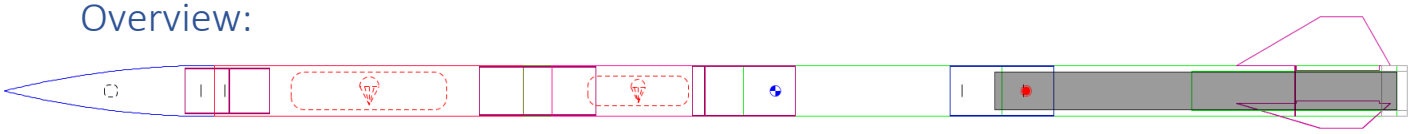
Level 3 Certification Project – April 14, 2018

Payton Kramer – NAR 99295 / TRA 14209

Overview:



Length:	110 in
Diameter:	4 in
Motor Mount ID:	75 mm
Weight:	15.5 lbs dry (28 lbs with motor)
CG:	60.5 in from the nose (with motor)
CP:	80 in from the nose
Motor:	Aerotech M1315W
Estimated Apogee:	15,000 ft (OpenRocket)

Airframe:

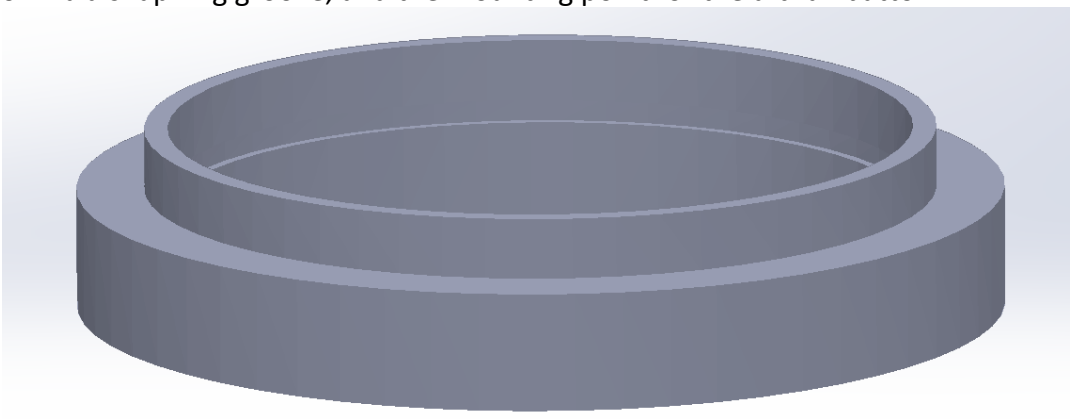
This project was designed with modularity in mind. The fin-can (natural fiberglass section) is composed of two separate fiberglass body tubes, topped with a coupler and bulkhead, allowing for two configurations. The use of floating nut plates allows the upper tube to be easily removed, and the coupler/bulkhead to be moved to the top of the lower tube. The upper (red fiberglass) section of the rocket is also composed of two separate body tubes, with a central coupler containing the avionics bay. This layout allows both the main and drogue parachutes to be pushed by their respective charges, preventing deployment issues. The nose cone remained empty, giving additional payload space for future telemetry or camera uses.

General Build Conventions and Material Selection:

- All fiberglass airframe
- 3M Scotch Weld 2216 B/A Gray epoxy used for all assembly
- All couplers were attached with floating nut plates and bolts for later modularity
- Standard 15/15 rail buttons

Retainer

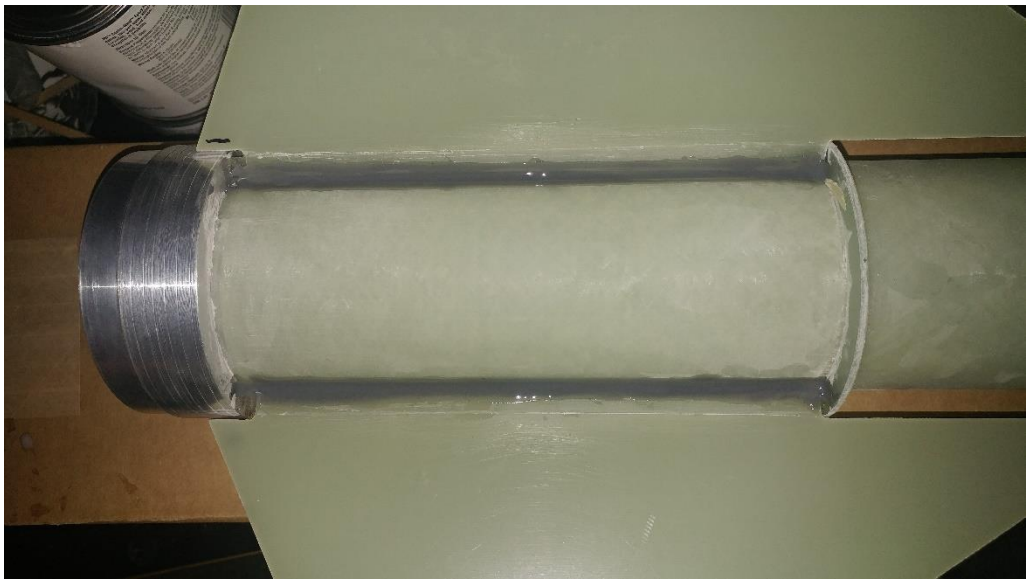
A piece of aluminum stock was machined to serve as the bottom centering ring, motor retention via a snap ring groove, and the mounting point for the aft rail button.



A CAD render of the centering ring/retainer

Fin Can Assembly:

Fin slots were extended to reach the end of the fin-can body tube, allowing for the motor mount/fin assembly to be slid out for internal fillets. Using the fin slots, the fins were tacked into place on the motor mount with epoxy, and then the motor mount/fins unit was slid out allowing for the internal fillets shown below.



Centering rings and retainer attached, internal fin fillets

Once these internal fillets were cured, the motor mount, fins, and centering rings were slid back in and bonded into place. External fillets were then applied.

Bonding the motor mount assembly to the body tube

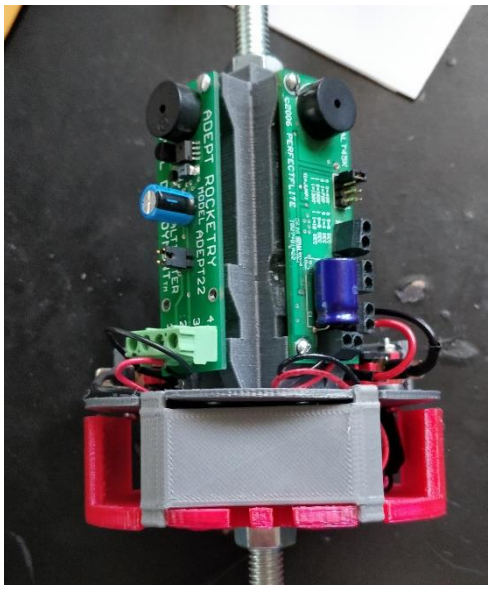
The fin-can's upper body tube is attached via an internal coupler, and topped with another coupler with a bulkhead. This upper bulkhead has the below pictured eyebolt that serves as the bottom connection of the drogue parachute's shock cord. A fiberglass ring was added inside the coupler, against the bulkhead for additional bonding surface area. Both the coupler inside the fin-can, and the upper one are attached with floating nut plates with an identical bolt pattern. This allows for the previously mentioned modularity in which the coupler/bulkhead assembly can be moved to the lower location and the upper tube removed.

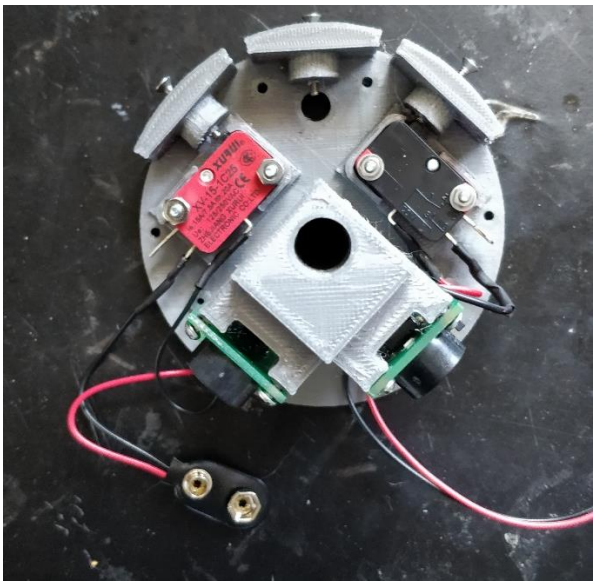
The top bulkhead of the fin-can, a coupler ring was cut and snapped into the coupler against the bulkhead to give a larger bonding area in the coupler.

The completed fin-can

Electronics and Recovery:

Avionics Bay:





The AV bay is placed inside the coupler connecting the two red tubes, allowing for both the drogue and the main to be "pushed" out by the charge. The AV bay contains two altimeters for redundancy, a PerfectFlite Hi-Alt 45k and an Adept 22. The altimeters were mounted on a 3d printed sled that also holds two arming switches and the two 9V batteries powering the altimeters.

Charges:

Altimeter	Drogue Charge	Main Altitude	Main Charge
Hi-Alt 45k	3.5g	1000ft	3.5g
Adept 22	3.5g	900ft	4g

Ground testing of recovery charges confirmed that a charge of 3.5g of black powder with two 0.1in shear pins consistently works for both the drogue and the main. I chose to offset the main parachute deployment altitude for the altimeters, and gave the lower one a bigger charge. The thinking being if for some reason the smaller charge was not adequate at 1000ft, the larger one at 900ft would hopefully give the push needed.

Parachutes:

Chute	Equivalent Round Size	CD	Speed After Deployment
Drogue – Skyangle 36	32.5in	1.34	47.8 ft/s
Main - Spherachute	120in	1.5	12.7 ft/s

Test Flight:

On November 11, 2017, the completed rocket was flown on a smaller K550 motor. All electronics and recovery worked as planned, and the flight gave confidence to the simulation model.

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The infamous profile pic that would go on to get me lots of DMs.

Need a ladder when your arming switches are 10’ off the ground.

Certification Flight:

After the successful test flight, the certification qualifying flight was completed on April 14th, 2018 with an Aerotech M1315 motor. No changes were made to the rocket, as well as none to my outfit (how's that for picture continuity?). The flight went perfectly, reaching an apogee of 14,500 ft, and had a successful post-flight inspection, granting me Level 3 Certification.

Posing before arming

Picture from my automated, sound triggered pad camera, see my Flickr for details on that setup

After takeoff, still mid photographer stance