Milestone Review Flysheet 2018-2019

Institution	Cedar Falls High School Rocket Club

Milestone	FRR

Vehicle Properties

Total Length (in)	100"
Diameter (in)	5"
Gross Lift Off Weigh (lb)	25.5 lb
Airframe Material(s)	Fiberglass
Fin Material and Thickness (in)	Fiberglass (0.125")
Coupler Length(s)/Shoulder Length(s) (in)	12"

Motor Properties

Motor Brand/Designation	Cesaroni K590
Max/Average Thrust (lb)	336.674 lbf
Total Impulse (lbf-s)	539.002 lbf-s
Mass Before/After Burn (lb)	4.396 lb / 1.666 lb
Liftoff Thrust (lb)	337 lbf
Motor Retention Method	AeroPack Retainer - 54mm

Stability Analysis

Center of Pressure (in. from nose)	72.45 in
Center of Gravity (in. from nose)	61.70 in
Static Stability Margin (on pad)	2.15
Static Stability Margin (at rail exit)	
Thrust-to-Weight Ratio	20.4:1
Rail Size/Type and Length (in)	1515 rail x 96" long
Rail Exit Velocity (ft/s)	78.04 ft/s

Ascent Analysis

Maximum Velocity (ft/s)	650.06
Maximum Mach Number	0.58
Maximum Acceleration (ft/s^2)	622.01
Target Apogee (ft)	5280
Actual Apogee (from altimeter.) (ft)	4,915

Recovery System Properties - Overall

Total Descent Time (s)	105
Total Drift in 20 mph winds (ft)	2500

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		
Energetics Mass - Drogue Chute (grams)	Primary	4g
	Backup	6g
Energetics Mass - Main Chute (grams)	Primary	6g
	Backup	8g
Energetics Mass - Other (grams) - If Applicable	Primary	
	Backup	

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Perfectflite Stratologger
Secondary Altimeter Make/Model	Perfectflite Stratologger
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	AIM Xtra
Additional Locators (if applicable)	Here2 - CAN GNSS
Transmitting Frequencies (all - vehicle and payload)	***Required by CDR*** (Complete on pages 3 and 4)
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+ hours for all electronics

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Topflight	
Size or Diameter (in or ft)			24-inch	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee +1 sec	
Velocity at Deployment (ft/s)			23	
Terminal Velocity (ft/s)			71.76	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			1/2 in. tubular kevlar	
Recovery Harness Length (ft)			25	
Harness/Airframe Interfaces		Forged eyebolts mounted to bulkplates that are Rocketpoxied to airframe		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	30.14	45.39	50	

Recovery System Properties - Main Parachute

Manufacturer/Model			Topflight Recovery Parachute	
Size or Diameter (in or ft)			78 in	
Main Altimeter Deployment Setting (ft)			700 feet	
Backup Altimeter Deployment Setting (ft)			600 feet	
Velocity at Deployment (ft/s)			72 fps	
Terminal Velocity (ft/s)			19.5	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			1/2 in. tubular kevlar	
Recovery Harness Length (ft)			25	
Harness/Airframe Interfaces		Forged eyebolts mounted to bulkplates that are Rocketpoxied to airframe		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	30.14	45.39	50	

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Payload	
Payload 1 (official payload)	Overview Our parafoil recovery system, as it is currently defined, consists of a parafoil sheet (with an area of approximately 5m^2), two separate servos with strings connecting each one to one side of the parafoil each, an on-board power source, and lastly, a flight controller. We have GPS compatibility with the chosen flight controller, as GPS data is what the flight controller will use when relaying information to the servos to, in turn, direct the payload down to the target area. There will be a safety backup of a manual override that will allow a person to take control of the flight controller and direct the parawing down by controlling the servos via radio remote control.
Payload 2 (non-scored payload)	Overview

Test Plans, Status, and Results	
Ejection Charge Tests	The full scale rocket ground tests were successful. The booster section uses a 4g black powder charge to release the drogue parachute and ground testing showed that this was more than adequate for ensure the rocket separates at apogee. The main parachute uses a 6g black powder charge to eject from the upper body tube at 700ft AGL. Again ground testing showed this created adequate pressure to eject the main parachute, parawing, and nosecone from the upper body tube.
Sub-scale Test Flights	The subscale test flight was very successful. The full data and analysis are in the CDR Report, but general specifics are an altitude of 3129ft, successful separation of launch vehicle at apogee, and successful operation of the Jolly Logic "Chute Release" mechanism to release the main parachute at 500 ft.
Vehicle/Payload Demonstration Flights	The full-scale rocket and live payload were launched on March 3, 2019 which much success. The launch vehicle flight sequences all went perfectly. The max altitude reached was 4,915ft AGL. At apogee the drogue chute ejection charge successfully separated the rocket. The descent rate under drogue was an acceptable 72 ft/sec. At 700ft AGL the main chute ejection charge also successfully deployed the main parachute. The descent rate under main chute was an accepatable 19.5 ft/sec. The payload, which is also the nose cone of the rocket, did separate from the rest of the vehicle, but it did so at apogee rather than during main chute deployment at 700ft AGL due to the shear pins not having enough strength to hold the nosecone to the rest of the rocket. When the payload separated, the pilot chute did deploy successfully and brought the payload down in a very safe manner and descent speed. Because of the extreme cold temperatures we were unable to get picture/video of the parawing because by the time that happened every team member's camera/phone has shut down due to the battery being too cold. When we reached the payload after landing, it was evident that the parawing had been successfully released from the manual chute release mechanism and deployed correctly. But again no pictures were possible because no one's phone could turn back on. To resolve the problem with the nosecone separating at apogee, the team will increase the number of shear pins holding it on to the rest of the rocket and then complete new ground testing of the ejection charges to make sure they can still seprate the nose cone during main parachute deployment at 700ft AGL

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Transmitter #1			
Location of transmitter:	Main vehicle electronics bay		
Purpose of transmitter:	Location the main airframe of the launch vehicle		
Brand	AIM Xtra	RF Output Power (mW)	50
Model		Specific Frequency used by team (MHz)	432.0000
Handshake or frequency hopping? (explain)	Handshake with AIM BASE receiver		
Distance to closest e-match or altimeter (in)	No e-matches		
Description of shielding plan:	Use of a Faraday cage to separate GPS transmitter from altimeter electronics		

Transmitter #2			
Location of transmitter:	Nose cone		
Purpose of transmitter:	Locating the nose cone / payload section of the rocket		
Brand	Here2	RF Output Power (mW)	100
Model	CAN GNSS	Specific Frequency used by team (MHz)	Freq. hopping
Handshake or frequency hopping? (explain)	Freq. hopping.		
Distance to closest e-match or altimeter (in)	No e-matches		
Description of shielding plan:	None		

Transmitter #3			
Location of transmitter:	Nose cone		
Purpose of transmitter:	Telemetry		
Brand	PixHawk	RF Output Power (mW)	100
Model	PX4	Specific Frequency used by team (MHz)	Freq. hopping
Handshake or frequency hopping? (explain)	Freq. hopping		
Distance to closest e-match or altimeter (in)	No e-matches		
Description of shielding plan:	None		

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