

TREL

Halcyon Update

TEXAS ROCKET ENGINEERING LAB

February 2025



The University of Texas at Austin
Aerospace Engineering
and Engineering Mechanics
Cockrell School of Engineering

Program Update

While most students headed home after final exams, we accelerated, and TREL matured semesters in the gap between them.

For the entirety of winter break (except one week for holidays) a lean crew of ~15 students averaged ~12 hrs/day for 7 days/wk of hands-on work in the lab. This incredible commitment allowed us to complete the vehicle, ground systems, ground software, and flight software for our first rocket ever alongside going vertical and running extensive checkouts on all systems.

While we were originally planning to launch in January out of Spaceport America, our watch item for WMSR range support did not close on time. We pivoted to pushing for a static fire, but then our crane (lift) vendor was also unable to support this timeline. We went back to the schedule drawing board, and this catalyzed an effort to bring lift capability in-house. Over the next month, we iterated daily to inch our way towards independence. With a new timeline, on-demand lift/lower capability, and a new test site – we now plan to extensively validate Halcyon with tanking tests, cold flows, and static fires ahead of launch in March.

Section by Buckner Newberry, Halcyon Chief Engineer

Progress

Propulsion

- Engine bay assembly completed and leak checked
- RP press/vent assembly completed and leak checked
- RCS assembly completed and leak checked
- dP assembly completed and leak checked
- Ox tank press/vent assembly and ambient/cryo leak checks completed
- Intertank purge lines integrated
- Raceway transfer lines fabricated and integration completed
- First integrated engine assembly on-vehicle
- Integrated vehicle leak checks completed

Structures

- Fiberglass nosecone fabricated, painted, and integrated
- Composite intertank coupler (test article) compression and bending tests passed
- Composite intertank coupler (flight article) fabricated and integrated
- Raceway tube/harness mounts and cover mounts printed and bonded
- TVC assembly machined, assembled, and integrated
- TVC dynamic load testing completed

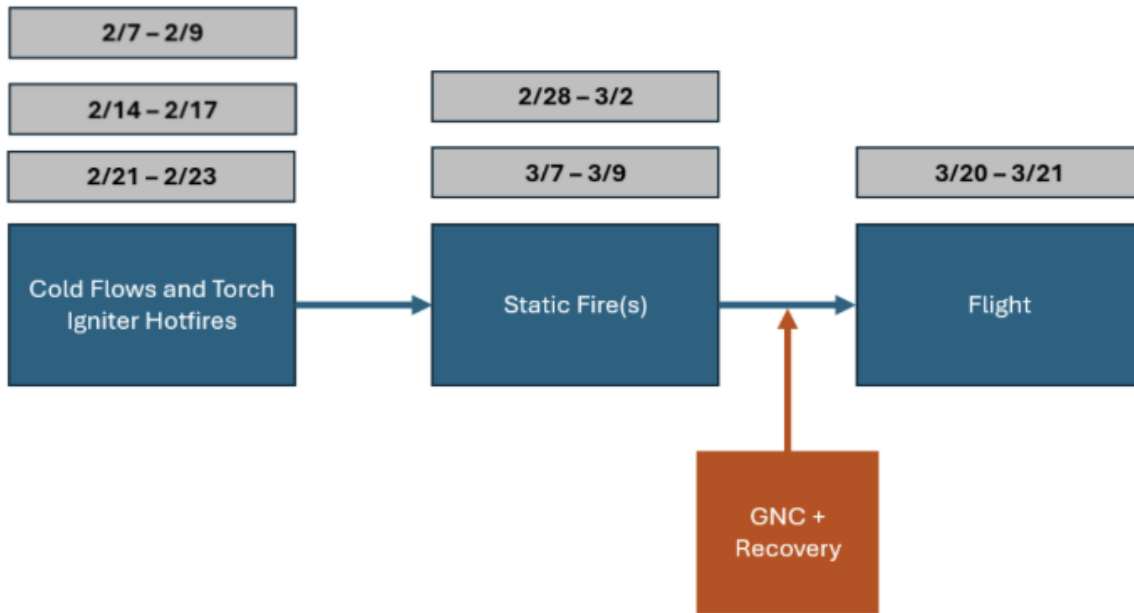
Avionics, Software, and GNC

- Avionics build and integration completed, full sensor and valve checks completed
- GSW and FSW communication to and from GSE and vehicle hardware validated
- Monte Carlo dispersions completed and final hazard area delivered to FAA
- TVC controller functional and tuning against wind data in progress
- Initial full body CFD completed

Infrastructure, Test, and Launch

- Lab space completely re-configured and initial internal machine shop stood up
- First-ever internal structural compressive test performed using hydraulic actuator system
- First-ever internal structural bending test performed
- Vehicle GSE activated with GSE LN2 fill tests
- dP purge, intertank purge, tank press, engine purge, and vehicle pneumatics supply built
- Full GSE trailer leak checks completed
- GSE-to-vehicle transfer lines fabricated, leak checked, and fit checked
- Vehicle integration crates and tables fabricated
- Launch mount and weld stands modified to allow for horizontal pinning of rocket
- Concrete and rock anchors fabricated and installed on launch mount and winch stand
- In-house lift capability (pivoting with winch) developed with only retrofitted hardware

Path to Flight



Section by Buckner Newberry, Halcyon Chief Engineer

Neptune3: Moving Forward

As we look toward the next iteration and the next generation of TREL's vehicle, we recently decided to make a large change in the vehicle architecture for our second vehicle, Neptune3.

The ultimate goal of TREL is to have the capability to launch orbital payloads, something far beyond the scope of anything a collegiate team has ever done or is even close to doing. Our previous plan for MkII had been to use a second Havoc engine to attempt to reach the Kármán line. We recently decided that this was a dead end for our program and would not present enough of a relevant learning experience for the iteration after, which will be our orbital rocket.

Instead, we will be using three of our in-development electric pump-fed engines, Riptide, on a new vehicle Neptune3, pulling development away from our pressure-fed Havoc and towards the development of TREL's next-generation engine.

This change allows us to encounter and work to solve problems we will encounter on our quest for orbit related to multi-engine startup and control, feedlines, and pump control a year earlier than our previous plan. We will use the propellant COPVs that were to be on our pressure-fed rocket, and we will incorporate smaller pressurant tanks, allowing us to progress our knowledge of active pressurization control. Neptune3 is an inspiring and challenging stepping stone toward our orbital rocket in an unprecedented step for collegiate rocketry.

Section by Ian Cochran, Neptune3 Chief Engineer

Structures



Image: *Taj Lee trims the nosecone*



Image: *First fiberglass nosecone integration*



Image: *Taj Lee installing the intertank composite coupler for the first time*



Image: *Taj Lee and Daniel Brzostowski installing TVC assembly for the first time*

Some images have been altered for ITAR compliance

Propulsion

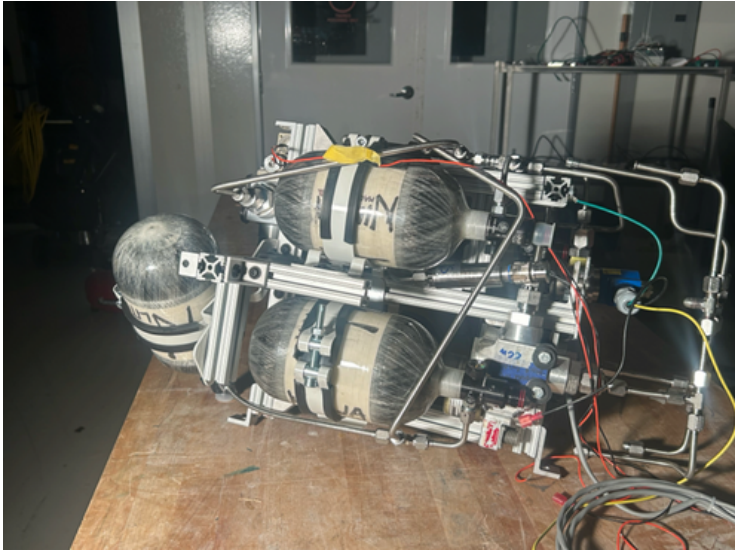


Image: *Completed reaction control assembly*



Image: *Completed LOx tank level measurement assembly*

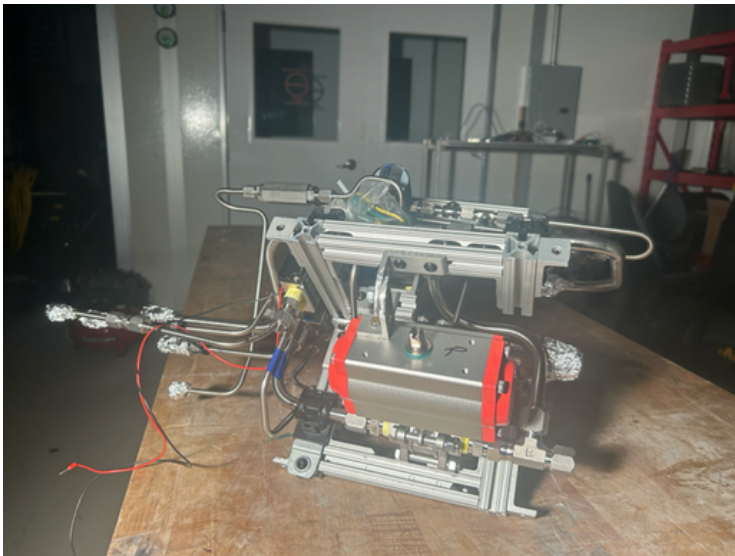


Image: *Completed LOx tank forward assembly*

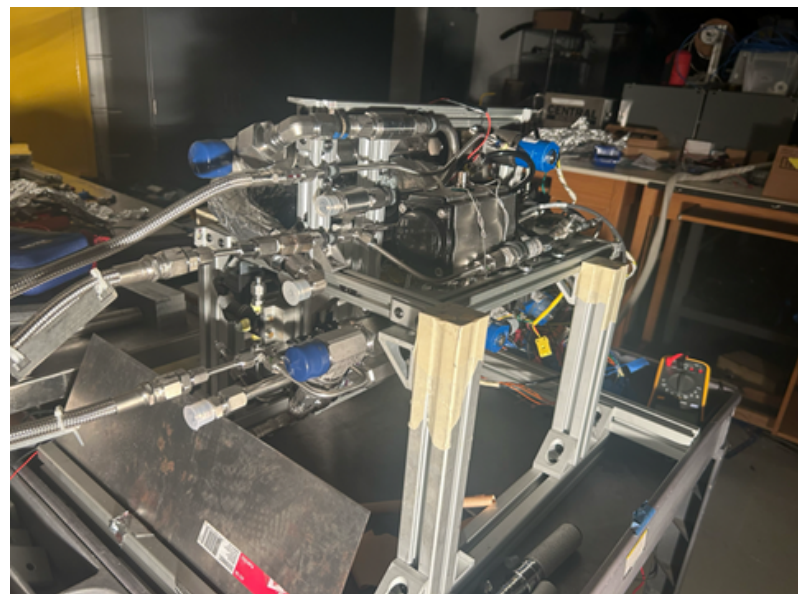


Image: *Completed engine bay assembly*

Propulsion

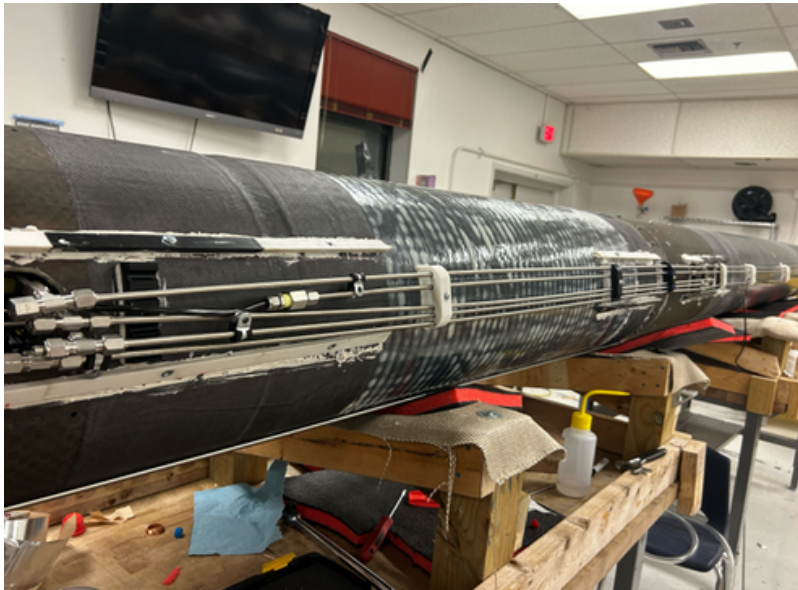


Image: First integration of all raceway lines



Image: First integration of engine into completed engine bay

Avionics

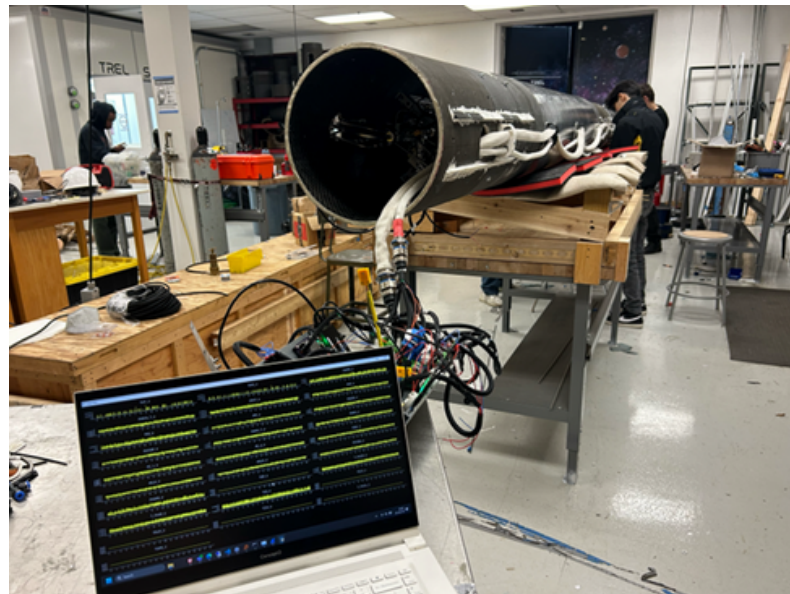


Image: First checkout of full integration suite

Image: Saatvik Aggarwal performing “rocket surgery” on avionics plated

Full Vehicle Integration



Image: First full Halcyon integration

Ground Support Equipment



*Image: Kushal Ambatipudit
running igniter test
operations*

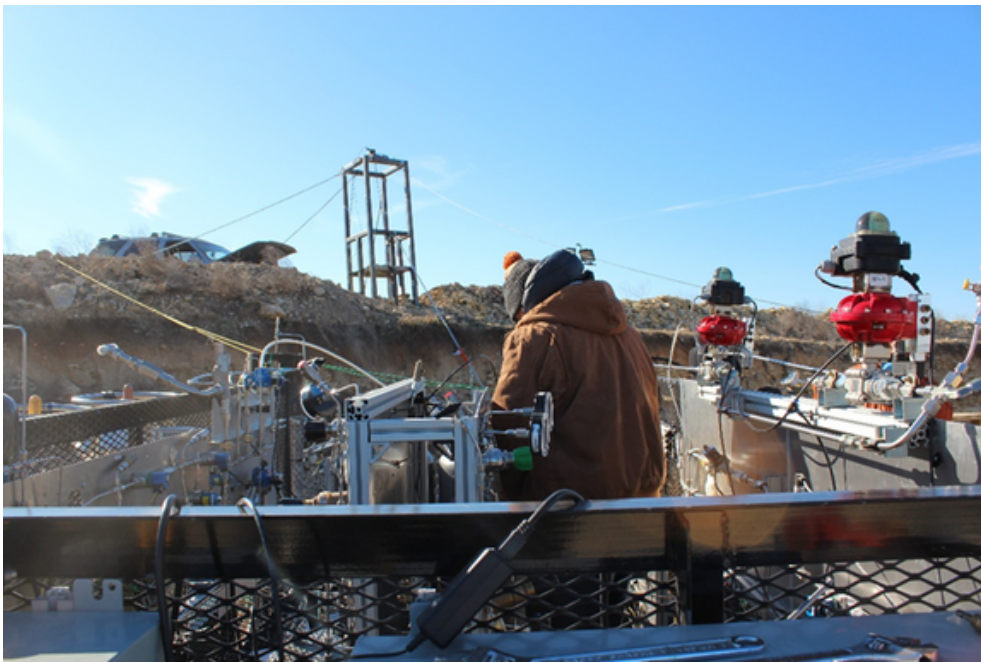


Image: *Halcyon GSE trailer*



Image: *Halcyon GSE trailer*



Image: *GSE trailer with industry friends/mentors Will Hilal and Ian Salamon, who visited test site and lent a hand in GSE build work*

Lift Development

Image: *Halcyon team attempting RP-1 tank lift*



Image: *Halcyon team following first successful RP-1 tank lift*



Image: *Lift “corset” iterations prepped for the first dual-tank lift test attempt*



Image: *Halcyon team ahead of tank-only lift test attempt*



Image: *Digging to set concrete anchors for lift infrastructure*



Image: *Halcyon team preps Halcyon for first integrated lift attempt*



Image: *Halcyon team preps Halcyon for first integrated lift attempt*



Image: *Mason Nothaft overseeing lift operations*

Image: Ryan Grassman performing final lift checks before attempt



Image: First full vehicle lift attempt (unsuccessful)



Image: Ryan Grassman performing final lift rigging checks

Some images have been altered for ITAR compliance

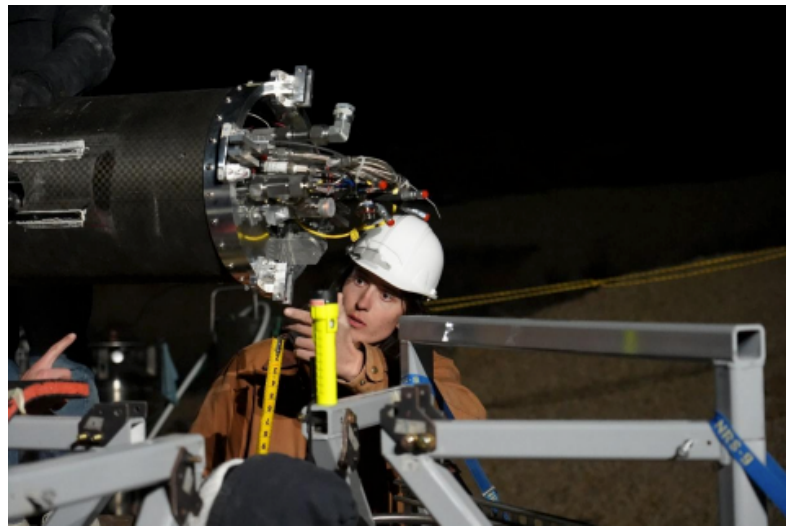


Image: Halcyon prior to first integrated lift attempt



Image: Halcyon team after first successful lift



Image: *Halcyon raised over the test site*



Image: *Lowering Halcyon*



Some images have been altered for ITAR compliance

Image: *Caelix Kidwell on stability tagline during lift*



Some images have been altered for ITAR compliance

To Joe Foote, Josh Weber, and Gary Weber,

Thank you for letting us use your ranch for this critical phase in our program's development. We're on a mission to supercharge undergraduate engineering education, and we couldn't do it without you.

Just as much, thank you for providing us with memories that will last a lifetime. The work is hard, and the days are long, but this campaign has brought the team together in ways we couldn't expect.

Thank you for making our undergraduate years unforgettable.

Sincerely,
The Texas Rocket Engineering lab





Program Update

This semester, TREL Skunkworks is expanding. This month we excited to take in a new round of promising recruits as well as introduce four new ambitious projects:

1. Propellant Feedlines,
2. Stage Separation,
3. Capsule,
4. LN2 Vaporizer.

Each one of these projects hosts the necessary development for a rocket with multiple stages, multiple engines, and a payload. As of this December, Skunkworks' first finished project, the Antenna Ground Station, will track Halcyon during its very first launch.

Additionally, we are thrilled to announce that the following Skunkworks initiates have transitioned to Halcyon where they are now applying their skills and experience! These members have worked incredibly hard this past semester and we are excited to see their next accomplishments working on Halcyon.

Skunkworks Initiate Transitions

Name	Skunkworks Team	Halcyon Team	Name	Skunkworks Team	Halcyon Team
Josue Renteria	Propellant Measurement	Fluids	Liam Cooper	LOx Valve	Integration
Jervis Benjamin	Propellant Measurement	Fluids	Ronil Shah	LOx Valve	Fluids
Gordon Lee	Propellant Measurement	FSW	Dora Chang	Ground Station	Avionics
Bradford Le	3DOF RCS	GNC	Kellen Schuster	Ground Station	Fluids
Zachary Handel	3DOF RCS	Structures	Tiffany Chen	Ground Station	GSW
Vivaan Rupani	3DOF RCS	Orbital Test Stand	Sujan Goruganti	Ground Station	Orbital Test Stand
Daniel Milan	3DOF RCS	FSW	Abbas Ma	Ground Station	TVC

Fall 2024 Project Updates

RCS Test Bed	This semester, the RCS Test Bed Team is machining a second iteration by improving the thrust level from their nozzle design and adjusting the rotary union to reduce stiffness. On software, they are reforming the current simulation code for easier adaptability and portability. With this new stand, the team will test out a variety of control algorithms to optimize the pendulum's self-stabilization, which they will then document in order to reach publication.
Propellant Measurement	The Propellant Measurement Team is working to improve their current equipment and enhance their design's reliability and precision. This semester, the team is conducting a number of temperature and vibrational tests to improve their design. This team is additionally integrating their design with Halcyon for the first launch.
Custom Liquid Oxygen Valve	The LOx Valve Team is going to carefully machine their first prototype valve this semester. The team will then test the design's efficacy and reusability for ways to improve and will work towards the ambitious goal of a functional valve by the end of the semester.
Antenna Ground Station	As the first Skunkworks project to reach completion, the Antenna Ground Station Team has a fully tested and finalized design. With their design now integrated with the Avionics and GSW teams on Halcyon, this system will already use its automated tracking system to receive the telemetry from Halcyon during its first launch.
Steel Tank Research	The Steel Tanks Research team will present their research from this past semester at an AIAA conference in March. Alongside this presentation, this team is excited to continue to conduct tests to better answer their research questions and refine their current understanding.

Spring 2025 New Projects

LN2 Vaporizer	The new LN2 Vaporizer Team is posed to create a LN2 vaporizer that will accommodate the high quantity of gaseous nitrogen required for this growing program. This team will construct a reliable and long-lasting Vaporizer for TREL's future. Objectives: This semester, the team will investigate the performance of various heating sources, frost mitigation, flow regulation, and design their prototype. Working through testing, this team will build a fully functioning and usable vaporizer.
Stage Separation	The Stage Separation Team will develop a separation system for a multi-stage Halcyon vehicle. The project will be led by a senior design team of experienced engineers who will apply their previous TREL experience to this ambitious project. Objectives: Beginning with the first size iteration of Mark 3 and working towards the design of a high-fidelity model, this team will create a usable stage separation system for Halcyon by the end of the year.
Propellant Feedlines	The Propellant Feedlines Team will design a feedlines and basin system to deliver propellant to a set of multiple engines at consistent pressure and rate. Objectives: This team is prepared to design a system to avoid both water hammering and vapor pull-through. By testing the geometry and mechanics of their structure, this team deliver a fully functioning design by the end of the semester.
Capsule	The Capsule Team will construct a capsule capable and prepared for space environments that will support the transport of future payloads. This team will prioritize the prototyping and research of certain designs to inform future semesters' work on TREL's capsule system. Objectives: The team will consider the capsule's recovery, payload capacity, ACS and ECLSS. The goal for this team is to prototype a model capsule and evaluate those additions for their work in the following semester.



Image: *Dora Chang, on Antenna Ground Station, testing the automated tracking software with simulated rocket trajectories.*

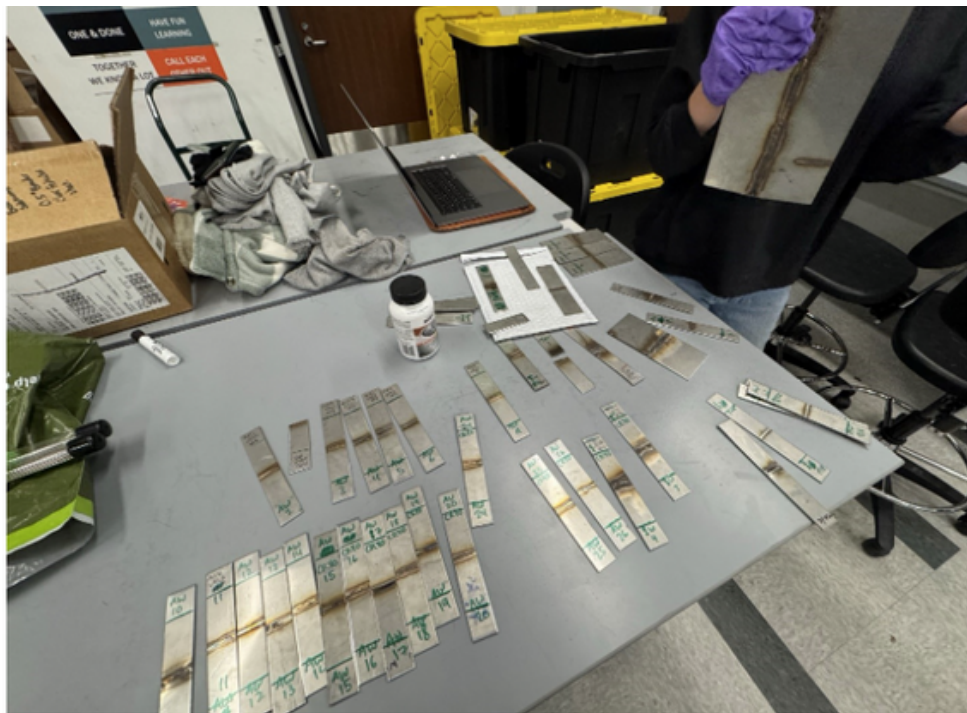


Image: *Anastasia Herberger and Taj Lee perform weld inspections.*

Section by Trent Mosher, Chief Engineer

OPERATIONS

Program Update

TREL Operations is spooling up once again for an exciting and productive semester. I'll keep this month's update short and sweet as we busy ourselves with the start of the semester activities.

We have concluded Spring Recruitment! With a hefty 207 applications, the Internal Operations team, Operations Leads, Skunkworks Chief Engineer, Orbital Test Stand Chief Engineer, and myself diligently reviewed every single one, selecting a total of 33 new members across our Operations, Skunkworks, and Orbital Test Stand Programs. With our recent official onboarding, we are very excited to see our new members get to work and what goals they will accomplish in the next month.

For Operations in particular, in the next month we hope to make considerable progress on planning the Longhorn Liquid Innovation & Flight Technology Challenge, UT's inaugural liquid rocketry competition.

Further, all our teams remain hard at work maintaining the day-to-day operations of TREL. Finance & Supply Chain is ensuring all the remaining hardware has been purchased for MK1 and is moving forward with budgeting for the Skunkworks and Orbital Test Stand Programs for the upcoming semester. Internal Development is ensuring all our new members have access to and are properly trained and educated on the use of our ITAR-restricted resources, ensuring TREL remains compliant. Marketing & Communications is looking to release new media regarding the recent progress on MK1 (keep an eye on our Instagram, @texasrocketlab). Corporate Development is making headway on some new sponsorships, as well as starting a new initiative dedicated to the professional development of our members. And finally, Safety & Facilities is working hard on training our new onboardees, as well as keeping our lab spaces safe, clean, and stocked with everything we might need!

INGENUITY AWARDS

During our bi-weekly all hands meetings we give out an “Ingenuity Award” for a member who goes above and beyond what is expected of them - we want to shout them out here as well:

Kushal Ambatipudi, Halcyon Test and Launch Lead:

“Kushal took the initiative to independently hunt down an opportunity to acquire 2 enclosed trailers for use as operations trailers at Pancake, Texas. He closed the deal at \$300 per trailer, “An Absolute Mad Man”.

-Nominator



Zachary Handel, Structures Team Member:

“Recently graduated from Skunkworks’ 3DOF RCS, now a Halcyon Structures Team member, Zach rose to the occasion “first week on the job” to deliver critical path welding jobs for launch mount and weld stands. TREL would not be where we are at in regards to lift capability and our timeline without Zach showing up in this way.

Section by Buckner Newberry, Halcyon Chief Engineer

-Nominator

