Milestone Review Flysheet 2018-2019

Institution	Purdue University	Milestone	CDR

Vehicle Properties	
Total Length (in)	116
Diameter (in)	5.15
Gross Lift Off Weigh (lb.)	30
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)	3.67
Static Stability Margin (at rail exit)	3.5
Thrust-to-Weight Ratio	11.84
Rail Size/Type and Length (in)	1.5, 144
Rail Exit Velocity (ft/s)	81.25

Ascent Analysis	
Maximum Velocity (ft/s)	601
Maximum Mach Number	0.54
Maximum Acceleration (ft/s^2)	279
Predicted Apogee (From Sim.) (ft)	4850

Recovery System Properties - Overall	
Total Descent Time (s)	92.19
Total Drift in 20 mph winds (ft)	1594.17

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			
Kinetic Energy of Each Section (Ft-lbs)	Fore Section	Mid Section	Aft Section	Section 4
	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)	700			
Velocity at Deployment (ft/s)	86			
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			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	34.65	24.04	53.42	N/A

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	Altus Metrum Telemetrum
Secondary Altimeter Make/Model	Missileworks RRC3+ Sport
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Altus Metrum Telemetrum
Additional Locators (if applicable)	N/A
Transmitting Frequencies (all - vehicle and payload)	Likely to be 70cm ham band

Recovery Electronics		
Rocket Locators (Make/Model)	Altus Metrum Telemetrum	
Transmitting Frequencies (all - vehicle and payload)	70cm ham band	
Ejection System Energetics		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	4
	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	3.2
			Backup	3.2
Pad Stay Time (Launch Configuration)	3 hours	Energetics Masses - Other (grams) - If Applicable	Primary	N/A
			Backup	N/A

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Payload

	Overview
Payload 1 (official payload)	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.
Payload 2 (non-scored payload)	N/A

Test Plans, Status, and Results

Ejection Charge Tests	Several tests will be conducted. The first test will have each half of the launch vehicle constructed fully on either side (minus motor) around the avionics bay. Each half will be attached to the avionics bay and a manual electrical signal will be 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 will be conducted several times on either side to ensure safe deployment of both the drogue and main parachutes. A secondary test will be conducted on the altimeters to verify that they are sending electrical charges to the e-match. This testing will be conducted by wiring both avionics systems to their own light (rather than e-match) . We will then turn on the altimeters as we would for final flight and place the two systems in a vacuum. In the vaccum we will then decrease the pressure to simulate an increase in altitude. Our lights should light up at both apogee and at the set altitude above ground level.
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 team would like to have the full-scale vehicle fully constructed and ready to launch by Feburary. Contruction is currently being done to produce a fin mount jig, as well as individual avionic and payload bays are beginning to go together. For example sleds are being printed for avionics bays, hardware is being purchased, and holes are being drilled. The current plan is to launch our full scale rocket on Feburary 10th at the "local" Indiana Rocketry Inc. Launch Day. This is when the Payload will also be tested.
Payload Demon-stration Flights	The team would like to have an operational payload on the full-scale test flight that is planned to happen in Feburary. The payload being tested will have the rover contained in a separate vessle inside the payload bay. Upon safe landing of the full-scale, the vessle will eject from the bay and deploy the rover. The rover will be tested for accuracy in meeting the criteria as defined by NASA and the team.

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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:	Transmitter #2 is responsible for sending the signal to the payload from the RDO to trigger payload ejection.		
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:	Transmitter #3 is responsible for recording the altitude of the rocket and to trigger the ejection of the parachutes.		
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