Milestone Review Flysheet 2024-2025

Institution	North Carolina State University	Milestone	CDR

Vehicle Properties

Total Length (in)	95.75
Diameter (in)	6.17
Aspect Ratio	16:1
Gross Lift Off Weight (lb)	38.39
Ballast Amount (lb) / Material / Location	0
Launch Vehicle Burn Out Weight (lb)	34.37
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	G10 Fiberglass and 3/16 in.
Coupler Length(s)/Shoulder Length(s) (in)	Nose Cone: 6/3 (in.) Forward AVAB: 16/7 (in.) Aft AVAB: 16/6 (in.)

Motor Properties

Motor Brand/Designation	Aerotech L1520T
Max/Average Thrust (lb)	396.86/352.46
Total Impulse (lbf-s)	835.37
Mass Before/After Burn (oz)	128.79/63.39
Liftoff Thrust (N)	1545.4
Motor Retention Method	1/8 in. thick custom 6061-T6 aluminum retainer plate secured to thrust bulkhead with four #8-32 machine screws.

Stability Analysis

Center of Pressure (in. from nose)	71.89
Center of Gravity (in. from nose)	58.78
Static Stability Margin (on pad)	2.13
Static Stability Margin (at rail exit)	2.18
Thrust-to-Weight Ratio	9.05
Rail Size/Type and Length (in)	1515 / 144 in.
Rail Exit Velocity (ft/s)	71.79

Ascent Analysis

Maximum Velocity (ft/s)	632.8
Maximum Mach Number	0.56
Maximum Acceleration (ft/s^2)	296.47
Target Apogee (ft)	4600
Predicted Apogee (From Sim.) (ft)	4809.76

Recovery System Properties - Overall

Total Descent Time (s)	71.486
Total Drift in 20 mph winds (ft)	2096.93

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		#FFF Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2.75
	Backup	3.25
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 StratologgerCF
Secondary Altimeter Make/Model	Altus Metrum EasyMini
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Eggtimer Rocketry Eggfinder Mini
Additional Locators (if applicable)	N/A
Transmitting Frequencies (all - vehicle and payload)	919 MHz 144.39 MHz; 902-928 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Altimeter circuits are fully independent of each other and all other electronics. Each altimeter has its own independent battery, micro switch, e-matches, and black powder charges.
Pad Stay Time (Launch Configuration)	4 hours

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Fruity Chutes Classic Elliptical	
Size or Diameter (in or ft) / drag coeficient			18 in / 0.8427	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee + 1 s	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			106.58	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in. flat Kevlar	
Recovery Harness Length (ft)			18	
Harness/Airframe Interfaces		3/8" Steel Eye Bolts, 3/8" Steel Quick Links, and Zinc-plated 5/16" Steel 2" ID U-Bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	3685.179	2381.641		

Recovery System Properties - Main Parachute

Manufacturer/Model			Fruity Chutes Iris Ultra Compact	
Size or Diameter (in or ft) / drag coefficient			96 in / 1.236	
Main Altimeter Deployment Setting			550 ft	
Backup Altimeter Deployment Setting			500 ft	
Velocity at Deployment (ft/s)			106.58	
Terminal Velocity (ft/s)			16.42	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in. flat Kevlar	
Recovery Harness Length (ft)			16	
Harness/Airframe Interfaces		3/8" Steel Eye Bolt, 3/8" Steel Quick Links, and Zinc-plated 5/16" Steel 2" ID U-Bolts		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	36.932	50.577	56.555	

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Payload

	Overview
Payload 1 (official payload)	STEMCRaFT: A STEMnaut capsule mounted inside the Nose Cone of the rocket, capable of retaining 4 STEMnauts, while also recording and transmitting data. The STEMCRaFT features a Raspberry Pi, an ESP32S, an IMU, a barometric pressure sensor, and a GPS to record the time of landing, maximum velocity, landing velocity, G-forces sustained, calculated STEMnaut crew survivability, temperature of the landing site, apogee reached, battery check/power status, orientation of on-board STEMnauts, and the landing coordinates. Upon landing, these data points are encoded and sent on the 2-meter band via APRS to a NASA receiver. There will be 2 batteries for independent power supply: a 2200mAh 2s LiPo for the data collection system and a 2200mah 2s LiPo for the transmission system. Pull-pin switches will arm the system and are rated to 5 amps or 42 watts from the power supply.
	Overview
Payload 2 (non-scored payload)	Air Brakes: An onboard computer predicts a flight profile for the rocket after motor burnout. It then controls fins to slow the rocket's ascent as needed to hit a target apogee. The mechanism uses 3D printed parts to make up the housing and four fins, which are coupled together in a gear system. The fins are rotated into the airstream by a central gear which is actuated by a powerful servo to ensure the system can overcome any friction from aerodynamic forces which may bind the mechanism. Two seperate batteries will be used to power independent circuits: a 2200mAh 2s LiPo for the flight computer and a 2200mAh 4s Lipo for the Servo.

Test Plans, Status, and Results

Ejection Charge Tests	A ground ejection test will be performed prior to every launch of the competition Launch Vehicle, satisfying Team Derived Requirement RF.24. A successful ejection test of the Subscale was completed on November 15, 2024 and the first ejection test of the Full-scale is scheduled for February 14, 2025. Ejection testing consists of configuring the Launch Vehicle into its final launch day configuration, then testing the drogue and main recovery events to verify black powder calculations are correct. In the event that the Launch Vehicle fails to separate, 0.2 grams of black powder is added to the ejection charge and the test is repeated.
Sub-scale Test Flights	Two successful test flights of the Subscale Launch Vehicle were conducted on 11/16/24. Aerotech J500G motors were used for both flights. All phases of both flights were nominal and the Launch Vehicle was successfully recovered undamaged. The test flights had recorded apogees of 1500 ft. and 1513 ft., which were 4.2% and 3.6% off of the predicted apogee of 1567 ft., respectively. The primary payload consisted of data collection systems for the STEMCRaFT. The primary payload experienced a software crash during the initial flight and performed nominally during the second flight. The secondary air brakes payload mechanism did not deploy on either flight. However, the associated electronics and data logging components performed nominally.
Vehicle Demonstration Flights	The Vehicle Demonstration Flight is scheduled for February 22, 2025. In the event that the February 22nd launch date is not achieved, a backup launch will be conducted on March 8, 2025. Both of these launch dates meet the March 17, 2025 deadline. This flight will evaluate the performance of the vehicle subsystmes of the Full-scale Launch Vehicle. This launch will complete all Team Derived Requirements and NASA Requirements pertaining to the Launch Vehicle. Successful completion of this flight will satisufy NASA Requirement 2.19.1.
Payload Demonstration Flights	The Payload Demonstration Flight is scheduled for February 22, 2025. In the event that the February 22nd launch date is not achieved, a backup launch will be conducted on March 8, 2025. Both of these launch dates meet the April 14, 2025 deadline. The Payload Demonstration Flight is planned to occur on the same date as the Vehicle Demonstration flight to allow time for possible reflights of the Payload for data collection prior to the competition launch. This flight will evaluate the performance and safety of the competition payload and the experimental payload. This launch will complete all Team Derived Requirements and NASA Requirements pertaining to the payload. Successful completion of this flight will satisfy NASA Requirement 2.19.2.

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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
Model	Eggfinder Mini	Specific Frequency used by team (MHz)	919
Handshake or frequency hopping? (explain)	Fixed Frequency, ID 8		
Distance to closest e-match or altimeter (in)	5.25		
Description of shielding plan:	A sheet of aluminum foil will be added between the tracker and other recovery electronics on the AV sled.		

Transmitter #2			
Location of transmitter:	Nose Cone/Payload Bay		
Purpose of transmitter:	Payload challenge. 2m Transmitter.		
Brand	NICE RF	RF Output Power (mW)	4000
Model	SA858	Specific Frequency used by team (MHz)	APRS (144.390)
Handshake or frequency hopping? (explain)	Fixed Frequency.		
Distance to closest e-match or altimeter (in)	24		
Description of shielding plan:	Altimeters will be shielded from RF with a sheet of aluminum foil in the Nose Cone/Payload Bay.		

Transmitter #3			
Location of transmitter:	Nose Cone/Payload Bay		
Purpose of transmitter:	Recieve Remote Overide Transmission		
Brand	Digi International	RF Output Power (mW)	100
Model	Digi XBee-PRO 900HP (S3B)	Specific Frequency used by team (MHz)	902-928
Handshake or frequency hopping? (explain)	Frequency Hopping		
Distance to closest e-match or altimeter (in)	24		
Description of shielding plan:	Altimeters will be shielded from RF with a sheet of aluminum foil in the Nose Cone/Payload Bay.		

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