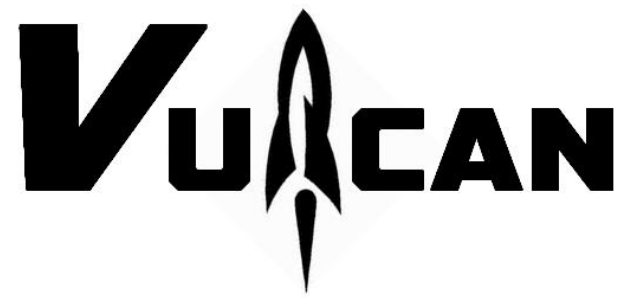


# Project Vulcan

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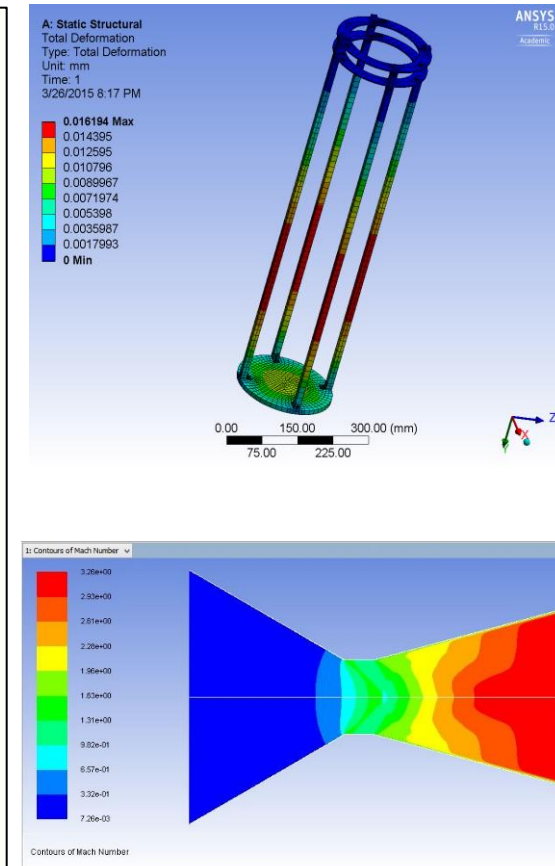
**Mission Statement and Purpose:** Our mission is to design and construct a test platform to demonstrate the construction methods, propulsion design and payload capacity of a sounding rocket that can succeed the project and be launched to 10,000 ft. while carrying a 10lb. technical payload. The purpose of a sounding rocket is to carry a research payload to a target altitude in order to obtain scientific data in order to further research on a desired subject.

## Airframe:

The airframe team designed, manufactured and built a structurally sound rocket capable of housing a 10 pound payload with a 6 inch diameter by 12 inch long payload and comprised of 6 main components:

- Nosecone (Wind Tunnel Testing)
- Drogue Parachute Bay (Ground Test Fire of Charges)
- Electronics & Payload Bay (Crush test and Ansys)
- Main Parachute Bay (Ground Test Fire of Charges)
- Propulsion System (Thrust Stand Test)
- Fins (Aerodynamic Analysis)

The rockets general design is a rib-stiffener assembly that sustains all the critical loads the rocket is exposed to. This design allows for easy access to all internal components by skin removal and satisfies the requirement of a student built airframe.



## Propulsion:

The student designed propulsion system chosen was a hybrid type for the throttle control, transportation abilities and non-toxic exhaust, without the loss of Isp.

- Acrylonitrile butadiene styrene (ABS) fuel grain
  - 3D Printed in-house
  - Familiarity from hybrid competition
  - HTPB requires two weeks to properly cure
  - Burn stability across temperature ranges is higher than HTPB
- Custom Carbon-Graphite nozzle
  - Withstand extreme temperature
  - Relatively cheap (C/C, Inconel)
- Aluminum 6061 Components
  - Cheap and lightweight material
  - Easy to machine

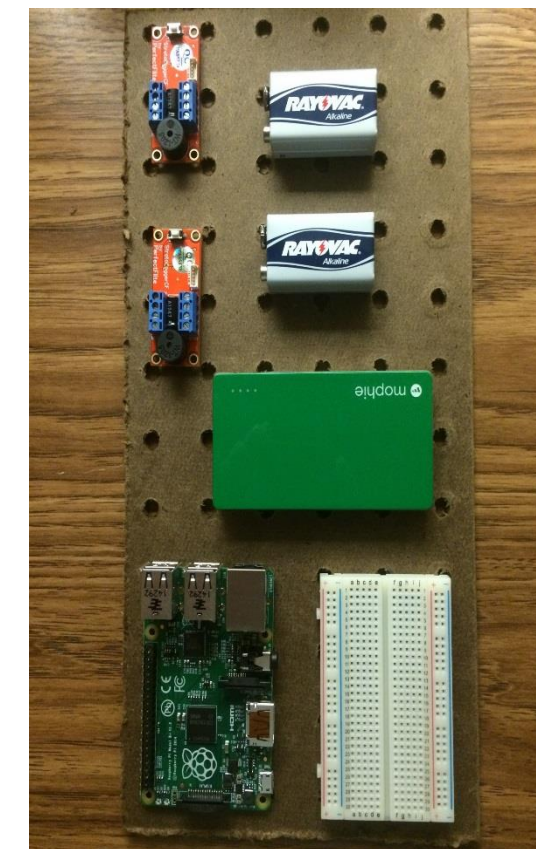
**Stem Outreach:** One of the goals of Vulcan was to generate STEM Outreach in the local area. In order to generate some outreach, Vulcan teamed up with Indiatlantic Elementary School to help Mrs. Egan's 5<sup>th</sup> grade class make a rocket payload as a part of their science project. Each student was able to bring in a small item from home to see how it reacted to the changes in pressures and g forces as the rocket ascends. Each of the small items was then placed into a ping pong ball with a pressure hole and taped shut.



## Avionics:

- Raspberry Pi Model B+ (Flight Computer)
  - Can interface with hardware, save flight data and run custom programs simultaneously
  - Runs on 5V, 1Amp power supply
  - Can deploy chutes using data from altimeters
- 2 StratoLoggerCF altimeters
  - Dual deployment capabilities and pressure drop protection to ensure accurate data
  - Record flight data
  - ±0.1% accuracy
  - Runs on nominal 9V

All components are secured to the avionics sled on one side, the other to be used by the payload, and powered separately to avoid potential failure.



Chute	Parachute Diameter (in)	Parachute Type	Cd	Alt. Deployed (ft agl)	Rocket Velocity After Deployment (ft/s)	Ejection Charge Mass (grams BP)
Drogue	30	Elliptical	1.5	Apogee	62.3	2.205
Main	120	Torodial (Iris)	2.2	500	12.6	3.528

	INLET	THROAT	EXIT
<b>Diameter [m]</b>	0.03749	0.01097	0.02573
<b>Diameter [in]</b>	1.475984	0.43188976	1.012992
<b>Pressure [Pa]</b>	3137114.57	1746776.18	101325.00
<b>[atm]</b>	30.961	17.239	1.00
<b>[psi]</b>	445.00	253.3485	14.69595
<b>Temperature [K]</b>	1060.93	947.2589	545.9365
<b>Velocity [m/s]</b>	0.01	605.9234	1289.7147
<b>Mach Number</b>	0	1.0	2.8037
<b>Mass-flow-rate [kg/s]</b>	0.337866		
<b>Length [m]</b>	0.02297	0.00439	0.02754
<b>Length [in]</b>	0.90433	0.17283	1.08425
<b>Angle</b>	30° Convergence	N/A	15° Divergence

**NORTHROP GRUMMAN**



Engineering & Science  
 Student Design Showcase  
 at Florida Institute of Technology

