Milestone Review Flysheet 2018-2019

Institution	Purdue University

Milestone	FRR

Vehicle Properties

Total Length (in)	120
Diameter (in)	5.15
Gross Lift Off Weigh (lb.)	40.3
Airframe Material(s)	FWFG
Fin Material and Thickness (in)	3/16" G10 FG
Coupler Length/Shoulder Length(s) (in)	12"

Motor Properties

Motor Brand/Designation	Aerotech L1520-T
Max/Average Thrust (lb.)	381.42 / 323.67
Total Impulse (lbf-s)	841.55
Mass Before/After Burn (lb.)	8.05/4.09
Liftoff Thrust (lb.)	355.2
Motor Retention Method	Aeropack Motor Retainer

Stability Analysis

Center of Pressure (in from nose)	88.221
Center of Gravity (in from nose)	69.317
Static Stability Margin (on pad)	3.87
Static Stability Margin (at rail exit)	3.5
Thrust-to-Weight Ratio	8.81
Rail Size/Type and Length (in)	1.5, 144
Rail Exit Velocity (ft/s)	63.9

Ascent Analysis

Maximum Velocity (ft/s)	604
Maximum Mach Number	0.54
Maximum Acceleration (ft/s^2)	279
Predicted Apogee (From Sim.) (ft)	4876

Recovery System Properties - Overall

Total Descent Time (s)	92.19
Total Drift in 20 mph winds (ft)	2,800

Recovery System Properties

Drogue Parachute

Manufacturer/Model	Skyangel Cert-3 Drouge
Size/Diameter (in or ft)	24"
Altitude at Deployment (ft)	Apogee
Backup Altimeter Deployment Setting	Apogee + 1 second
Velocity at Deployment (ft/s)	8.11
Terminal Velocity (ft/s)	6.57
Recovery Harness Size/Thickness (in)	1/2" tubular nylon
Recovery Harness Length (ft)	2
Harness/Airframe Interfaces	1/4" SS quick link through looped tether ends and 1/4" SS I-bolts through bulkheads

	Fore Section	Mid Section	Aft Section	Section 4
Kinetic Energy of Each Section (Ft-lbs)	1560.61	1082.64	2405.7	N/A

Recovery System Properties

Main Parachute

Manufacturer/Model	Skyangle Cert-3 XLarge
Size/Diameter (in or ft)	100"
Altitude at Deployment (ft)	900
Velocity at Deployment (ft/s)	90.4
Terminal Velocity (ft/s)	13.5
Recovery Harness Material	Tubular Kevlar
Recovery Harness Size/Thickness (in)	1/2" Thick
Recovery Harness Length (ft)	40'
Harness/Airframe Interfaces	1/4" SS quick link through looped tether ends and 1/4" SS I-bolts through bulkheads

	Section 1	Section 2	Section 3	Section 4
Kinetic Energy of Each Section (Ft-lbs)	34.65	24.04	53.42	N/A

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Altus Metrum Telemetrum

Recovery Electronics

Altus Metrum

Secondary Altimeter Make/Model	Missileworks RRC3+ Sport		Rocket Locators (Make/Model)	Altus Metrum Telemetrum	
Other Altimeters (if applicable)	N/A		Transmitting Frequencies (all - vehicle and payload)	70cm ham band	
Rocket Locator (Make/Model)	Altus Metrum Telemetrum		Ejection System Energetics		Black Powder
Additional Locators (if applicable)	N/A		Energetics Mass - Drogue Chute (grams)	Primary	3
Transmitting Frequencies (all - vehicle and payload)	Likely to be 70cm ham band			Backup	4
Describe Redundancy Plan (batteries, switches, etc.)	Fully redundant and independent systems with individual batteries, switches, wires, and ejection charges.		Energetics Mass - Main Chute (grams)	Primary	4
Pad Stay Time (Launch Configuration)	3 hours			Backup	5
			Energetics Masses - Other (grams) - If Applicable	Primary	N/A
				Backup	N/A

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Payload

Payload 1 (official payload)	Overview The launch vehicle created by the team will carry an autonomous rover and soil sampling system. The rover will be deployed from the payload bay upon landing and must drive at least 10 feet away from any part of the rocket. The rover will consist of two large wheels on either side of a chassis. The chassis will hold the control unit, power system, motion unit, as well as the object detection method needed for navigation. The soil collection apparatus will be deployable from the rear of the chassis. Once the payload bay has landed completely, a signal will be sent to deploy the rover. When the payload bay receives the signal, a black powder charge will ignite, launching a fairing capsule out of the payload bay. The fairing will open via spring loaded hinges, and the rover will deploy. Finally, it will autonomously navigate away from the rocket and take a soil sample.
Payload 2 (non-scored payload)	Overview N/A

Test Plans, Status, and Results

Ejection Charge Tests	Several tests were conducted for both Payload ejection and rocovery ejection. The first test had have each half of the launch vehicle constructed fully on either side (minus motor) around the avionics bay. Each half was attached to the avionics bay and a manual electrical signal was sent the the e-matches, igniting the black powder in the chagre well thus allowing us to measure accuracy of how much black powder we use. This test was conducted several times on either side to ensure safe deployment of both the drogue and main parachutes. A secondary test was conducted on the altimeters to verify that they are sending electrical charges to the e-match. This testing was conducted by wiring both avionics systems to their own e-match. We also turned on the altimeters as we would for final flight and place the two systems in a vacuum. In the vaccum we then decreased the pressure to simulate an increase in altitude. Our e-mathces ignited at both apogee and at the set altitude above ground level. Similar Tests were conducted with Payload ejection tests.

Sub-scale Test Flights	The sub-scale vehicle is fully constructed and has been successfully flown. On our subscale flight, the Missile Works RRC3+ Sport was the primary altimeter and for redundancy the JollyLogic AltimeterOne. This allowed assurance that the team understood how the RRC3+ Sport operated and to verify that our max altitude was accurate. On the RRC3+ Sport the altimeter reached a max altitude of 895 ft and the AltimeterOne reached a max altitude of 884 ft. The main reason that these are slightly off is that the AltimeterOne was attached to the shock cord at a lower resting height than the AltimeterOne. Another possible reason for the differences is the sampling rate on the RRC3+ Sport is higher than that of the AltimeterOne.
Vehicle Demon-stration Flights	The full scale vehicle is fully constructed and has been successfully flown. On our full scale flight, the Missile Works RRC3+ Sport was the secondary altimeter and the Altus Metrum Telemetrum was used as the primary altimeter. This allowed assurance that the team understood how the Telemetrum and RRC3+ Sport operated and to verify that our max altitude was accurate. On the RRC3+ Sport the altimeter reached a max altitude of 4,263 ft and the Telemetrum reached a max altitude of 4,321 ft. One reason for the differences is the sampling rate on the RRC3+ Sport is lower than that of the Telemetrum. The vehicle demonstration flight (VDF) was successful after recovering the rocket after a soft landing.
Payload Demon-stration Flights	The team attempted to conduct both the vehicle demonstration flight and payload demonstration flight at the same time. When the main parachute was deployed, it broke the payload retention system, and the payload section fell from about 750 ft. The rover was completely destroyed. A second iteration of the rover is currently being done. A second motor has also been purchased with the hopes that we will be able to fly between March 17th and March 24th. In order to have the FRR Addendum completed by March 25th.

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Transmitter #1

Location of transmitter:	Transmitter #1 is located on the rover, contained within the payload's active retention system while in flight.		
Purpose of transmitter:	Transmitter #1 receives the signal sent from the RDO to eject the rover from the rocket.		
Brand	Xbee	RF Output Power (mW)	60
Model	Pro Series 1 (802.15.4)	Specific Frequency used by team (MHz)	2400

Handshake or frequency hopping? (explain)	Transmitters #1 and #2 are assigned 64-bit addresses in the manufacturing process. Each transmitter will be programmed to only send and receive data from the other transmitter. In this way, a basic handshake will be made between each transmitter.
Distance to closest e-match or altimeter (in)	29.9
Description of shielding plan:	Shielded boxing, short connections

Transmitter #2			
Location of transmitter:	Transmitter #2 is located with the team at the RDO.		
Purpose of transmitter:	nsmitter #2 is responsible for sending the signal to the payload from the RDO to trigger payload ejecti		
Brand	Xbee	RF Output Power (mW)	60
Model	Pro Series 1 (802.15.4)	Specific Frequency used by team (MHz)	2400
Handshake or frequency hopping? (explain)	Transmitters #1 and #2 are assigned 64-bit addresses in the manufacturing process. Each transmitter will be programmed to only send and receive data from the other transmitter. In this way, a basic handshake will be made between each transmitter.		
Distance to closest e-match or altimeter (in)	29.9		
Description of shielding plan:	Shielded boxing, short connections		

Transmitter #3			
Location of transmitter:	Transmitter #3 is located in the Telemetrum in the Avionics Bay		
Purpose of transmitter:	nitter #3 is responsible for recording the altitude of the rocket and to trigger the ejection of the parac		
Brand	TI	RF Output Power (mW)	40
Model	CC1120	Specific Frequency used by team (MHz)	435
Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the altimeter and laptop on ground to track the flight of the rocket and deploy the parachutes when necessary.		
Distance to closest e-match or altimeter (in)	1.25		
Description of shielding plan:	Shielded boxing, short connections		

Transmitter #4			
Location of transmitter:	Transmitter #4 is located in the RRC3 Sport in the Avionics Bay		
Purpose of transmitter:	Transmitter #4 is responsible for recording the altitude of the rocket and to trigger the ejection of the parachutes. This is used as a redundancy to the Telemetrum.		
Brand	TI	RF Output Power (mW)	40
Model	MSP430	Specific Frequency used by team (MHz)	16
Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the altimeter and laptop on ground to track the flight of the rocket and deploy the parachutes when necessary.		
Distance to closest e-match or altimeter (in)	1.25		
Description of shielding plan:	Shielded boxing, short connections		

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Transmitter #5			
Location of transmitter:	N/A		
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:	N/A		
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
N/A