Milestone Review Flysheet 2018-2019

Institution	Oregon State University

Milestone	CDR

Vehicle Properties

Total Length (in)	123.5
Diameter (in)	6.25
Gross Lift Off Weigh (lb)	48.9
Airframe Material(s)	Carbon Fiber, Fiberglass
Fin Material and Thickness (in)	Carbon Fiber, 0.125
Coupler Length(s)/Shoulder Length(s) (in)	12.5 / 6.25

Motor Properties

Motor Brand/Designation	Cesaroni L2375-WT
Max/Average Thrust (lb)	586.3 / 533.7
Total Impulse (lbf-s)	1102.67
Mass Before/After Burn (lb)	9.71 / 4.06
Liftoff Thrust (lb)	553.5
Motor Retention Method	Threaded Retainer

Stability Analysis

Center of Pressure (in. from nose)	86.29
Center of Gravity (in. from nose)	73.02
Static Stability Margin (on pad)	2.1
Static Stability Margin (at rail exit)	2.25
Thrust-to-Weight Ratio	12
Rail Size/Type and Length (in)	1515 / 144
Rail Exit Velocity (ft/s)	88.8

Ascent Analysis

Maximum Velocity (ft/s)	669
Maximum Mach Number	0.61
Maximum Acceleration (ft/s^2)	364
Target Apogee (ft)	4500
Predicted Apogee (From Sim.) (ft)	5296

Recovery System Properties - Overall

Total Descent Time (s)	75.3 (fore), 71.7 (aft)
Total Drift in 20 mph winds (ft)	2209 (fore), 2104 (aft)

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	3.35, 3.35
	Backup	4.35, 4.35
Energetics Mass - Main Chute (grams)	Primary	0.33, 0.33
	Backup	0.33, 0.33, 2.0, 2.0, 2.5, 2.5
Energetics Mass - Other (grams) - If Applicable	Primary	5.5
	Backup	8.25

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	PerfectFlite StratoLoggerCF
Secondary Altimeter Make/Model	Missleworks RRC3
Other Altimeters (if applicable)	Jolly Logic AltimeterThree
Rocket Locator (Make/Model)	X-Bee Pro 900HP
Additional Locators (if applicable)	Sparkfun Venus GPS
Transmitting Frequencies (all - vehicle and payload)	CC1200: 433 MHz Xbee PRO 900HP: 900 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Three altimeters for each section, separate batteries for each altimeter, separate charges for each altimeter, two Tender Descenders per main chute.
Pad Stay Time (Launch Configuration)	Altimeters: 8+ hours Tracking Unit: 9 hours

Recovery System Properties - Drogue Parachute

Manufacturer/Model	Top Flight Recovery / XTEAR-18
Size or Diameter (in or ft)	18 in. (fore) / 18 in. (aft)
Main Altimeter Deployment Setting	Apogee
Backup Altimeter Deployment Setting	Apogee +1 s
Velocity at Deployment (ft/s)	1.7
Terminal Velocity (ft/s)	146 (fore) /127 (aft)
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	1 in. Nylon Webbing
Recovery Harness Length (ft)	20 (fore) / 20 (aft)
Harness/Airframe Interfaces	3/8 in. forged steel eyebolts connected to altimeter bay bulkheads.

Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	4499 (fore)	3480 (aft)	452.2 (nosecone)	N/A

Recovery System Properties - Main Parachute

Manufacturer/Model	Fruity Chutes Toroidal
Size or Diameter (in or ft)	8 ft (fore) / 8 ft (aft)
Main Altimeter Deployment Setting (ft)	700
Backup Altimeter Deployment Setting (ft)	700, 600
Velocity at Deployment (ft/s)	146 (fore) / 127 (aft)
Terminal Velocity (ft/s)	13.2 (fore) / 14.0 (aft)
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	1 in. Nylon Web
Recovery Harness Length (ft)	20 (fore) / 20 (aft)
Harness/Airframe Interfaces	3/8 in. forged steel eyebolts connected to altimeter bulkheads.

Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	50.20 (fore)	69.8 (aft)	7.0 (nosecone)	N/A

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Payload

Payload 1 (official payload)	Overview	The rover will be contained within the fore section of the airframe. Upon landing, the rover will be ejected from the airframe using black powder charges. The rover will have two coaxial, independently driven wheels with a chassis suspended between them. A spring-loaded stabilizer arm will act as a third point of contact with the ground. An Arduino Teensy 3.6 development board will autonomously control the motors to move the rover, receiving input from a sensor array including active sonar, passive sonar, and a nine-degree-of-freedom IMU. An auger will be mounted in the center of the chassis. When the rover is deployed the auger will periodically gather soil samples and store them in an internal containment unit. After collection, the rover will autonomously drive to a Scientific Base Station where it will perform an additional scientific experiment.
Payload 2 (non-scored payload)	Overview	None

Test Plans, Status, and Results

Ejection Charge Tests	Sub-Scale Test Plan and Results: A remote ignition system was used to ignite charges and ensure proper seperation and drogue parachute ejection with selected amount of black powder. Three consecutive successful tests for all sections. Full-Scale Test Plan: After final launch vehicle assembly with bulkheads and recovery system, a remote ignition system will be used to ensure proper seperation and drogue parachute ejection with selected amount of black powder five consecutive times.
Sub-scale Test Flights	Test Plan: Sub-scale launch vehicle was constructed with a 4 in. diameter airframe and launched twice on December 8th, 2018 and January 4th, 2019. Status: Completed. Results: The December 8th flight resulted in a main parachute deployment at apogee. The January 4th flight never had a main parachute deployment. The flights demonstrated several mistakes in the recovery system design, which have been accounted for.
Vehicle Demon-stration Flights	Test Plan: The full scale launch vehicle will be manufactured from final design choices. Altitude and descent calculations will be calculated and verfied with simulations. The full scale launch vehicle is planned for demonstration flights on February 9th, February 16th, and February 23rd. All of these flights are planned to have the full scale payload and retention systems on board. Status: Final design of full scale launch vehicle and payload are complete. Manufacturing is beginning. Results: Demonstration not yet completed.
Payload Demon-stration Flights	Test Plan: The competition payload is planned to fly in all full scale flights. The payload demonstration flights will be the same flights as the vehicle demonstration flights. Status: Final design of full scale launch vehicle and payload are complete. Manufacturing is beginning. Results: Demonstration not yet completed.

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Transmitter #1			
Location of transmitter:	Nosecone		
Purpose of transmitter:	Tracking/Telemetry		
Brand	Digi	RF Output Power (mW)	250
Model	Xbee PRO 900HP	Specific Frequency used by team (MHz)	900
Handshake or frequency hopping? (explain)	Frequency hopping, 400KHz wide channels		
Distance to closest e-match or altimeter (in)	6		
Description of shielding plan:	Conductive spray paint RF shielding around recovery electronics to ensure no interference with recovery electronics and to ensure that ejection takes place at the correct altitude.		

Transmitter #2			
Location of transmitter:	Nosecone		
Purpose of transmitter:	Long Range Tracking/Telemetry		
Brand	Texas Instruments	RF Output Power (mW)	40
Model	CC1200	Specific Frequency used by team (MHz)	433
Handshake or frequency hopping? (explain)	Frequency hopping		
Distance to closest e-match or altimeter (in)	6		
Description of shielding plan:	Conductive spray paint RF shielding around recovery electronics to ensure no interference with recovery electronics and to ensure that ejection takes place at the correct altitude.		

Transmitter #3			
Location of transmitter:	Aft section of airframe directly above the motor		
Purpose of transmitter:	Tracking/Telemetry		
Brand	Digi	RF Output Power (mW)	250
Model	Xbee PRO 900HP	Specific Frequency used by team (MHz)	900
Handshake or frequency hopping? (explain)	Frequency hopping, 400KHz wide channels		
Distance to closest e-match or altimeter (in)	4		
Description of shielding plan:	Conductive spray paint RF shielding around recovery electronics to ensure no interference with recovery electronics and to ensure that ejection takes place at the correct altitude.		

Transmitter #4			
Location of transmitter:	Aft section of airframe directly above the motor		
Purpose of transmitter:	Long Range Tracking/Telemetry		
Brand	Texas Instruments	RF Output Power (mW)	40
Model	CC1200	Specific Frequency used by team (MHz)	433
Handshake or frequency hopping? (explain)	Frequency hopping		
Distance to closest e-match or altimeter (in)	4		
Description of shielding plan:	Conductive spray paint RF shielding around recovery electronics to ensure no interference with recovery electronics and to ensure that ejection takes place at the correct altitude.		

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Transmitter #5

Location of transmitter:	Fore section above payload bay		
Purpose of transmitter:	Payload Ejection		
Brand	Digi	RF Output Power (mW)	250
Model	Xbee PRO 900HP	Specific Frequency used by team (MHz)	900
Handshake or frequency hopping? (explain)	Frequency hopping, 400KHz wide channels		
Distance to closest e-match or altimeter (in)	6		
Description of shielding plan:	Conductive spray paint RF shielding around recovery electronics to ensure no interference with recovery electronics and to ensure that ejection takes place at the correct altitude.		

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

None