If All Else Fails, SOLID ROCKETS WILL PREVAIL!

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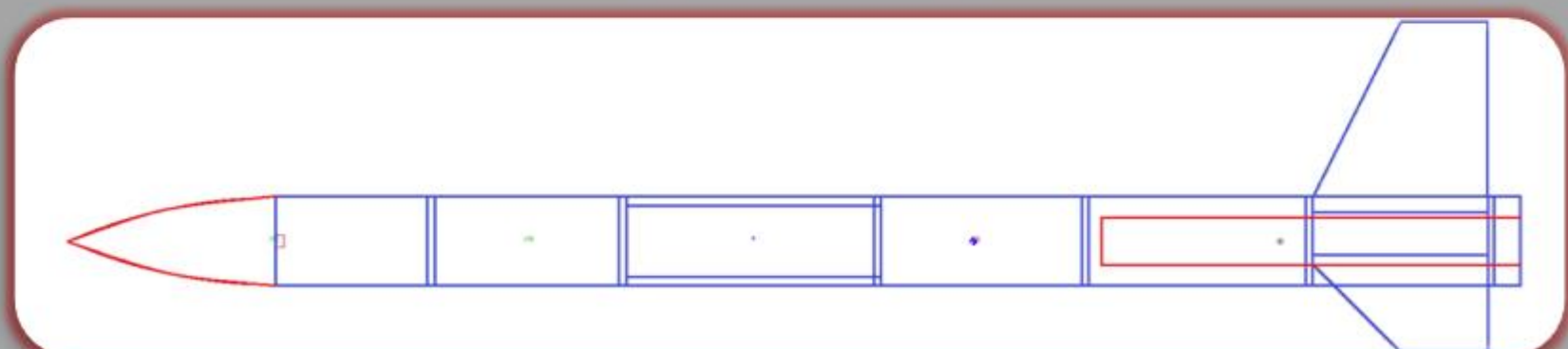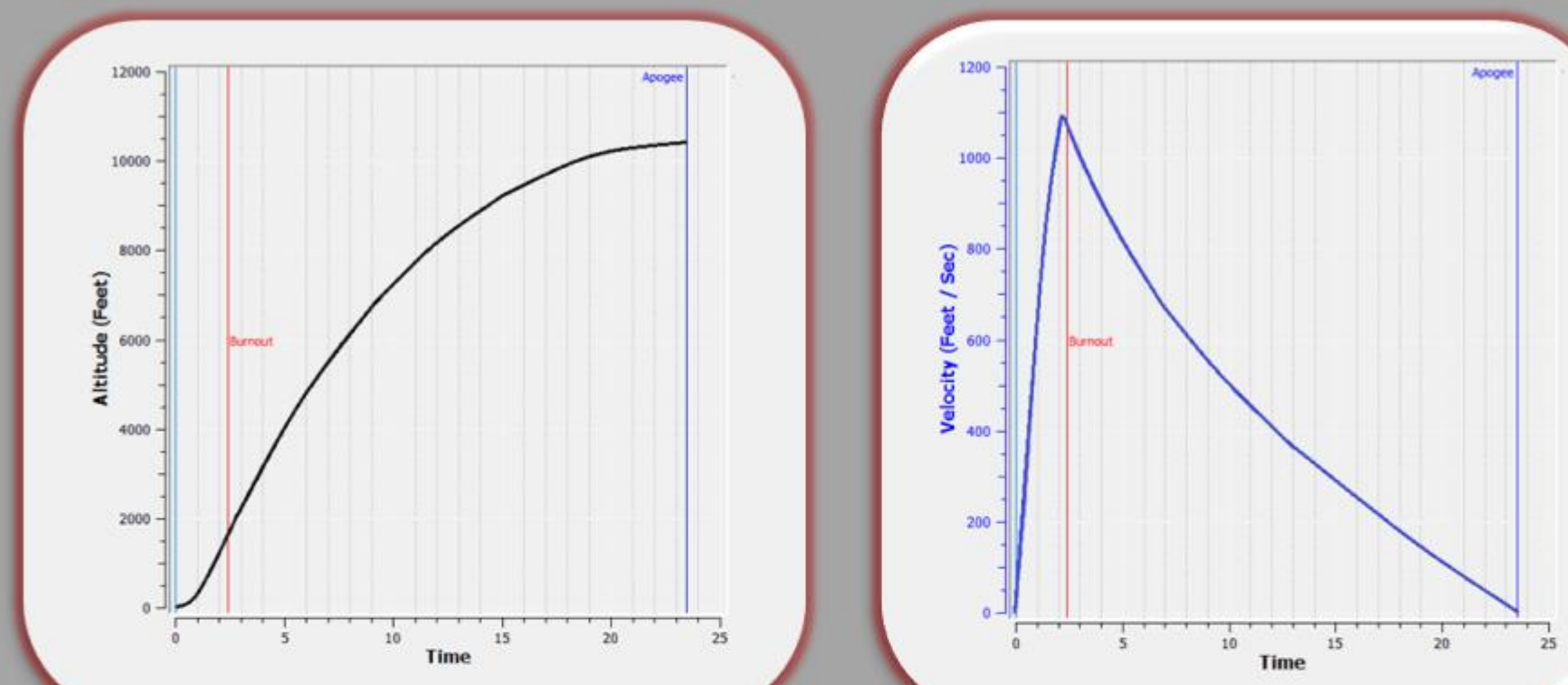
WASHINGTON STATE UNIVERSITY

TESTING REALITY

Insert Pic of Testing and Description of What We Tested and Why

SIMULATING REALITY

Based on the model generated in Rocksim, simulations were conducted which produces following maximum metrics. The plots below demonstrate the results of the simulation and the final model of the rocket.
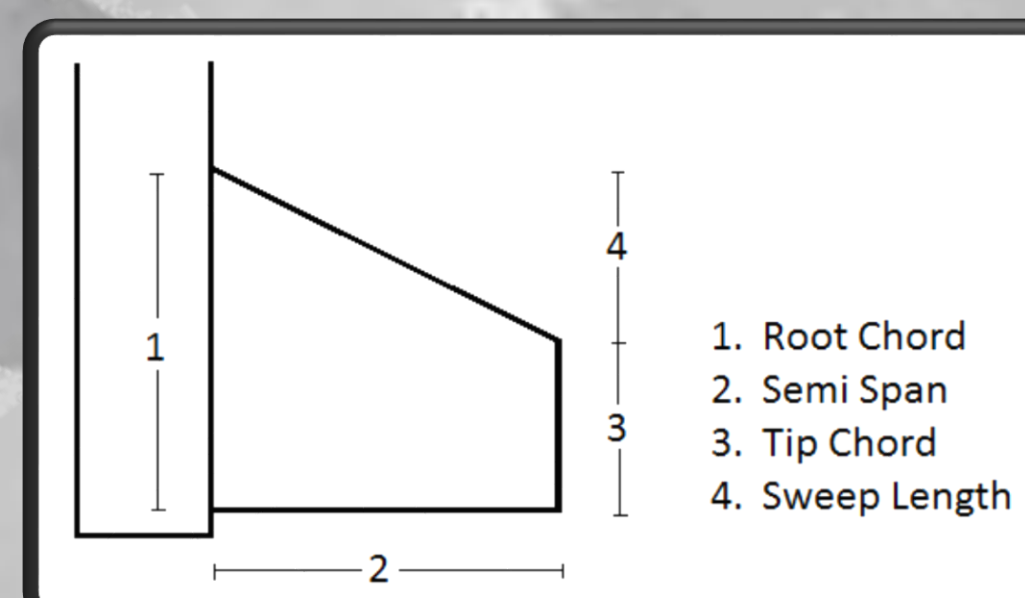
- **Altitude: 10,432 ft**
- **Velocity: 1,094.3 ft/s**
- **Mach Number: 0.98**

FOUR MONTHS AGO...

A group of twelve students with a short time frame and no prior knowledge of rocket science set out on the ultimate goal of launching a rocket to 10,000 feet at the IREC competition.

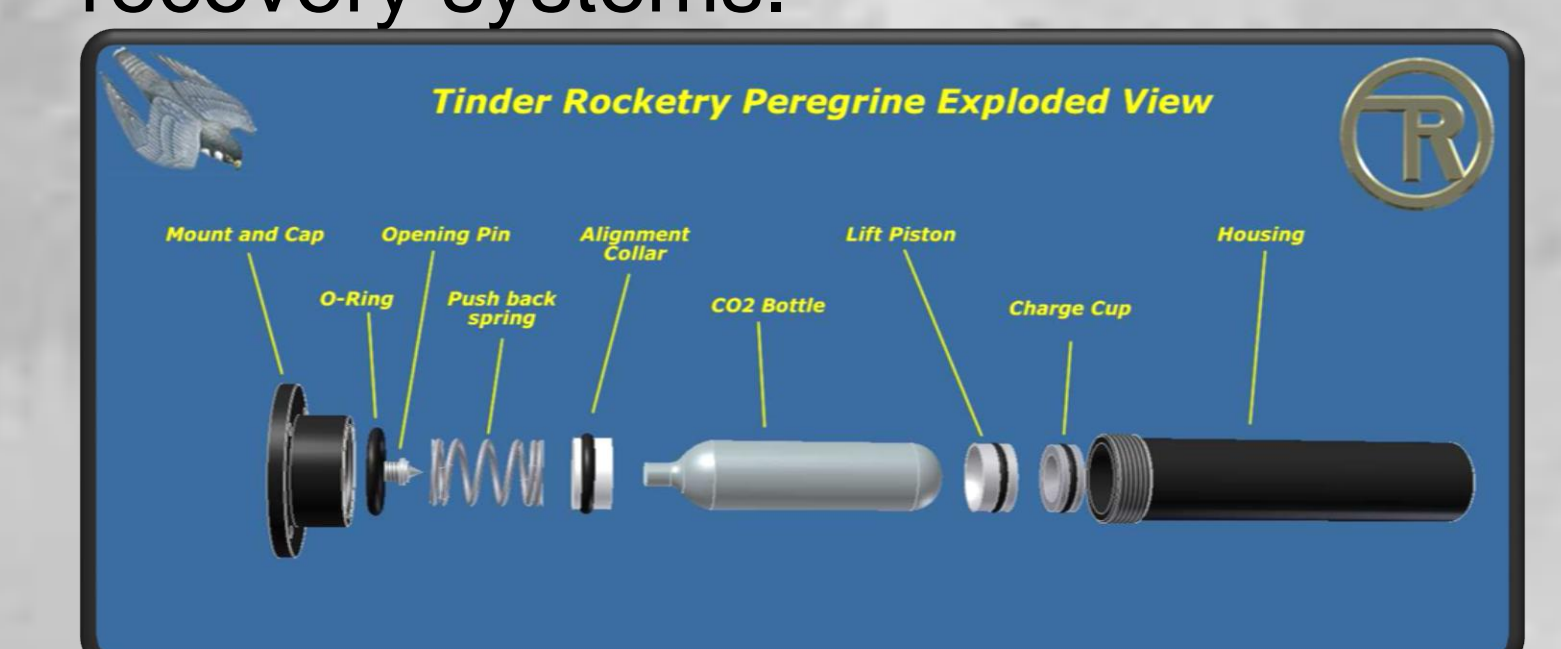**Insert Pic of Full Group with Rocket (edges will fade into background)**

SENDING IT UP

The first challenge in our rocket design was selecting the proper solid fuel mixture. Based on George P. Sutton's book, *Rocket Propulsion Elements*, the WSU Rocket club, and professional recommendations, we decided to use a fuel blend of **12% HTPB 68% Ammonium Perchlorate and 20% Aluminum**. Due to a lack of experience with mixing solid fuels, we decided to purchase our motor from a supplier, along with a casing for that motor. **The motor that best reflected the desired fuel blend was the L2200G by Aerotech with the RMS 75/5120 casing.** This reloadable system allowed us to launch our rocket multiple times.
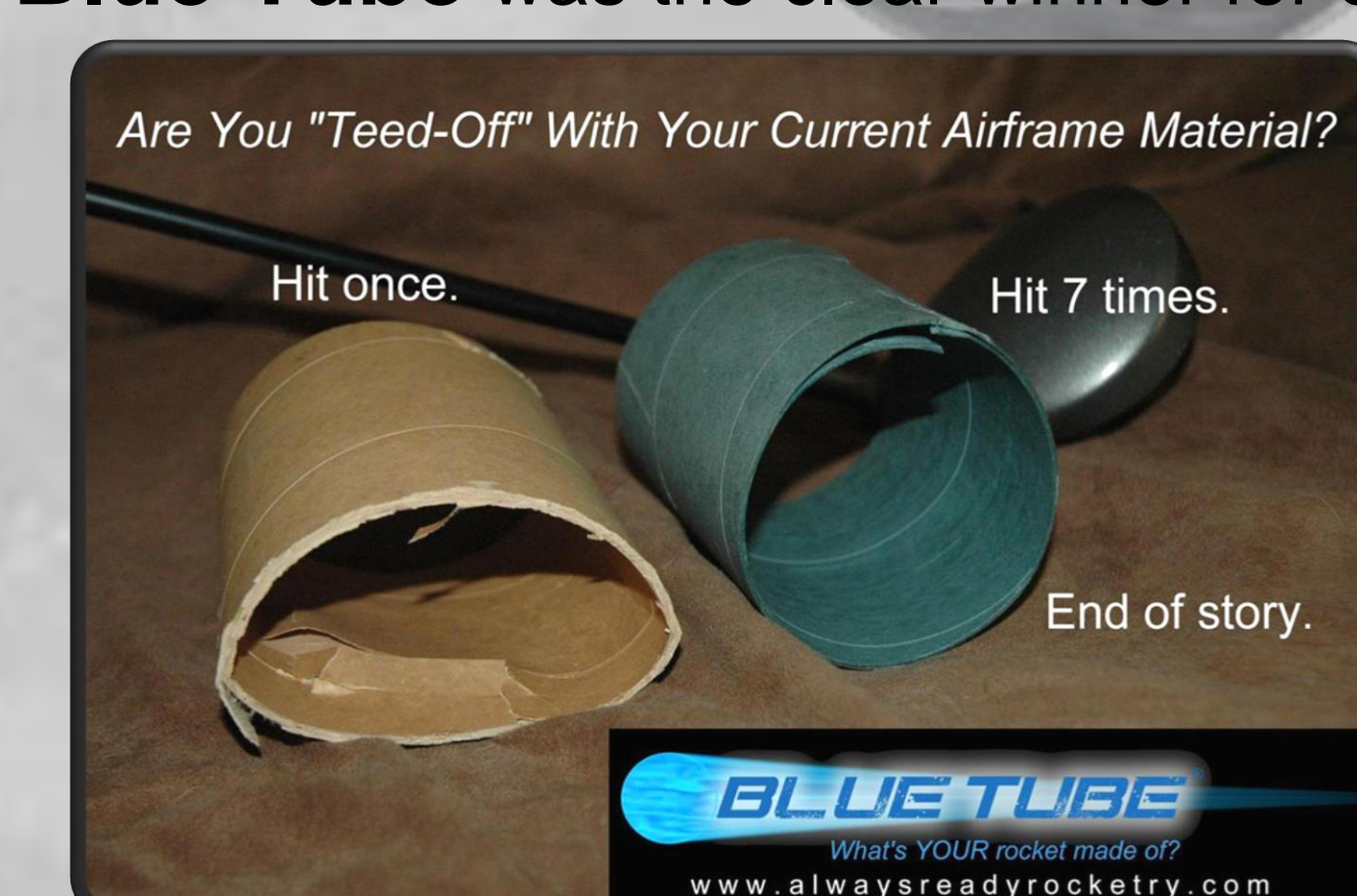
BRINGING IT DOWN

The rocket uses a dual chute system consisting of a 24" elliptical drogue and an 84" Iris Ultra main. The chute deployment system consists of two **Stratologger CF boards for altitude detection and Exhaustless Peregrine CO_2 systems for chute deployment.** The chute deploys without spark or flame unlike more common black powder systems. This was chosen for it's compatibility with the hybrid and liquid rocket teams in order to simplify the design for their recovery systems.

KEEPING IT TOGETHER

The process for selecting a fuselage material began by analyzing seven options quantified by durability, heat resistance, difficult of finish, weight, cost, and availability. These were narrowed down to fiberglass and Blue Tube. Based on a metric table, the deciding factor was the integration into the system. The supplier of Blue Tube offered a custom made fuselage that integrated well with the nose cone, fins and internal structures. Based on this, **Blue Tube** was the clear winner for our fuselage choice.

REDUCING THE DRAG

The nose cone design began by looking at the plot shown to the right. The plot was generated from an experiment done for NASA's Sugar Shot to Space by Vicente Alvero Zambrano. This plot compares the different nose cone shapes' drag coefficients against their Mach number. At our desired Mach number (0.98), the best nose cone shapes are the Tangent Ogive and the Power Series. Using a table of metrics, we decided on the **Tangent Ogive** shape.

Nose cone drag coefficient
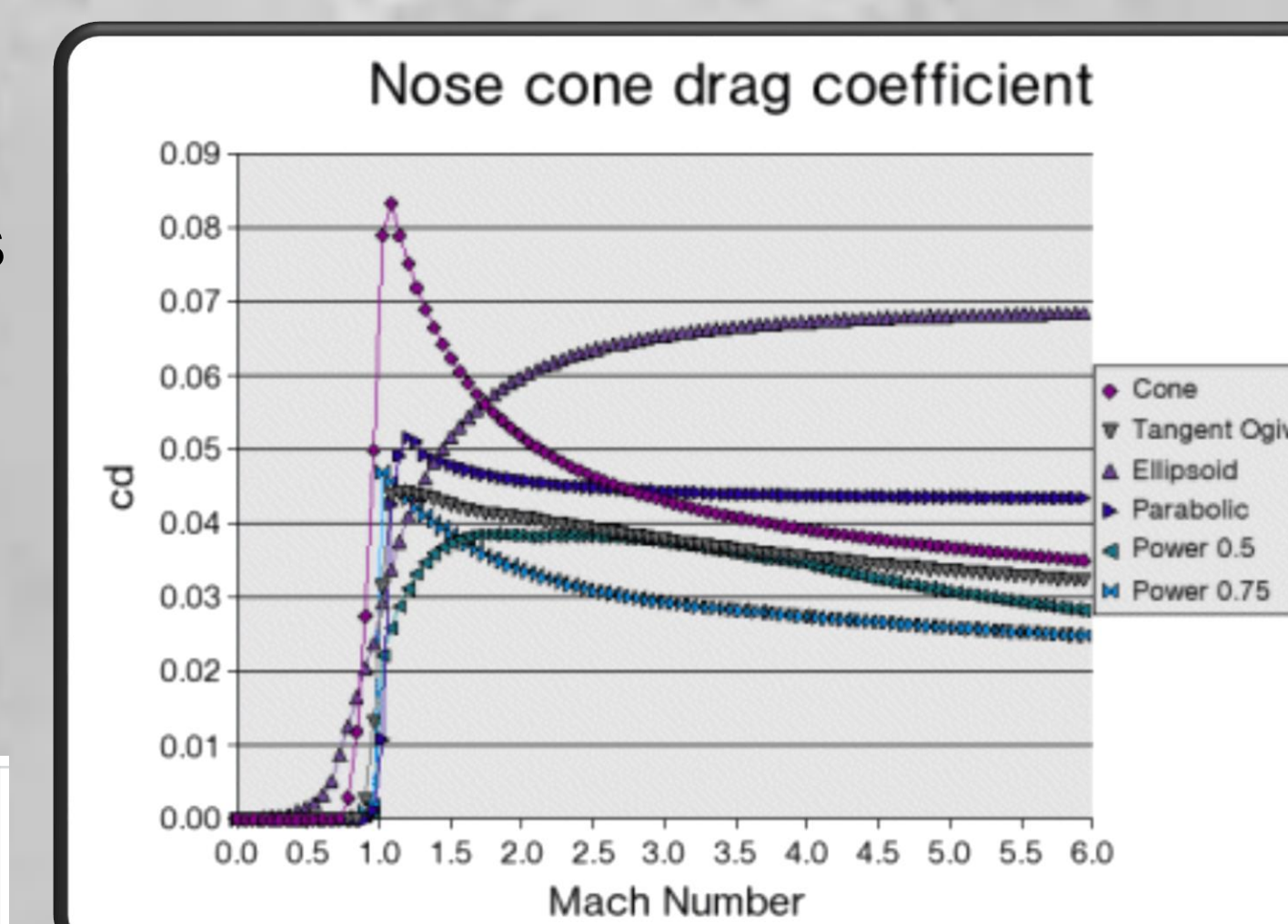
	Drag Coefficient	Requires Machining	Tangent at Base?	Used in Amateur Rocketry?	Used in Supersonic Flight?	Integration into System	Results
Power Series	+ (GREAT)	- (YES)	- (NO)	+ (YES)	+ (YES)	+ (EASY)	+2
Tangent Ogive	0 (MID)	+ (NO)	+ (YES)	+ (YES)	+ (YES)	+ (EASY)	+5

MAKING IT STEADY

Standard dimensional characterisitics for fin design were used and modeled in Rocksim. Once the rocket model was finalized in the software, the dimensions of the fins were varied by a trial and error process until the desired overall height of the rocket was reached. The final fin dimensions were:

- **Root chord: 11 inches**
- **Semi span: 11 inches**
- **Tip chord: 5.5 inches**
- **Sweep length: 5.5 inches**
- **Thickness: 9 mm**

1. Root Chord
2. Semi Span
3. Tip Chord
4. Sweep Length