

# Milestone Review Flysheet 2017-2018

**Institution** Cal Poly Pomona

**Milestone** FRR

Vehicle Properties	
Total Length (in)	120
Diameter (in)	6
Gross Lift Off Weight (lb.)	46.2
Airframe Material(s)	Blue Tube (vulcanized fiber)
Fin Material and Thickness (in)	Plywood (max thickness = 0.5 in)
Coupler Length/Shoulder Length(s) (in)	12/6

Motor Properties	
Motor Brand/Designation	Aerotech L1420R
Max/Average Thrust (lb.)	408/319
Total Impulse (lbf-s)	1127
Mass Before/After Burn (lb.)	43.69/38.04
Liftoff Thrust (lb.)	319.23
Motor Retention Method	Screw on retainer

Stability Analysis	
Center of Pressure (in from nose)	97.89
Center of Gravity (in from nose)	67
Static Stability Margin (on pad)	3.07
Static Stability Margin (at rail exit)	3.07
Thrust-to-Weight Ratio	8.8
Rail Size/Type and Length (in)	1515 - 12 ft
Rail Exit Velocity (ft/s)	73.1

Ascent Analysis	
Maximum Velocity (ft/s)	630
Maximum Mach Number	0.6
Maximum Acceleration (ft/s <sup>2</sup> )	237
Predicted Apogee (From Sim.) (ft)	5263

Recovery System Properties				
Drogue Parachute				
Manufacturer/Model		Top Flight Recovery Ultra X-Type		
Size (ft <sup>2</sup> )		4.4		
Altitude at Deployment (ft)		5280 +/- 75		
Velocity at Deployment (ft/s)		0		
Terminal Velocity (ft/s)		97.7		
Recovery Harness Material		Kevlar		
Recovery Harness Size/Thickness (in)		1/2		
Recovery Harness Length (ft)		36.5		
Harness/Airframe Interfaces		U bolt, quicklink, and swivel		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	1587	1705	3591	n/a

Recovery System Properties				
Main Parachute				
Manufacturer/Model		Top Flight Recovery Crossfire		
Size/Diameter (ft)		10		
Altitude at Deployment (ft)		500		
Velocity at Deployment (ft/s)		97.7		
Terminal Velocity (ft/s)		13.94		
Recovery Harness Material		Kevlar		
Recovery Harness Size/Thickness (in)		1/2		
Recovery Harness Length (ft)		39		
Harness/Airframe Interfaces		U bolt, quicklink, and swivel		
Kinetic Energy of Each Section (Ft-lbs)	Module 1	Module 2	Module 3	Module 4
	32.1	34.7	73.1	n/a

Recovery Electronics				
Altimeter(s)/Timer(s) (Make/Model)		Perfectflite Stratologger CF		
Redundancy Plan and Backup Deployment Settings		Redundant Perfectflite Stratologger CF with redundant black powder charges		
Pad Stay Time (Launch Configuration)		1+ hours		

Recovery Electronics			
Rocket Locators (Make/Model)		Eggfinder GPS and Trackimo GPS	
Transmitting Frequencies (all - vehicle and payload)		900 MHz for Eggfinder / Quadband (850/900/1800/1900 MHz) for Trackimo	
Ejection System Energetics		4F Black Powder	
Energetics Mass - Drogue Chute (grams)	Primary	5	
	Backup	6.5	
Energetics Mass - Main Chute (grams)	Primary	6	
	Backup	8	
Energetics Masses - Other (grams) - If Applicable	Primary	n/a	
	Backup	n/a	

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Payload	
Payload 1 (official payload)	<p style="text-align: center;">Overview</p> <p>The payload experiment is a custom rover that will be deployed from the launch vehicle after landing. It will be equipped to travel a distance of 5 ft from the landing site of the launch vehicle regardless of its orientation. Once the payload has reached its destination, it shall deploy solar panels.</p>
Payload 2 (non-scored payload)	<p style="text-align: center;">Overview</p> <p style="text-align: center;">N/A</p>

Test Plans, Status, and Results	
Ejection Charge Tests	<p>All ejection charges will be ground tested prior to any test flight to ensure proper separation takes place, the black powder charges are sized correctly, and that the parachutes fully deploy from their sections.</p> <p style="text-align: center;">Sub-Scale tests completed: 12/30/17 1/3/18</p> <p style="text-align: center;">The results are listed in the CDR Milestone Review Flysheet.</p> <p style="text-align: center;">Full-Scale tests completed: 2/16/18 2/23/18</p>
Sub-scale Test Flights	<p>The sub-scale model was launched on 1/6/18 and was considered successful. The launch vehicle was recovered in reusable condition and demonstrated an excellent flight, which confirmed a favorable stability of 2.59 caliber. Flight data was successfully recovered and revealed an apogee altitude of 4,313 ft.</p>
Full-scale Test Flights	<p style="text-align: center;">Test flights have been conducted on: 2/17/2018 2/24/2018</p> <p>Both tests were considered successful as they achieved their respective objectives. The first test flight proved the integrity of the design changes to the recovery system. It also confirmed that the SPOC system integration into the launch vehicle would remain structurally intact. The apogee altitude was 6,826 ft with full deployment of the recovery system.</p> <p>The second test flight proved the structural integrity of the hollowed bulkhead component of the payload bay. It also validated altitude predictions and confirmed the robustness of the components that were structurally enhanced after the initial test. The maximum altitude of the launch vehicle was reported at 5,454 ft. by both the primary and secondary altimeters.</p> <p style="text-align: center;">Specific details of both tests are listed in Section 7.1.1.2 in the FRR report.</p>

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### Additional Comments

The hollowed bulkhead for the payload bay initially failed testing using maple wood material. It was changed to cast iron and was flight tested on 2/24/18 and found to be structurally intact during post-flight assessment. The payload experiment was not tested with the launch vehicle (its flight test on 3/3/18 was cancelled due to poor weather conditions) but its integration components were tested in flight with the rover's simulated mass on 2/24/18.

Specific details are in Section 7.1.1.2 and 7.1.1.3 of the FRR report.