

Milestone Review Flysheet 2017-2018

Institution University of South Florida

Milestone CDR

Vehicle Properties	
Total Length (in)	111
Diameter (in)	5.148
Gross Lift Off Weigh (lb.)	48.7
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	FRP Fiberglass at 1/8"
Coupler Length/Shoulder Length(s) (in)	12 / 5

Motor Properties	
Motor Brand/Designation	Aerotech
Max/Average Thrust (lb.)	407.8 / 319.2
Total Impulse (lbf-s)	1034.8
Mass Before/After Burn (lb.)	10.1 / 4.4
Liftoff Thrust (lb.)	340
Motor Retention Method	AeroPack 75mm Flanged Motor Retaining Center

Stability Analysis	
Center of Pressure (in from nose)	88.3
Center of Gravity (in from nose)	68.34
Static Stability Margin (on pad)	3.88
Static Stability Margin (at rail exit)	3.95
Thrust-to-Weight Ratio	7.07:1
Rail Size/Type and Length (in)	1515 and 96 in
Rail Exit Velocity (ft/s)	57.7

Ascent Analysis	
Maximum Velocity (ft/s)	602.89
Maximum Mach Number	0.54
Maximum Acceleration (ft/s ²)	224.28
Predicted Apogee (From Sim.) (ft)	5304

Recovery System Properties									
Droge Parachute									
Manufacturer/Model	SkyAngle / Classic II								
Size/Diameter (in or ft)	28								
Altitude at Deployment (ft)	Apogee								
Velocity at Deployment (ft/s)	-3.41								
Terminal Velocity (ft/s)	-69								
Recovery Harness Material	Tubular Kevlar								
Recovery Harness Size/Thickness (in)	1/2 in								
Recovery Harness Length (ft)	30 ft								
Harness/Airframe Interfaces	The 1/2" tubular kevlar shock cord is epoxied and secured to the motor mount. The droge parachute's shroud lines will be attached to a d-link in a butterfly or another standard loop in the shock cord closer to the booster section.								
Kinetic Energy of Each Section (Ft-lbs)	<table border="1"> <thead> <tr> <th>Section 1</th> <th>Section 2</th> <th>Section 3</th> <th>Section 4</th> </tr> </thead> <tbody> <tr> <td>421.39</td> <td>1168.07</td> <td>561.86</td> <td>1449</td> </tr> </tbody> </table>	Section 1	Section 2	Section 3	Section 4	421.39	1168.07	561.86	1449
Section 1	Section 2	Section 3	Section 4						
421.39	1168.07	561.86	1449						

Recovery System Properties									
Main Parachute #1 (p. 4 for #2)									
Manufacturer/Model	Fruity Chutes / Iris Ultra								
Size/Diameter (in or ft)	66 in								
Altitude at Deployment (ft)	950								
Velocity at Deployment (ft/s)	-69								
Terminal Velocity (ft/s)	-16.95								
Recovery Harness Material	Tubular Kevlar								
Recovery Harness Size/Thickness (in)	1/4 in								
Recovery Harness Length (ft)	20 ft								
Harness/Airframe Interfaces	*Slowest speed reached before second main parachute deploys. Shroud lines attached to a 500 pound ball bearing swivel. This swivel will be secured to shock cord with d-link, and upper bulkhead of main altimeter bay.								
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25.43	58.49	33.9	64.44						

Recovery Electronics	
Altimeter(s)/Timer(s) (Make/Model)	Atlas Metrum / EasyMini
Redundancy Plan and Backup Deployment Settings	Each altimeter will be paired with a spare altimeter set to deploy 50 feet after its parent charge with the same charge mass
Pad Stay Time (Launch Configuration)	8 hours

Recovery Electronics		
Rocket Locators (Make/Model)	SB1 Sounding Locator	
Transmitting Frequencies (all - vehicle and payload)	None	
Ejection System Energetics (ex. Black Powder)	Black Powder	
Energetics Mass - Droge Chute (grams)	Primary	1.5
	Backup	2
Energetics Mass - Main Chute (grams)	Primary	4
	Backup	4.5
Energetics Masses - Other (grams) - If Applicable	Primary	2
	Backup	1.75

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Payload

Payload	
	Overview
Payload 1 (official payload)	The Society of Aeronautics and Rocketry at the University of South Florida are designing, developing and testing a depolyable rover to be their competitive payload of choice. The rover is essentially a cylinder in shape, with wheels at the ends and all necessary electrical components in the rover body situated between the two wheels. The rover is expected to be 5 inches wide and 14 inches long, but will continue to be redesigned to have reduced size but perform the same tasks.
	Overview
Payload 2 (non-scored payload)	

Test Plans, Status, and Results

Ejection Charge Tests	<p>The full scale rocket will have three points of separation; the drogue section (booster section and main altimeter bay), the first main (main altimeter bay and rover compartment) and the second main (rover compartment and nosecone). Extensive ground testing at a safe location has been conducted and the following ejection charges and shear pin combinations will be used.</p> <ol style="list-style-type: none"> 1. Drogue: 1.5 and 2 g black powder; 2 x 2-56 shear pins 2. Main 1: 4 and 4.5 g black powder; 2 x 2-56 and 2 x 4-40 shear pins 3. Main 2: 2 and 1.75 g black powder; 3 x 2-56 shear pins
Sub-scale Test Flights	<p>The subscale test flights were done on December 16th, 2017. The temperature was in the 60s with minimal winds. Pre-launch procedures before first flight included loading and setting the black powder charges, activating altimeters with standard 9V batteries, securing the payload altimeter bay and folding and storing the recover equipment. Safety officer verified all parts and procedures. First flight used a Cesaroni 54mm 4G K740. Apogee was 3,146 feet and max acceleration of 88 fps² and max velocity of 401 fps. Drogue deployed at apogee as expected. The second deployment charge at 1,000 feet, with the first main separating from the rover compartment but the charges did not detach from the main altimeter bay and first main did not deploy. The third deployment charge at 800 feet detached the nosecone and deployed parachute. For the second flight, a Cesaroni 54mm 4G K940 was used. This flight reached an apogee of 2,587 feet and max acceleration of 70 fps² and max velocity of 362 fps. Deployment and separation at apogee was successful.</p> <p>At 1,000 feet the charges detached the two 4-40 used on this flight for the main altimeter bay. The shock cord stored in the payload section / rover compartment did not fully extend and detach from the rocket because the parachute was tightly packed. The drogue and first main shock cord became entangled. The rocket safely reached ground without any damage.</p>
Full-scale Test Flights	<p>The ascent of the launch vehicle went well. Given the data received from the EasyMini altimeters on board showed the max acceleration to be 4.12 Gs during the boost phase and the time to apogee at around 28.1 seconds. The drogue chute slowed the launch vehicle to a steady descent rate 77 feet per second until the first main parachute deployment at 950 feet AGL. At this point, the Booster and Main Altimeter Bay separate from the rest of the launch vehicle and descended at an average rate of 28 feet per second for 31 seconds until touchdown. The main parachute responsible for deploying at 800 feet AGL to recover the Nosecone and Rover Compartment airframe was not attached properly, allowing these sections to descend at an unsafe rate. Fortunately, there was no damage to the launch vehicle or electronics stored within the Payload Altimeter Bay.</p>

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Additional Comments

Note that all calculations were done using the maximum ballast weight of 4.25 lbs.

Recovery System Properties				
Main Parachute #2				
Manufacturer/Model		SkyAngle / Classic II		
Size/Diameter (in or ft)		60 in		
Altitude at Deployment (ft)		800		
Velocity at Deployment (ft/s)		-48.09		
Terminal Velocity (ft/s)		-15.13		
Recovery Harness Material		Tubular Kevlar		
Recovery Harness Size/Thickness (in)		1/2 in		
Recovery Harness Length (ft)		20 ft		
Harness/Airframe Interfaces		The SkyAngle parachute comes equipped with a swivel on the end of its shroud lines, which will be attached via d-link to the 20 feet of 1/2" tubular kevlar shock cord. This shock cord will be stored and attached to the U-bolt		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	20.26	56.16	27.02	69.67