Milestone Review Flysheet 2021-2022

Institution	Cedar Falls High School

Milestone	FRR

Vehicle Properties

Total Length (in)	104.5
Diameter (in)	6.17
Gross Lift Off Weigh (lb)	31.82
Airframe Material(s)	Fiberglass
Fin Material and Thickness (in)	3/16" Fiberglass
Coupler Length(s)/Shoulder Length(s) (in)	Ebay coupler = 14" w/ 2" switchband Nose coupler = 5" shoulder, 6" in payload, 4" switchband

Motor Properties

Motor Brand/Designation	CTI K1440
Max/Average Thrust (lb)	411.18(max) / 323.05 (avg)
Total Impulse (lbf-s)	533.25
Mass Before/After Burn (oz)	66.77/26.9
Liftoff Thrust (N)	1700
Motor Retention Method	AeroPak Retainer

Stability Analysis

Center of Pressure (in. from nose)	77.26
Center of Gravity (in. from nose)	65.03
Static Stability Margin (on pad)	1.98
Static Stability Margin (at rail exit)	2.05
Thrust-to-Weight Ratio	11.79:1
Rail Size/Type and Length (in)	1515 rail x 144in
Rail Exit Velocity (ft/s)	94.61

Ascent Analysis

Maximum Velocity (ft/s)	494.19 (500 actual)
Maximum Mach Number	0.44 (0.44 actual)
Maximum Acceleration (ft/s^2)	463.31
Target Apogee (ft)	3,750
Predicted Apogee (From Sim.) (ft)	3219.89 (3257 actual)

Recovery System Properties - Overall

Total Descent Time (s)	67.81
Total Drift in 20 mph winds (ft)	1,989

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	3.3g
	Backup	5g
Energetics Mass - Main Chute (grams)	Primary	4g
	Backup	6g
Energetics Mass - Other (grams) - If Applicable	Primary	
	Backup	

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Perfectflite StratologgerCF
Secondary Altimeter Make/Model	Perfectflite StratologgerCF
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Featherweight GPS
Additional Locators (if applicable)	N/A
Transmitting Frequencies (all - vehicle and payload)	921.400 MHz
Describe Redundancy Plan (batteries, switches, etc.)	2 altimeters w/ independent power 2 ejection charges for both drogue and main chute events
Pad Stay Time (Launch Configuration)	2+ hrs

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Fruity Chutes - Elliptical	
Size or Diameter (in or ft)			24in	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee +1 sec	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			63.12 (43mph)	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			3/8" tubular kevlar (3600lb breaking strength)	
Recovery Harness Length (ft)			35	
Harness/Airframe Interfaces		5/16" forged Steel Eye Bolt secured to fiberglass bulkplates using a locknut and washers +Forged steel quick link		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	704.34 (actual)	1043.95 (actual)		

Recovery System Properties - Main Parachute

Manufacturer/Model			FruityChutes - Iris Ultra	
Size or Diameter (in or ft)			72in	
Main Altimeter Deployment Setting (ft)			700	
Backup Altimeter Deployment Setting (ft)			500	
Velocity at Deployment (ft/s)			63.12 (43 mph)	
Terminal Velocity (ft/s)			20.57 (14 mph)	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			3/8" tubular kevlar (3600lb breaking strength)	
Recovery Harness Length (ft)			35 ft	
Harness/Airframe Interfaces		5/16" forged Steel Eye Bolt secured to fiberglass bulkplates using a locknut and washers +Forged steel quick link		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	74.8 (actual)	43.78 (actual)	58.3 (actual)	

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Payload	
Payload 1 (official payload)	Overview First, a camera array to record 360 degree video footage to make a virtual reality experience. Three GoPro cameras will be housed in the upper payload section and use acrylic window sections to simultaneously record a full 360-degree high-resolution video that will then be uploaded to a video editing sofware. The software will stitch the videos together in a way that will allow the final video file to be viewed through a VR headset to give the viewer the perspective that they are inside of the vehicle during flight.
Payload 2 (non-scored payload)	Overview Second, a computer board that collects orientation, accelerometer, and altitude data that will be used as an information display overlay (or a heads up display) in the virtual reality video.

Test Plans, Status, and Results	
Ejection Charge Tests	Completed. Ejection charge ground testing was conducted prior to any sub-scale or full-scale launches that will use charges. The amount of black powder was calculated prior to testing and then testing took place in an open field with minimal personnel in attendance to reduce safety risks. The calculated black powder amounts were proven to cause successful deployment during these tests.
Sub-scale Test Flights	Completed. Sub-scale test flights were conducted at a 50% scale of vehicle size. The sub-scale vehicle included windows in the design, but no cameras. The dual deployment recovery method was replicated and successfully tested in the subscale model. The test flight proved vehicle stability and integrity, but raised concernes about ejection charge igniters and stability margin. These concerns were adressed in the creation of the full-scale.
Vehicle Demonstration Flights	Completed (2-20-22). The vehicle demonstration flight was conducted at the same time as the payload demonstration flight. The vehicle reached an apogee of 3,257 feet and perfromed in line with all performance expectations. It was recovered safely with no damage. The vehicle safely carried the payload to an apogee of over 3,000 feet and safely returned it to the gorund, meeting mission success criteria.
Payload Demonstration Flights	Completed (2-20-22) The vehicle demonstration flight was conducted at the same time as the payload demonstration flight. The camera array recorded video footage at 4K 60 fps for the duration of flight, meeting success criteria. The PCB experienced a shorting issue caused by a launch-day assembly error (this issue is explained in more detail in the report, section 5.2). The short prevented the PCB from recording necessary data. However, the secondary data recording system embedded inside of the cameras was able to record accelerometer and gyroscope data. This, along with altitude data from the primary altimeter, supplements the lost data from the PCB error, meaning that all planned data was collected, meting the mission success criteria. Note: The PCB was functional before and after flight. No damage was sustained. The team traced the shorting issue to the assembly error.

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Transmitter #1			
Location of transmitter:	Vehicle electronics bay		
Purpose of transmitter:	GPS tracking of the vehicle		
Brand	Featherweight Altimeters	RF Output Power (mW)	50
Model	Featherweigth GPS	Specific Frequency used by team (MHz)	921.400 MHz
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)	9 in from closest e-match, 6 in from closest altimeter		
Description of shielding plan:	1/4" plywood bulkplate with 1/2" chicken wire that acts as a Faraday cage and contains GPS in individual compartment		

Transmitter #2			
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 #3			
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 #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