

Milestone Review Flysheet 2020-2021

Institution North Carolina State University

Milestone FRR

Vehicle Properties

Total Length (in)	110.25
Diameter (in)	6.17
Gross Lift Off Weigh (lb)	49.28
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)	83.235
Center of Gravity (in. from nose)	67.83
Static Stability Margin (on pad)	2.17
Static Stability Margin (at rail exit)	2.23
Thrust-to-Weight Ratio	6.93
Rail Size/Type and Length (in)	1515 - 144 in
Rail Exit Velocity (ft/s)	69.44

Ascent Analysis

Maximum Velocity (ft/s)	481.32
Maximum Mach Number	0.428
Maximum Acceleration (ft/s ²)	255.85
Target Apogee (ft)	4473
Predicted Apogee (From Sim.) (ft)	3678

Recovery System Properties - Overall

Total Descent Time (s)	84.9
Total Drift in 20 mph winds (ft)	2490.9

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)	4f Black Powder	
Energetics Mass - Drogue Chute (grams)	Primary	2.6
	Backup	3.1
Energetics Mass - Main Chute (grams)	Primary	2.9
	Backup	3.6
Energetics Mass - Other (grams) - If Applicable	Primary	0.1
	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)	2x PerfectFlite StratoLogger CF; 2x Jolly Logic Chute Release
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, 921 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Fully independent recovery system with two altimeters having separate black powder charges, screw switches, 9V 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)	18			
Main Altimeter Deployment Setting	Apogee			
Backup Altimeter Deployment Setting	Apogee + 1 second			
Velocity at Deployment (ft/s)	0			
Terminal Velocity (ft/s)	120.6			
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	5/16 in. quick links connecting a bowline knot to a 5/16 in U-bolt			
Kinetic Energy of Each Section (Ft-lbs)	Nose/Mid	Fin Can	Section 3	Section 4
	7443.4	2413.9	N/A	N/A

Recovery System Properties - Main Parachute

Manufacturer/Model	Fruity Chutes 120-inch Iris UltraCompact			
Size or Diameter (in)	120			
Main Altimeter Deployment Setting (ft)	700			
Backup Altimeter Deployment Setting (ft)	650			
Velocity at Deployment (ft/s)	120.6			
Terminal Velocity (ft/s)	13.7			
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	5/16 in. quick links connecting a bowline knot to a 5/16 in U-bolt			
Kinetic Energy of Each Section (Ft-lbs)	Nosecone	Midsection	Fin Can	Section 4
	39.9	35.2	30.9	N/A

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Payload

Overview

<p>Payload 1 (official payload)</p>	<p>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 electronic rotary latch and nylon shear pins. At apogee, the latch unlocks, leaving just the shear pins retaining LOPSIDED. At 700 ft AGL, the main parachute deploys, pulling the top of LOPSIDED, breaking the shear pins, and pulling LOPSIDED out of the payload bay. Two redundant Jolly Logic Chute Releases constrain the payload parachute deployment bag to prevent premature payload parachute deployment until 600 ft AGL. At 500 ft AGL, an ARRD separates LOPSIDED from the main parachute recovery harness. After landing, the chute is released by two electromechanical cabinet 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.</p>
<p>Payload 2 (non-scored payload)</p>	<p>Overview</p> <p>N/A</p>

Test Plans, Status, and Results	
<p>Ejection Charge Tests</p>	<p>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 CDR 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.</p>
<p>Sub-scale Test Flights</p>	<p>The subscale test flight was successfully completed on November 21, 2020. The vehicle reached an apogee of 1,657ft and experienced a successful dual-deploy recovery. The static stability margin was lower than predicted at 1.7.</p>
<p>Vehicle Demonstration Flights</p>	<p>The vehicle demonstration flight was completed on February 21, 2021. The launch vehicle and recovery system functioned as designed, satisfying NASA requirement 2.18.1. The launch vehicle reached an apogee of 2,992 ft AGL. The static stability margin on the launch pad was 2.25, exceeding the 2.0 requirement. The vehicle demonstration flight carried a payload mass simulator which was retained and deployed using the same systems that will be used to retain and deploy the final payload. Some issues with these systems were noted and are discussed in the CDR Document.</p>
<p>Payload Demonstration Flights</p>	<p>The payload demonstration flight will be conducted on March 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.</p>

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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 TX/RX GPS Tracking System	Specific Frequency used by team (MHz)	921 MHz
Handshake or frequency hopping? (explain)	Handshake; to ensure transmission is only received by the team		
Distance to closest e-match or altimeter (in)	4		
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 Electronics Sled		
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)	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 sheet placed between the altimeter and the tracker section inside the payload		

Transmitter #3			
Location of transmitter:	Payload Electronics Sled		
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)	RFM69HCW module is capable of frequency hopping within 433 MHz spectrum spread		
Distance to closest e-match or altimeter (in)	0.5		
Description of shielding plan:	Aluminum foil will be placed between transmitter and altimeter		

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

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

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

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Additional Comments

N/A
