

Rocket Engine Static Test Stand

2017-2018 Senior Project, BSME



Team

- Ben P - Project Management, SolidWorks
- Brandon C - Safety, Fuel and Electrical Systems
- Micah H - Fundraising, Design, Legal, Data Acquisition
- Jason P - Acquisitions, Community Outreach

OTRP Goal

Compete in SpacePort America Cup

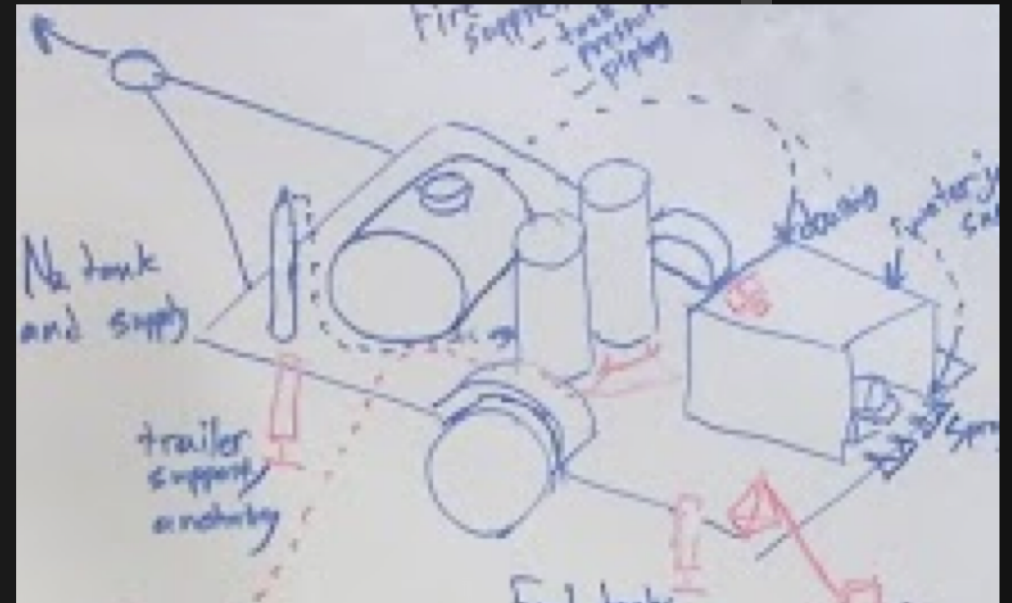
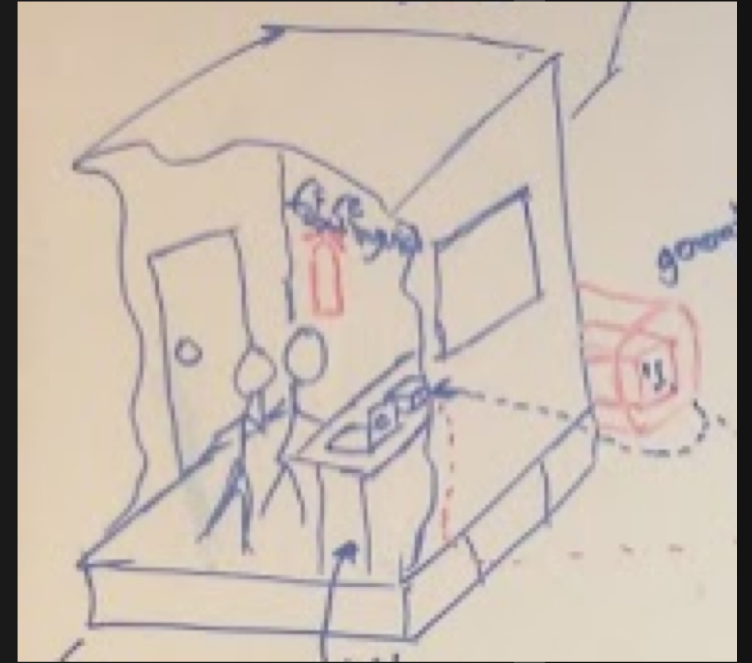
- 4 kg payload
- 10,000 ft apogee
- Liquid-fueled rocket category

Test Stand Requirements

- Accommodate engines of various sizes and designs
- Portability
- Remote operation
- Fire/blast suppression

Design Goals

- LOX (Cryogenic) propellant system
- Secure and measure up to 1000 lbs thrust
- Automation/DAQ
- Separate control building
- Fire suppression and water cooling
- Blast containment



Timeline

1. Find testing location
2. Design test stand
3. Design fuel system
4. Design instrumentation/control system
5. Design fire suppression system
6. Purchase parts
7. Manufacture/Assemble trailer

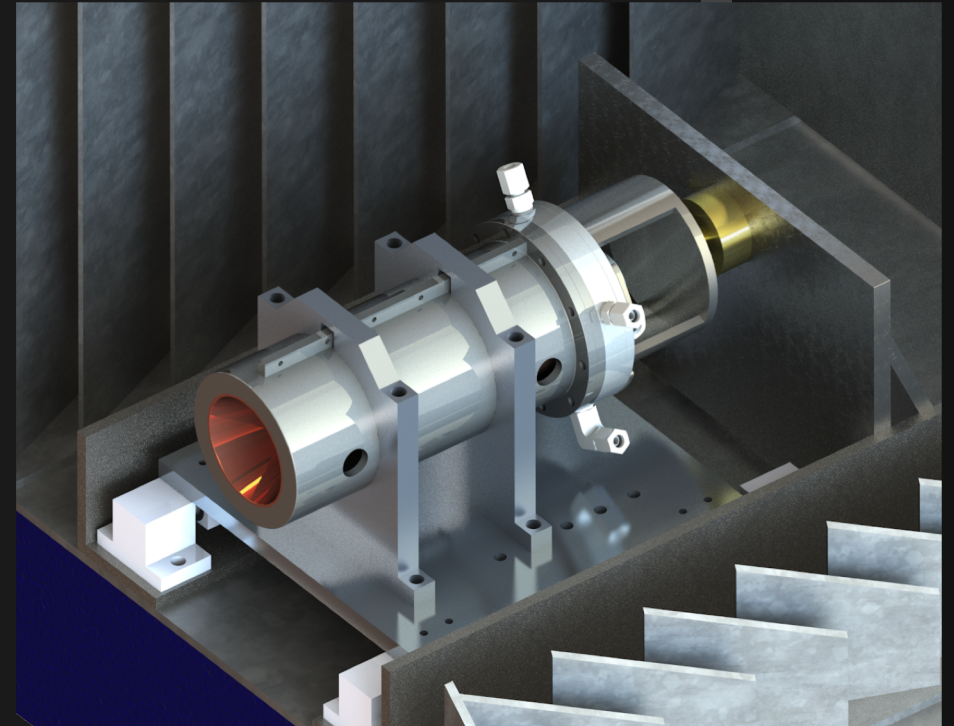
1 - Find Testing Location

- Allowed use of auxiliary lot
- No permanent construction
- Decided to build on trailer



2 - Design Test Stand

- Interchangeable motor clamps
- Linear bearings
- Load Cell
- Blast containment

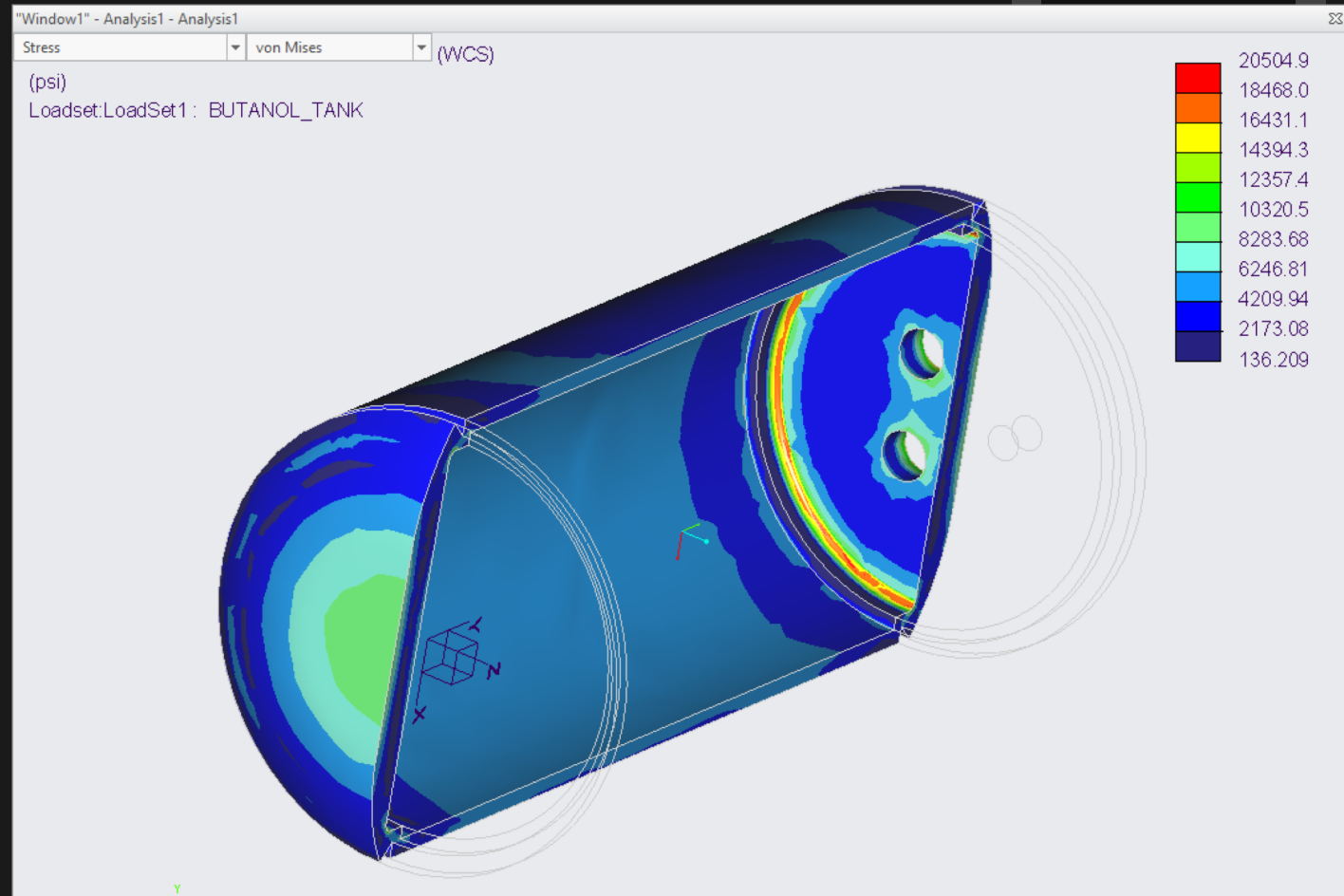


3 - Fuel System Requirements

- Support engines up to 1000 lb thrust
- Inert Gas Pressure Feed
- 3.0 Factor of Safety (minimum)
- Redundant Pressure Relief
- Hands-off Failsafe
- Liquid Oxygen Safe
- Built from Off-The-Shelf Components
- Remote Operation

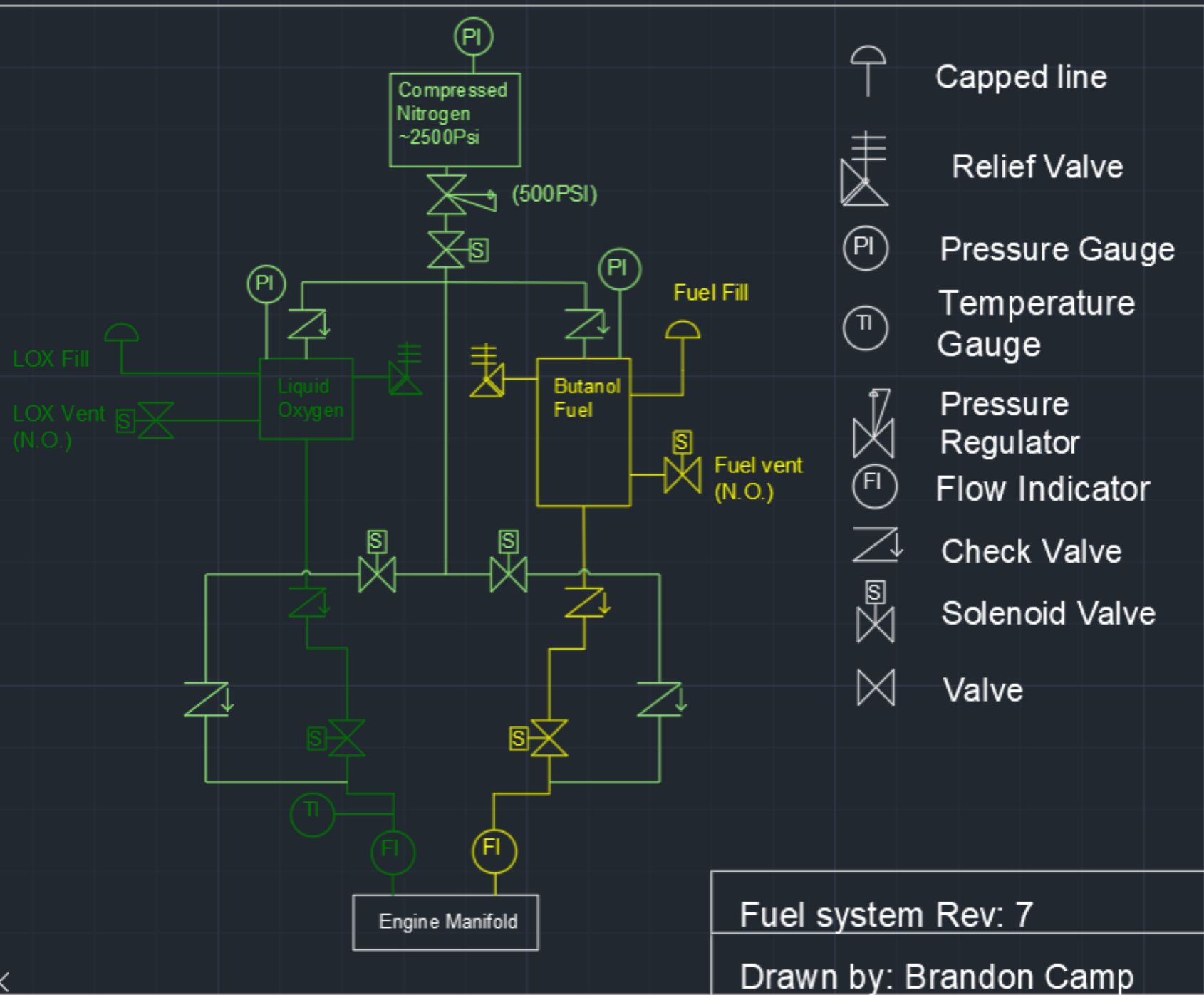
3 - Initial Fuel Tank Design

- Flight weight fuel tanks
- Preliminary FEA and sizing
- Abandoned due to cost and liability concerns



3 - Fuel System Current Design

- Commercially manufactured tanks
- Engine and manifold fuel purge
- Backflow prevention
- All components are in-house and ready for assembly

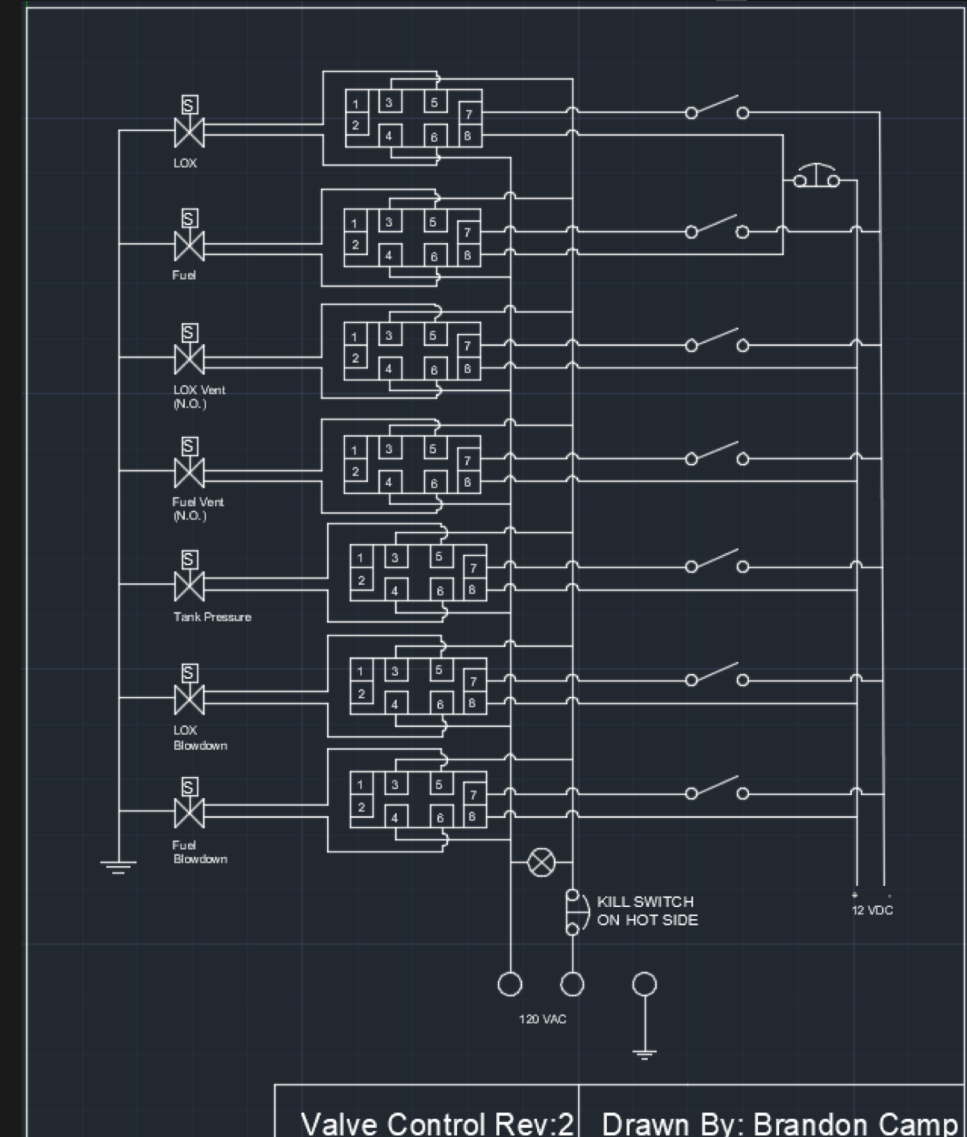


4 - Electrical System Requirements

- Common power source for all valves
- Emergency shutoff
- Independent valve control
- Upgradable to automatic control

4 - Electrical System Current Design

- 120VAC main system
- 12VDC control relay
- Interlocking killswitch



5 - Design Fire Suppression System

- Researched Chemicals
- All-metal enclosure
- Water flood system
- 275 Gallon tank



6 - Purchase Components

- Cryogenic valves - Ratermann Manufacturing, Magnatrol
- High Pressure hoses: Grainger (N2), Unisource (LOX)
- High pressure fuel tanks engineered and manufactured by Apache Stainless, delivered August 2018
- Acquired trailer, water supply tank, other hardware

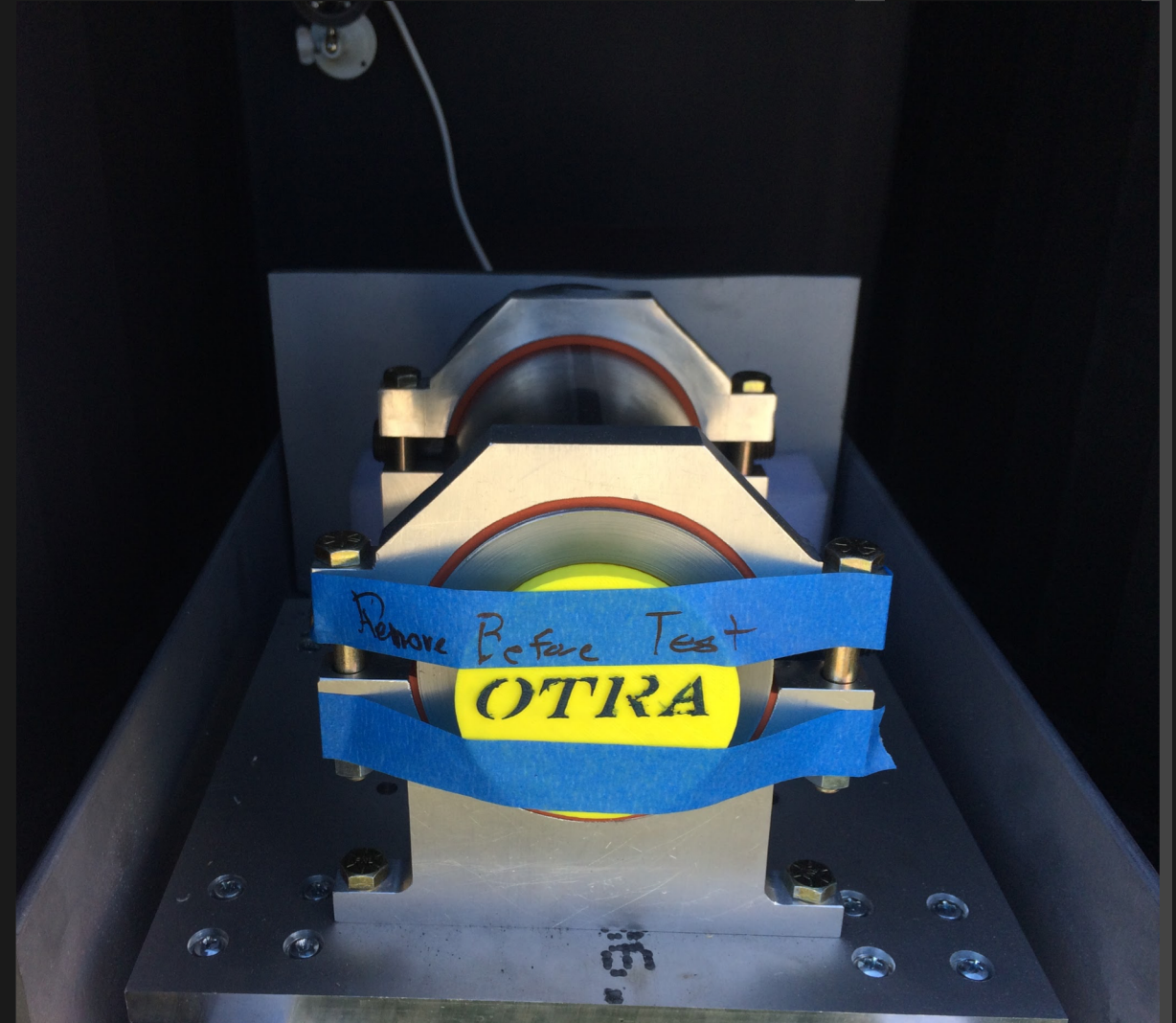
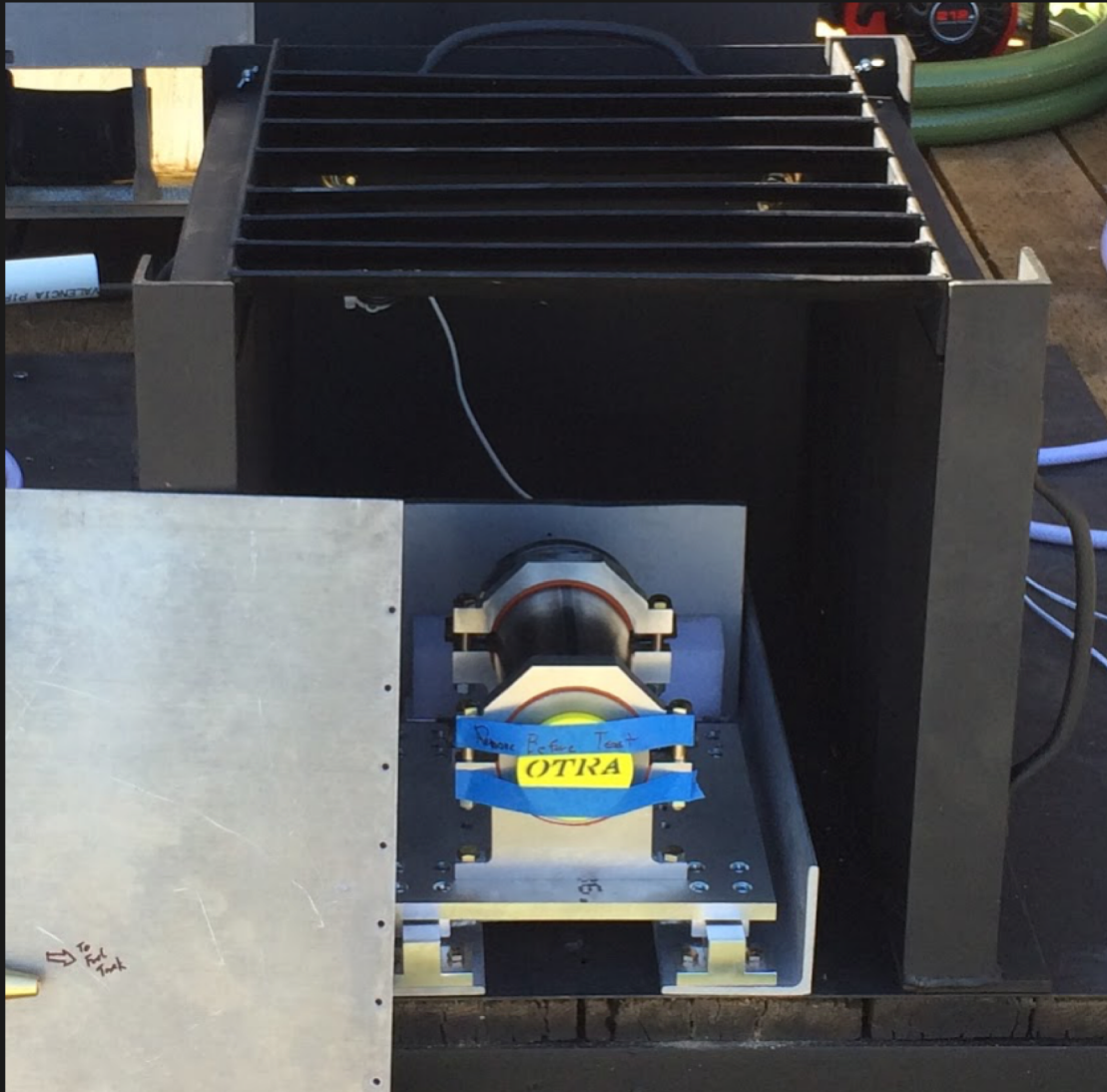
7 - Manufacture Trailer



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The Future

- Fully assemble propellant system
- Pressurize and test valves, leaks
- Program, set up, and test instrumentation
- Get insurance
- Static test fire

Questions?