Fisk University

NASA University Student Launch Initiative

Post Launch Assessment Review Report 2017-2018

Fisk University Mastering Aeronautics Team (FMAT)

Fisk University

1000 17th Ave. North,

Nashville, TN 37208

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1. Team Name

Fisk Altitude Achievement Missile Team

2. Motor Used

L990-BS: Cesaroni

Table 1.1 Motor Information

Motor Brand	Cesaroni
Motor Type	L 990 – BS Reload type
Diameter	54 mm
Length	25.6 inches
Total Weight	4.93 lbs.
Average Trust	220 lbs
Max Trust	365 lbs
Impulse	622 lbs
Burn Time	2.9 s

3. Brief Payload Description

Target detection payload, 2 raspberry pi computers, 2 raspberry pi cameras powered by 3.7V lithium ion battery, and 2 flight computers with 9V batteries as power sources. The payload was designed for the purpose of target detection. To meet this goal, two Raspberry Pi 3s were mounted on a board inside the payload bay. Each Pi was wired with a PiCamera that was tilted up towards a peephole drilled through the side of the payload bay. A single 3.7V lithium-ion battery powered both Pis, and the cameras attached to them. On the opposite side of the same board, the flight computers were attached. Each computer was powered by a standalone 9V battery.

4. Vehicle Dimensions and Summary

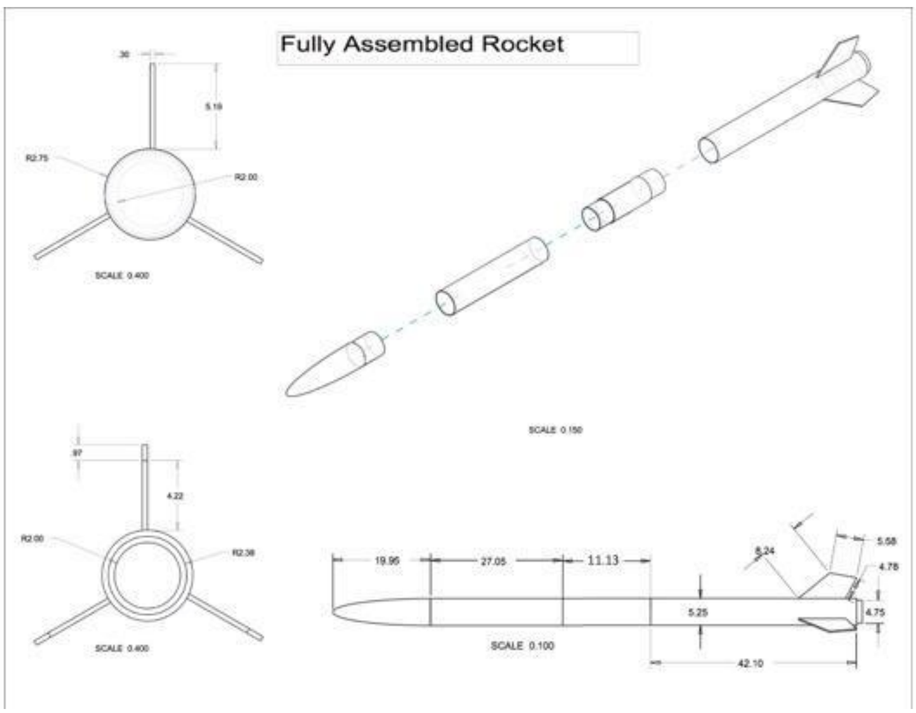
Fully Constructed Rocket Lengths and Weights: 100.15in/26.93

Nose cone length/weights: 19.95in/1.8lbs

Upper Section length/weights: 27.05in/3lbs

Payload length/weights: 11.13in/3.6lbs

Booster length/weights: 42.10in/10.6lbs (no motor)



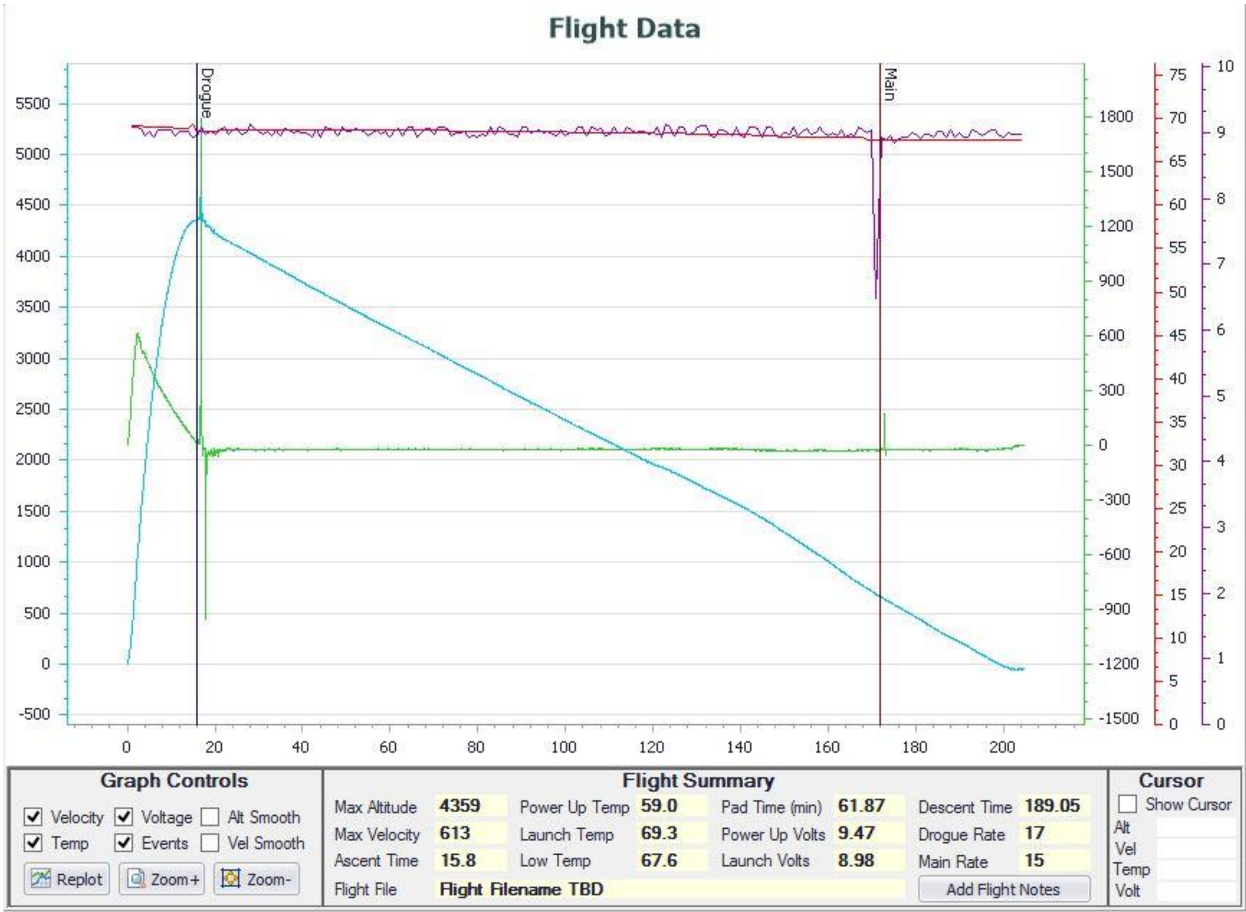
Dimensions of Rocket in Inches

Table 1.2: Components and Mass of the Rocket

Component	Weight (oz.)
Motor	117.82
Nose cone	20.5

Fin x3	11.1
Bulkhead x2	3.1
Booster Section	55.73
Upper Section	34.6
Motor Tube	18
Payload Bay	30.3
Centering Rings x3	2.2
Payload Board	7.9
Raspberry Pi x2	3.2
Pi Cameras x2	0.2
Main Parachute	14.4
Drogue Parachute	4.9
RRC3 Sport Altimeter x2	0.6
Motor Casing	7.7
Battery x2	7.5
Rods, nuts, fasteners etc.	2.65
Buckshot	80
Total	**430 ~ 26.93 lbs.**

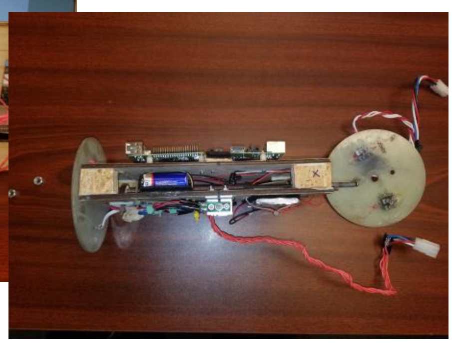
5. Data Analysis and Results of Vehicle



The flight vehicle reached an altitude of 4395ft. This height was attained rather smoothly, with no vehicle failure occurring during the rocket's ascent.

The main failures of the vehicle occurred during the rocket's descent, and included the following malfunctions: construction failure, PLA cylinder failure, and main shoot deployment at apogee.

As the rocket reached apogee during its ascent, the charges went off as normal, but our main and drogue shoots deployed simultaneously. The source of this failure was the fact that too much black powder was placed in the charges; 5 grams of black powder was placed instead of the standard 4.5 grams. Due to this error, the momentum from the charge that detonated to deploy the drogue shoot, forced the main shoot to deploy as well. This was verified by the flight computer data, which showed that the main parachute and the drogue parachute were programmed to detonate at the correct times. Upon inspection of the payload, we verified that it was oriented correctly, thus, an external force must have caused the main parachute to be deployed early. In the first two test launches, this error did not occur; the only alteration between those flights and the competition flight was the amount of black powder that was used in the charges. From these findings, it can be concluded that the increase in the amount of black powder used was at the very least, a factor in the early deployment of the main parachute. Additionally, the early deployment of our main caused our rocket to drift about a mile and a half from the launch pad.



6. Payload summary

Two board design with flight computers and recovery system on one board, and experiment electronics on the other board. Power supplies are located between each of the boards, and each system operates independently of each other.

7. Data Analysis and Results of Payload

Since the Raspberry Pi computers were not able to be powered on, there is no conclusive data pertaining to the experiment. The main cause of this failure was likely a poor soldering job, which resulted in unreliable connections; the team suspects that the connections came undone during the rocket's transit to the launch pad. Additionally, upon investigating the payload section post launch, it was discovered that charges displaced the entire payload section inside the rocket. Also, the force caused severe damage to the Raspberry Pi computers, damaging the power pins in the process. It has therefore been concluded that the computers would have lost power after the drogue parachute phase, and that the data that the reported data would have been severely limited anyhow.

8. Scientific Value

Because of the camera failure, no data was collected. The scientific value was very minimal. However, science is as much about failure as it is success. We will learn from our failures, and create successful experiments in the future.

9. Visual Data Observed

The team noticed that even though the main parachute deployed at apogee instead of 700 feet, the rocket still managed to touchdown on the field, though the distance was slightly longer than calculated. From this information, it was concluded that the initial parachute selection would have minimized drift to Nasa’s specifications, if the parachutes had opened in the correct order.

10. Lessons Learned

A test target detection experiment launch should be conducted prior to the competition, to be sure everything works according to plan. Errors are a common occurrence, and preparations for them need to be made. Additionally, more visual documentation of the construction of the rocket is necessary.

11. Summary of Overall Experience

The team originally wanted to conduct an experiment dealing with target detection. This experiment would have been a static system mounted onto a cylindrical collar that would then be attached to the outside of the payload bay. The team discovered this would not be possible because holes would have to be drilled through multiple sections of the rocket in order to connect the wiring. In addition to this, the collar extended beyond the launch rail, which was another unforeseen problem.

We later attempted to do another static system with a collar. This design would have the cameras mounted directly inside of the payload bay and the collar at a slight angle near the bottom of it. This angle would have a reflective material which would allow the cameras to look at the ground. It was later concluded that this was also unfeasible, as the reflective material was not flat enough to show clear images for the camera to look at; the mirrors slightly diffracted the light that struck them, so clear images of faraway objects were difficult to obtain. In addition to this, the problem of the collar extending beyond the launch rail still existed in this design.

Results

The design utilized was a static camera system mounted at an angle inside of the payload bay. These cameras would see through a hole that was drilled into the side of the rocket. This design was the most feasible of the designs, as it did not require drilling holes through too many sections of the rocket, and the cameras could be more easily mounted. This experiment, however, was not successful due to issues with the wiring between the power sources and the cameras.

Personal Value

Team lessons learned - The team needs to be more prepared and more knowledgeable about certain aspects of the rocket. This means having a better relationship with our mentor and asking him when we are unsure. The team also needs to be timelier, in order to be more effective at delivering reports. We attempted to have a camera system that could detect the necessary targets. Our experience in this competition also taught us that we really need to get started with building the actual rocket earlier so that actual testing can be performed. Perseverance is crucial to our success as a team. Conflict resolution is key to a successful team. Execution is important because a lot of ideas the other teams had for camera detection were the same one we had but they just executed better. We also learned that when we are doing our reports we need to have more visual documentation of the construction of our rocket and we need to be more knowledgeable about the parts and construction of our rocket as a whole. During the year there were times when some of our members didn't really know how to put parts of the rocket together or what parts of our rocket were and what their function was. We also noticed that at times we were unorganized in the sense that people didn't know what to work on or when reports were due so we did some things last minute. As such we think it's vitally important to our success to have a known schedule for things and to educate our members more on the parts and functions of the rocket as well as how to do things such as wiring, preparing the parachutes, and running simulations. Going along with that we think that we should use technology more to our advantage in the sense of recording the fabrication of the rocket and recording how to videos that show the members how to complete certain task. Another thing we think is important moving forward is more team bonding. The competition can be stressful so we feel it would be helpful if we put a day or two aside just to have fun and unwind as a team. Finally, our team learned the importance of every member on the team regardless of major. We feel like we did an okay job of putting our members in places where they could be most effective based on their skill sets.

Personal Skills Learned- There are always errors, and we need to always be prepared for them. Critically thinking is a big part of what is required to build rockets. Patience and teamwork are critical for being successful. The technical skills that we acquired during this year include: 3D design, reporting, how to make charges, use launch simulation software, solder, how to choose a motor for our rocket, and to use the various shop tools to work on the rocket.

12. Educational Engagement Summary

Fisk University's Rocket Team engaged in outreach with Nashville Metro Public Schools, over the course of the 2017-2018 academic year. Fisk's involvement included mentoring, presentations, and sponsorship of a middle school robotics team.

Fisk's rocket team also participated in Antioch Middle School's Career Fair. Fisk was represented by the faculty advisor, Dr. Bryan Kent Wallace. Dr. Wallace gave a presentation and showed videos highlighting the history of the Fisk University Rocket Team. This career fair was attended by approximately 500 students.

Initial work was conducted for Fisk sponsoring an environmental awareness club at Antioch Middle School. A faculty member has been secured at the Middle School who will be the onsite advisor to the club. Fisk will sponsor supplies to the environmental club. Funding for the club was secured by a grant from Duke Gas.

Fisk engaged in STEM engagement night for Middle School youth at Fisk's annual October Fest Event. Fisk Rocket Team introduced children to the concept of magnetism by using a ring thrower. At the press of a button, a magnetic field was generated through a coil magnet which allowed for the witnessed levitation.

Fisk introduced children to the concept of rotational inertia. Fisk utilized balance beams that had uneven distributions of weight. On one set, the weight was settled in the middle. On the second set, the weights were distributed equally on both ends. Fisk had the children have competitions to see who could spin them from side to side the quickest. They caught on quickly that they were able to get more rotations with the balance beams that had the weights in the middle as it possessed the lowest rotational inertia.

The activities included both an instructional and interactive segment. The students were taught the concepts behind coding and programming with visual aids such as PowerPoints. To further illustrate the concepts of coding, Fisk had the students pretend to be robots that received "code" in the form verbal instructions from other students. This was to help create an awareness that people are smart and robots can do nothing if humans don't write code for them.

Students were very enthusiastic and involved in the activities. Overall, they were very excited about grasping concepts and learning about new things such as the Curiosity Rover located on Mars and how coding works. Some students expressed eagerness about returning for the next Robotics class session.

13. Budget Summary

Rocket – The rocket budget breaks down into the actual rocket kit and supplies.

- Rocket Kit - PK-86 LOC Magnum LOCTronics – Fiberglass: $ 410
- Electronics - $400
- Paint: $50
- Power tools: $300

Van Rentals

- 1st Test launch, Talladega, AL - $500
  - Gas - $60
- 2nd Test Launch, Talladega, AL - $500
  - Gas - $60
- SLI Competition – 2 Vans, Huntsville, AL - $1,200
  - Gas - $120

Food

- 1st Test launch, Talladega, AL - $175
- 2nd Test Launch, Talladega, AL - $125
- SLI Competition – 2 Vans, Huntsville, AL - $2125

Lodging

- LaQuinta Inn - $1856