

Milestone Review Flysheet

Please see Milestone Review Flysheet Instructions.

Institution	University of Louisville
--------------------	--------------------------

Milestone	FRR
------------------	-----

Vehicle Properties	
Total Length (in)	108
Diameter (in)	6.11
Gross Lift Off Weight (lb)	38.8125
Airframe Material	Carbon Fiber
Fin Material	Fiberglass
Drag	Drag coefficient: 0.27

Motor Properties	
Motor Manufacturer(s)	Cesaroni
Motor Designation(s)	L1720-WT
Max/Average Thrust (lb)	437/398
Total Impulse (lbf-sec)	822.8
Mass (before, after burn)	7.36/3.49
Liftoff Thrust (lb)	425.73

Stability Analysis	
Center of Pressure (in from nose)	81.32
Center of Gravity (in from nose)	62.99
Static Stability Margin	3.05
Thrust-to-Weight Ratio	10.25
Rail Size (in)/ Length (in)	96
Rail Exit Velocity (ft/s)	60.6

Ascent Analysis		
Maximum Velocity (ft/s)	638	
Maximum Mach Number	0.57	
Maximum Acceleration (ft/s^2)	338	
Target Apogee (1st Stage if Multiple Stages)	5277	
Stable Velocity (ft/s)	50	
Distance to Stable Velocity (ft)	4.25	

Recovery System Properties				
Reefed Parachute				
Manufacturer/Model		Polyconical - custom made		
Size		1.77 ft^2		
Altitude at Deployment (ft)		Apogee		
Velocity at Deployment (ft/s)		0		
Terminal Velocity (ft/s)		73		
Recovery Harness Material		9/16" tubular nylon		
Harness Size/Thickness (in)		9/16"		
Recovery Harness Length (ft)		27		
Harness/Airframe Interfaces		1/4 inch U-bolt and quick link.		
Kinetic Energy of Each Section (ft-lbs)	Section 1	Section 2	Section 3	Section 4

Recovery System Properties				
Fully deployed Parachute				
Manufacturer/Model		Polyconical - custom made		
Size		132.73 ft^2		
Altitude at Deployment (ft)		800		
Velocity at Deployment (ft/s)		60.74		
Terminal Velocity (ft/s)		11.11		
Recovery Harness Material		9/16" tubular nylon		
Harness Size/Thickness (in)		9/16"		
Recovery Harness Length (ft)		27		
Harness/Airframe Interfaces		1/4 inch U-bolt and quick link		
Kinetic Energy of Each Section (ft-lbs)	Section 1 (Nosecone)	Section 2 (Propulsion Bay)	Section 3	Section 4
	60	60		

Recovery Electronics	
Altimeter(s)/Timer(s) (Make/Model)	PerfectFlite StratoLogger (x2)
Redundancy Plan	Nosecone avionics bay will utilize a Stratollogger CF for a primary and redundant altimeter. Reefing will be facilitated via a Stratollogger CF for both primary and secondary altimeters.

Recovery Electronics	
Rocket Locators (Make/Model)	Garmin Astro DC 40 (x1)
Transmitting Frequencies	Garmin Astro DC 40 - 151880 MHz
Black Powder Mass Upper Airframe Chute (grams)	4.3

Pad Stay Time (Launch Configuration)	1 hour
--------------------------------------	--------

Black Powder Lower Airframe Chute (grams)	N/A
---	-----

Milestone Review Flysheet

Please see Milestone Review Flysheet Instructions.

Institution	University of Louisville
--------------------	--------------------------

Milestone	CDR
------------------	-----

Autonomous Ground Support Equipment (AGSE)

Capture Mechanism	Overview
	A threadless screw will move down the height of the ground station where two gripper arms will grab the payload. From there, they will raise to system height, the rod rotates 90 degrees and then inserts the payload into the vehicle.
Container Mechanism	Overview
	The payload will be inserted into two clips, located inside the payload bay. The clips mechanically retain the capsule. The door to the payload bay will actuate via servo, sealing the payload from the environment.
Launch Rail Mechanism	Overview
	The rail will not be locked in place, instead, a screw mechanism will guide the tower to the proper position. A motor will monitor and provide necessary torque to keep the platform at the 5 degree of vertical position as stated from the statement of work. The motor will monitor and provide required torque to maintain position.
Igniter Installation Mechanism	Overview
	The igniter will be augmented with dowel rods and aluminum tape for shielding. Four wheels will extrude the igniter wire until it is in the proper placement in the vehicle. A magnetic field sensor will detect a magnetic flag on the wire to ensure proper placement.
CG Location of Launch Pad (in inches) When Rail is Horizontal (Use Base of Rail as the Reference Point)	
Moment Analysis	Vehicle horizontal: 22 inches (relative to ground) Vehicle in launch position: 26 inches (relative to ground)

Payload

Payload 1	Overview
	The AGSE will autonomously retrieve a payload utilizing a telescopic that will incorporate an acme screw and worm gearboxes to lock into specific positions. The launch vehicle will be secured to the AGSE using a guide tower launch platform. The guide tower will consist of three sheetmetal rails that will guide the rocket to a safe exit velocity. The vehicle will be actuated by a ball screw. The igniter will be installed using a belt driven igniter installation device. The igniter will be spooled prior to start of the autonomous sequence and will be straightened as it is inserted.
Payload 2	Overview

Test Plans, Status, and Results

Ejection Charge Tests	All ejection charges will be tested on the ground prior to flight to ensure that black powder charges are all properly sized.
	Sub-scale flight was successfully conducted. The vehicle achieved an altitude of 1359 ft. The recovery of the launch vehicle was successful, proving the reliability of the vehicle design and recovery system.

Sub-scale Test Flights	reliability of the vehicle design and recover system.
Full-scale Test Flights	Full-scale flight was successfully conducted. The vehicle achieved an altitude of 5172 ft AGL. The recovery of the vehicle was moderately successful. It was found that the 3D printed reefing deployment mechanism was not sufficient to hold the force of the reefed parachute. Another full scale test will be performed using a Tender Descender Level 2.

Milestone Review Flysheet

Please see Milestone Review Flysheet Instructions.

Institution	University of Louisville	Milestone	FRR
--------------------	--------------------------	------------------	-----

Additional Comments

Unconventional parachute deployment with Parachute reefing occurring at 800 ft.

|

|