Milestone Review Flysheet 2018-2019

Institution	LionTech Rocket Labs

Milestone	CDR

Vehicle Properties	
Total Length (in)	120
Diameter (in)	6
Gross Lift Off Weigh (lb)	36.6
Airframe Material(s)	Carbon Fiber, Fiberglass, Blue Tube
Fin Material and Thickness (in)	Fiberglass, 3/16"
Coupler Length/Shoulder Length (in)	12 / 6

Motor Properties	
Motor Brand/Designation	Cesaroni L1355
Max/Average Thrust (lb)	393 / 306
Total Impulse (lbf-s)	905
Mass Before/After Burn (lb)	10.9 / 4.2
Liftoff Thrust (lb)	360
Motor Retention Method	Plywood centering rings, steel-infused epoxy

Stability Analysis	
Center of Pressure (in. from nose)	94.3
Center of Gravity (in. from nose)	76.4
Static Stability Margin (on pad)	2.96
Static Stability Margin (at rail exit)	2.05
Thrust-to-Weight Ratio	7.77
Rail Size/Type and Length (in)	15-15 / 120
Rail Exit Velocity (ft/s)	75.5

Ascent Analysis	
Maximum Velocity (ft/s)	698
Maximum Mach Number	0.62
Maximum Acceleration (ft/s^2)	331
Target Apogee (ft)	5280
Predicted Apogee (From Sim.) (ft)	5289

Recovery System Properties - Overall	
Total Descent Time (s)	83.6
Total Drift in 20 mph winds (ft)	2421.4

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)		4F Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	1.5
	Backup	2
Energetics Mass - Main Chute (grams)	Primary	2
	Backup	3
Energetics Mass - Other (grams) - If Applicable	Primary	
	Backup	

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	Perfect Flight StrologgerCF
Secondary Altimeter Make/Model	Perfect Flight StrologgerCF
Other Altimeters (if applicable)	NA
Rocket Locator (Make/Model)	Americaloc GL300W
Additional Locators (if applicable)	NA
Transmitting Frequencies (MHz) (all - vehicle and payload)	UMTS: 850/1900/2100 GSM/GPRS: 850/900/1800/1900
Describe Redundancy Plan (batteries, switches, etc.)	9V battery, toggle switch
Pad Stay Time (Launch Configuration)	2 hours

Recovery System Properties - Drogue Parachute				
Manufacturer/Model			Fruity Chutes, Classical Ultra	
Size or Diameter (in or ft)			18 in	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee + 2 seconds	
Velocity at Deployment (ft/s)			91	
Terminal Velocity (ft/s)			87.3	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			1/2 in kevlar flat strap	
Recovery Harness Length (ft)			24	
Harness/Airframe Interfaces		3/8 in steel U-Bolt		
Kinetic Energy of Each Section (ft-lbs)	Section 1	Section 2	Section 3	Section 4
	1179.2	916.05	1362.68	NA

Recovery System Properties - Main Parachute				
Manufacturer/Model			Fruity Chutes, Iris Ultra	
Size or Diameter (in)			96	
Main Altimeter Deployment Setting (ft)			600	
Backup Altimeter Deployment Setting (ft)			500	
Velocity at Deployment (ft/s)			87.3	
Terminal Velocity (ft/s)			18.02	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			1/2 in kevlar flat strap	
Recovery Harness Length (ft)			27	
Harness/Airframe Interfaces		3/8 in steel U-Bolt		
Kinetic Energy of Each Section (ft-lbs)	Section 1	Section 2	Section 3	Section 4
	50.59	38.86	58.06	NA

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Payload

	Overview
Payload 1 (official payload)	The payload is a rover that will be autonomously deployed from the launch vehicle after landing by a ground station control system. The rocket will be separated using an initiator and a black powder charge. The rover will be retained with a fail-proof solenoid lock that has been verified to work during the vehicle demonstration flight. The rover will then travel at least 10 feet from the launch vehicle and recover a soil sample of 10 mililiters.
Payload 2 (non-scored payload)	N/A

Test Plans, Status, and Results

Ejection Charge Tests	All ejection charges for main deployment, drogue deployment, and payload deployment will be tested on the ground prior to flight to ensure that systems are functioning properly. Extensive calculations have been performed that provide great confidence that all separations will occur as planned.
Sub-scale Test Flights	The subscale test flight was successful since the rocket was launched and recovered according to our expectations while not causing any significant safety concerns. The only anomaly observed during flight was the rocket "wobbling" as it left the launch rail. We believe this was due to sections of body tube that were not flush with each other while fully assembled. This left significant amounts of room for the rocket to "bend" and "flex" while it was not supported in flight. This anomaly did not compromise the safety of our flight or even the principles of our rocket design, but manufacuring processes will be adjusted in the future to avoid this problem.
Vehicle Demon-stration Flights	The team successfully designed, constructed, launched, and recovered their 2018-2019 competition year rocket on February 9th. Launch day conditions were acceptable with little cloud cover, moderate winds of approximately 15 mph at the time of launch, and a temperature of 30 degrees℉. The rocket was launched from a launch rail at an angle of approximately 5 degrees and at 60 feet above sea level. The rocket had an apogee of 5,361 feet and took 84 seconds to land from apogee. All recovery systems perforemd exactly as expected, the launch vehicle experienced no structural damage, and the payload was successfully retained during flight.
Payload Demon-stration Flights	N/A

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Transmitter #1			
Location of transmitter:	At the ground station with the team		
Purpose of transmitter:	To send signals to the rocket and the rover		
Brand	LoRa	RF Output Power (mW)	
Model	RFM95	Specific Frequency used by team (MHz)	915
Handshake or frequency hopping? (explain)	N/A		
Distance to closest e-match or altimeter (in)	At the ground station away from the ematches and altimeters		
Description of shielding plan:	Aluminum foil lining the inside of the rotating bay		

Transmitter #2			
Location of transmitter:	Nose Cone		
Purpose of transmitter:	GPS Locator		
Brand	Ameriloc	RF Output Power (mW)	GSM 850 and EGSM 900
Model	GL300W	Specific Frequency used by team (MHz)	850/1900/2100
Handshake or frequency hopping? (explain)	Hopping		
Distance to closest e-match or altimeter (in)	24 in to wired e-match and Arduino Mega		
Description of shielding plan:	Surrounded by Carbon- Fiber body tube		

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