LIQUID
ROCKETRY
LAB

Why Are We Doing This?

Our organization's mission as a nonprofit is to give back as much of the knowledge we gain through our endeavors to the space community as it takes "its next giant leap for mankind".

- Rocketry and spaceflight has been a dormant industry up until very recently. We seek to provide a resource to develop the next generation of engineers in the space industry.
- We're working hard to bridge the gap between the industry and the research community and make information and opportunity more accessible.
- We want to inspire the next generation of engineers by bringing the aerospace industry back to where it began with the Wright Brothers' first flight in North Carolina.
- The local aerospace talent pool would have a place to call home to work on rocketry projects.
- We want to serve as an educational resource for K-12 students by providing them with access to space education that otherwise would not be available.

Pilot Project - Liquid Propulsion Sub-Orbital Class Rocket

We are one of the first student organizations in the country to set out on our goal to be the first amateur team to launch a liquid propulsion rocket designed to reach the Karman line: 100 km above sea level.

- The Launch Vehicle and Test Stand is designed and developed completely from scratch by our student team and by the support of our esteemed mentors.
- We are one of the few teams to have developed our own test stand and are currently working on launch vehicle design and static fire tests.
- Launch vehicle development will go into full phase after the static fire with a tentative launch date in 2025.

Leadership

Dr. Daniel Stancil
Faculty Advisor
ECE Dept. Head, NCSU
Alcoa Distinguished Professor
IEEE Fellow

Matthew Simpson
Chief Executive Officer

Alexander Allen
Chief Executive Engineer & Avionics Lead

Mark Funderburk
Chief Safety Officer

Bilal Syed
Chief of Staff

Kavin Govindarajan
Chief Financial Officer

Nazar Rush
Propulsion Lead

Cade Cuddy
Programming Lead

Ben Black
Structures Lead

Why Partner With Us?

Support Education

We are a nonprofit supporting education in North Carolina and the field of aerospace. All proceeds will go towards the development of the aerospace engineering program at NC State University and community development programs aimed at K-12 students in NC.

Access

Anyone affiliated with your company will be welcome to attend our launch and static fire events as well as tours of our lab.

Exposure

Your logo will be placed on our rocket, trailer, banners, and other materials. A biography will be placed on our website. We will also be attending career and education outreach events.

Collaboration

We will work directly with your organization and representative to promote your organization, products, and values.

What Are We Looking For?

Financial Support

We are a student run, non-profit organization that is working on the cutting edge of liquid propulsion. Your support would help us achieve our advanced propulsion research and lab equipment requirements.

Mentorship

The years of expertise that industry professionals from your organization have can help guide the next generation of aerospace professionals.

In Kind Donations

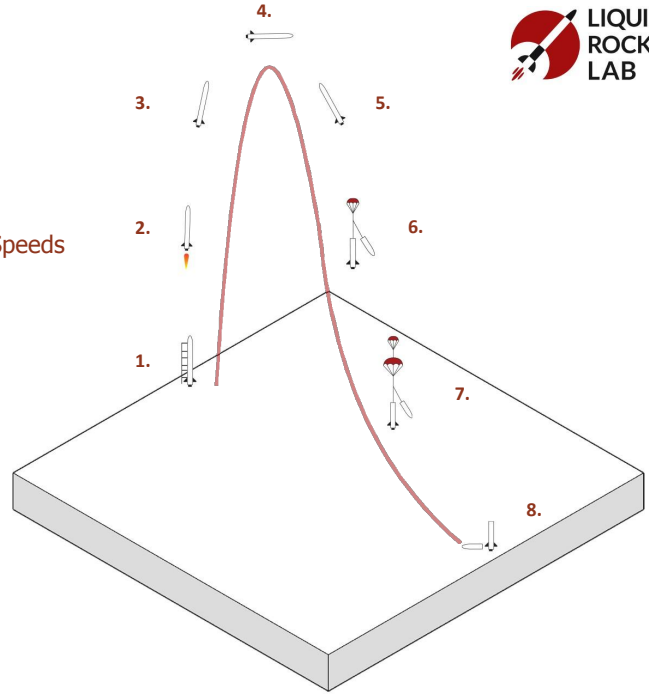
Showcase your organization's industry role by providing the parts or software for a team looking to break the boundaries of what is possible.

Anything Else!

If you see another way that your company can contribute to our cause, we are happy to chat and help work towards it.

The Mission

1. Rocket Launches
2. Engine Accelerates Rocket to Supersonic Speeds
3. Engine Cutoff
4. Edge of Space
5. Rocket Reorients for Re-entry
6. Drogue Chute Deploys
7. Main Chute Deploys
7. Landing



Our Current Partners

Follow Us!

linkedin.com/company/liquidrocketry

@liquidrocketry

facebook.com/liquidrocketry

@liquidrocketry

Thank You!

Thank you for your time. We appreciate any help your company can provide, no matter the medium or the amount!

If you have not met with us yet we would really appreciate a on- phone or in-person meeting to get to know your team.

Ready for liftoff?

Contact us at:

admin@liquidrocketry.com

Appendix

Overall Project Timeline

Engine Development

Test Stand Preliminary Design	Test Stand Fabrication Complete	Cold Flow Test	Static Fire Test
		In progress for Fall 2023	Tentatively scheduled for Fall 2024

Launch Vehicle Development

Preliminary Rocket Design Complete	Subscale Launch and Prototyping	Low Altitude Test Fight	Rocket Space Shot
In Progress			

Technical Details

Test Stand Project

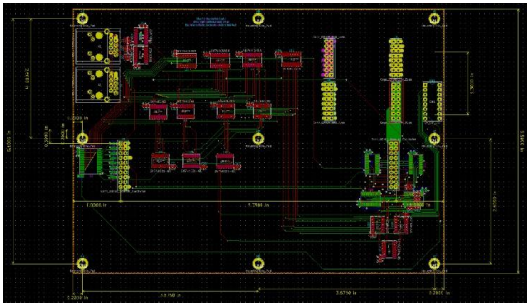
Structures

- The structures team has designed a supporting structure for the engine, propellant tank mounts, non-slip flooring, pressurant mounting, and a securement system to constrain movement at full thrust.
- The engine mount can accommodate many different configurations and is designed to operate safely at a thrust of 6000 lbf.
- The mobile capability of the test stand gives us flexibility of choosing a safe testing location.

Test Stand Project

Avionics - Data Acquisition

- The Avionics team developed a custom automated and remotely monitored test stand control system, capable of controlling all aspects of a test fire.
- The data acquisition system collects thousands of measurements per second from up to 1024 sensors which monitor engine health and performance.
- This data is streamed to mission control where it is visualized for test monitoring and later processed and analyzed to improve engine performance.

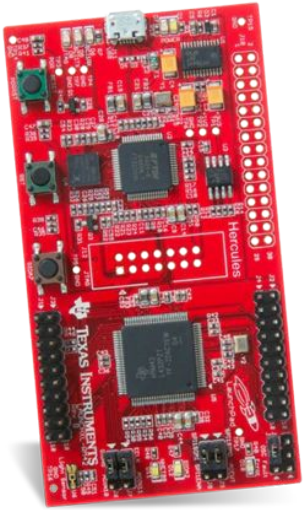


The data board serves as an attachment point to the primary data bus on the test stand for any relay or sensor boards and allows them to communicate with the processor using a custom, high-reliability data protocol.

Test Stand Project

Avionics - Automatic Control System

- The control system uses feedback from the sensor channels to monitor the state of the test stand and be sure everything is within safe operating parameters.
- All test procedures are pre-written and verified through several layers of both automatic and manual review. These are executed by the test stand computer to reduce human error.
- Building and programming these custom systems gain the team experience for work on the Launch Vehicle avionics systems.



We'll be using the Ti Hercules micro-controller for our systems

Test Stand Project

Propulsion - Plumbing Systems

- To propel our rocket up to 100 km in altitude, the propulsion team is designing, manufacturing, and testing a pressure-fed liquid rocket engine and its supporting fluids systems.
- The primary hardware supporting the engine is the plumbing system. Through the control of pneumatic valves, hydrogen peroxide and RP-1 (kerosene) propellants will be fed at 1000 psi to the engine using nitrogen gas cylinders for pressurization.
- To support testing of these systems, redundant instrumentation and automated procedures have been implemented to monitor and regulate the pressure, temperature, and flow rates on the test stand.
- Following validation of our plumbing hardware, the team is transitioning focus towards engine R&D.

To ensure a safe cold flow, a safety check is done for instrumentation and valves at our lab and at the test site. Additionally, all plumbing undergoes hydrostatic testing to verify it can withstand design pressures with a factor of safety.

Test Stand Project

Testing Language - Compiler Team

- Our tests are written as a series of simple, human readable instructions in a language we designed
- We created a compiler to translate these instructions into a format the test stand computer can understand and execute

```
test {
    section open_valve at 2500ms for 2500ms {
        at 0ms set relay1
    }

    section monitor_pressure at 6000ms for 30000ms {
        from 0ms to 30000ms require { 50psi < sensor1 < 75psi } else soft_abort
    }

    section close_valve at 36000ms for 2500ms {
        at 0ms unset relay1
    }
}

abort soft_abort {
    from 0ms to 5000ms require { 50psi < sensor1 < 100psi } else HARD_ABORT

    at 0ms set relay1
    at 1000ms unset relay1
    at 2000ms set relay1
    at 3000ms unset relay1
}
```

Test Stand Project

Data Visualization - Mission Control Team

- Our mission control team designed a simple, customizable user interface to visualize live data as it is received from the test stand
- This allows us to operate at a safe distance from the test stand and make split second decisions should anything go wrong

The Launch Vehicle

- The launch vehicle is currently in the very early research and design stages.

- Our launch vehicle will be powered with RP-1 (Rocket Propellant 1) which is refined kerosene and HTP (High Test Peroxide) which is a strong oxidizer.

- Right now we expect the launch vehicle to:

  - Be around 30 feet tall
  - Have a maximum apogee of 120 km
  - Reach a maximum speed of ~Mach 5
  - Have a thrust capacity of ~6000 lbf

- The test stand will be used to safely test and develop our engine until it is ready to be fired on the launch vehicle.

Icons courtesy of the Noun Project