3.7
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.)	Fully independent with two altimeters having separate black powder charges, switches, batteries, and E-matches
Pad Stay Time (Launch Configuration)	2.9 hr

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Fruity Chutes 18-inch 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)			117	
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 connecting a bowline knot to a U-bolt		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	3617.9	2287.6	2839	

Recovery System Properties - Main Parachute

Manufacturer/Model			Fruity Chutes 120-inch Iris UltraCompact	
Size or Diameter (in or ft)			120 in	
Main Altimeter Deployment Setting (ft)			675	
Backup Altimeter Deployment Setting (ft)			650	
Velocity at Deployment (ft/s)			117	
Terminal Velocity (ft/s)			12.6	
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 connecting a bowline knot to a U-bolt		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	18	26.6	33.1	N/A

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Payload

Overview

The payload, LOPSIDED, is a lander with four legs that is contained within the payload bay with its top facing the aft end of the bay. It is retained by an

Payload 1 (official payload)	electronic rotary latch and nylon shear pins. At apogee, the latch unlocks, leaving just the shear pins retaining LOPSIDED. At 675 ft AGL, the main parachute deploys, pulling the top of LOPSIDED, breaking the shear pins, and pulling LOPSIDED out of the payload bay. At 500 ft AGL, an ARRD separates LOPSIDED from the main parachute recovery harness. LOPSIDED then descends under a furled parachute until 200 ft AGL, when a Jolly Logic ChuteRelease allows the payload parachute to open fully. After landing, the chute is released by two electronic rotary latches. Two solenoid latches will unlock, allowing LOPSIDED to self-level. Then, the onboard cameras for the Planetary Observation System will capture an image and transmit it to the team using Transmitter 3 described below.
Payload 2 (non-scored payload)	Overview N/A

Test Plans, Status, and Results	
Ejection Charge Tests	In order to ensure that the altimeters used for ejection charges onboard the rocket are functioning properly, altimeters will be placed in a vacuum chamber and will be connected to a "drogue" and "main" circuit, each with an LED. If the LED illuminates at the correct pressure, then the altimeters will be deemed worthy for flight. Black powder ejection testing will be performed to confirm the calculations presented in the PDR document. The calculated amount of black powder will be manually ignited within the launch vehicle in its flight configuration to confirm proper separation. If the calculated black powder charge fails to produce proper separation, the charge size will be increased and the test will be repeated until proper separation is achieved.
Sub-scale Test Flights	The subscale test flight is scheduled for November 21, 2020. During this test, launch vehicle systems will be evaluated and any failures will be analyzed to prevent future occurances. The launch will also validate the recovery system and altimeter components. The subscale payload will consist of one camera that will be included in the final payload, and one accelerometer. These are included to test the functionality of these components in the intense environment of flight onboard the launch vehicle.
Vehicle Demonstration Flights	The vehicle demonstration flight is scheduled for February 20, 2021. This flight will validate all launch vehicle systems and provide mission confidence prior to the FRR milestone. This flight is designed to satisfy handbook requirement NASA 2.18.1.
Payload Demonstration Flights	The payload demonstration flight will be coincident with the vehicle demonstration flight on February 20, 2021. This flight will validate the payload retention and deployment systems, along with payload functionality after deployment. This will satisfy handbook requirement NASA 2.18.2.

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Transmitter #1			
Location of transmitter:	AV Bay		
Purpose of transmitter:	Launch Vehicle 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:	Aluminium foil sheet will be mounted to the AV sled between the tracker and recovery electronics		

Transmitter #2

Location of transmitter:	Payload		
Purpose of transmitter:	Payload Tracker		
Brand	BigRedBee	RF Output Power (mW)	250mW
Model	BRB900	Specific Frequency used by team (MHz)	900 MHz
Handshake or frequency hopping? (explain)	Fixed frequency		
Distance to closest e-match or altimeter (in)	1		
Description of shielding plan:	Aluminum foil sheet placed between the altimeter and the tracker section inside the payload		

Transmitter #3			
Location of transmitter:	Payload		
Purpose of transmitter:	Image Transmission		
Brand	Adafruit	RF Output Power (mW)	100 mW
Model	RFM69HCW	Specific Frequency used by team (MHz)	433 MHz
Handshake or frequency hopping? (explain)	Handshake; to ensure transmission is only received by the team		
Distance to closest e-match or altimeter (in)	> 1		
Description of shielding plan:	Aluminum foil will be placed between the transmitter and other payload electronics		

Transmitter #4			
Location of transmitter:			
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:			
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:			
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