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.)	37.2
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)	72.1
Static Stability Margin (on pad)	3.14
Static Stability Margin (at rail exit)	3.2
Thrust-to-Weight Ratio	9:1
Rail Size/Type and Length (in)	1515 and 96 in
Rail Exit Velocity (ft/s)	67.75

Ascent Analysis	
Maximum Velocity (ft/s)	793
Maximum Mach Number	0.71
Maximum Acceleration (ft/s^2)	302
Predicted Apogee (From Sim.) (ft)	6690

Recovery System Properties Drogue Parachute				
Manufacturer/Model	SkyAngle / Classic II			
Size/Diameter (in or ft)	20			
Altitude at Deployment (ft)	Apogee			
Velocity at Deployment (ft/s)	-3.32			
Terminal Velocity (ft/s)	-133.51			
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 drogue 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)	Section 1	Section 2	Section 3	Section 4
	827.59	4154.54	1918.12	603.39

Recovery System Properties Main Parachute #1 (p. 4 for #2)				
Manufacturer/Model	Fruity Chutes / Iris Ultra			
Size/Diameter (in or ft)	36 in			
Altitude at Deployment (ft)	950			
Velocity at Deployment (ft/s)	-125.19			
Terminal Velocity (ft/s)	-49.73*			
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.			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	727.65	3652.87	1686.5	530.53

Recovery Electronics	
Altimeter(s)/Timer(s) (Make/Model)	Atlus 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)	Transolve / BeepX	
Transmitting Frequencies (all - vehicle and payload)	None	
Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2 g
	Backup	2 g
Energetics Mass - Main Chute (grams)	Primary	3 g
	Backup	3 g
Energetics Masses - Other (grams) - If Applicable	Primary	1 g (Nosecone)
	Backup	1 g (Nosecone)

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Payload	
	Overview
Payload 1 (official payload)	The Society of Aeronuatics and Rocketry at the University of South Florida are designing, developing and testing a depolyable rover to be their competitive paylaod 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	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). Due to the deployment and separation failures experienced from the subscale flights, all three of these separation points will start with 2-56 shear pin sizes. Extensive ground testing at a safe location will be conducted to find out the necessary charge amounts to deploy the rocket sections and the equivalent weight / ballast that may reside within them. If necessary, the shear pin holes can be increased from 2-56 to 4-40 if necessary. Initial estimates have two 2-56 shear pins for the drogue section, four for the first main and three for the second main. If necessary, black powder charges can be increased in place of increasing shear pin size.
Sub-scale Test Flights	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. Saftey officer verified all parts and procedures. First flight used a Cesaroni 54mm 4G K740. Apogee was 3,146 feet and max acceleration of 88 fps^2 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 parchute. For the second flight, a Cesaroni 54mm 4G K940 was used was used. This flight reached an apogee of 2,587 feet and max acceleration of 70 fps^2 and max velocity of 362 fps. Deployment and separation at apogee was successful. At 1,000 feet the charges detached the two 4-40 used on this flight for the main alitmeter 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.
Full-scale Test Flights	The full scale test flight is scheduled for Saturday, February 17th, at Varn Ranch. This flight will include at the very least, a mock deployment system capable of holding and securing a ballast comparable to the rover's projected weight. Key features of the rover design such as the wheels and body plan to be included in this ballast-only configuration. Full scale construction is ahead of schedule, and the launch vehicle itself may become ready for a test flight on January 20th. The only conditions that will promote a launch in January are the acquirment of the Aerotech L1420 motor shipment, and if an adequate ballast has been prepared and prepared for launch. This full scale launch will provide valuable data and insight on the accuracy and dependancy on simulations, and the neccesary ballast configuration needed to deliver the launch vehicle to one mile high.

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Additional Comments

Note that all calculations were done using the minimum ballast weight of 0.375 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)			-20.46	
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 wil be stored and attached to the U-bolt		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	19.44	57.16	45.05	14.17