

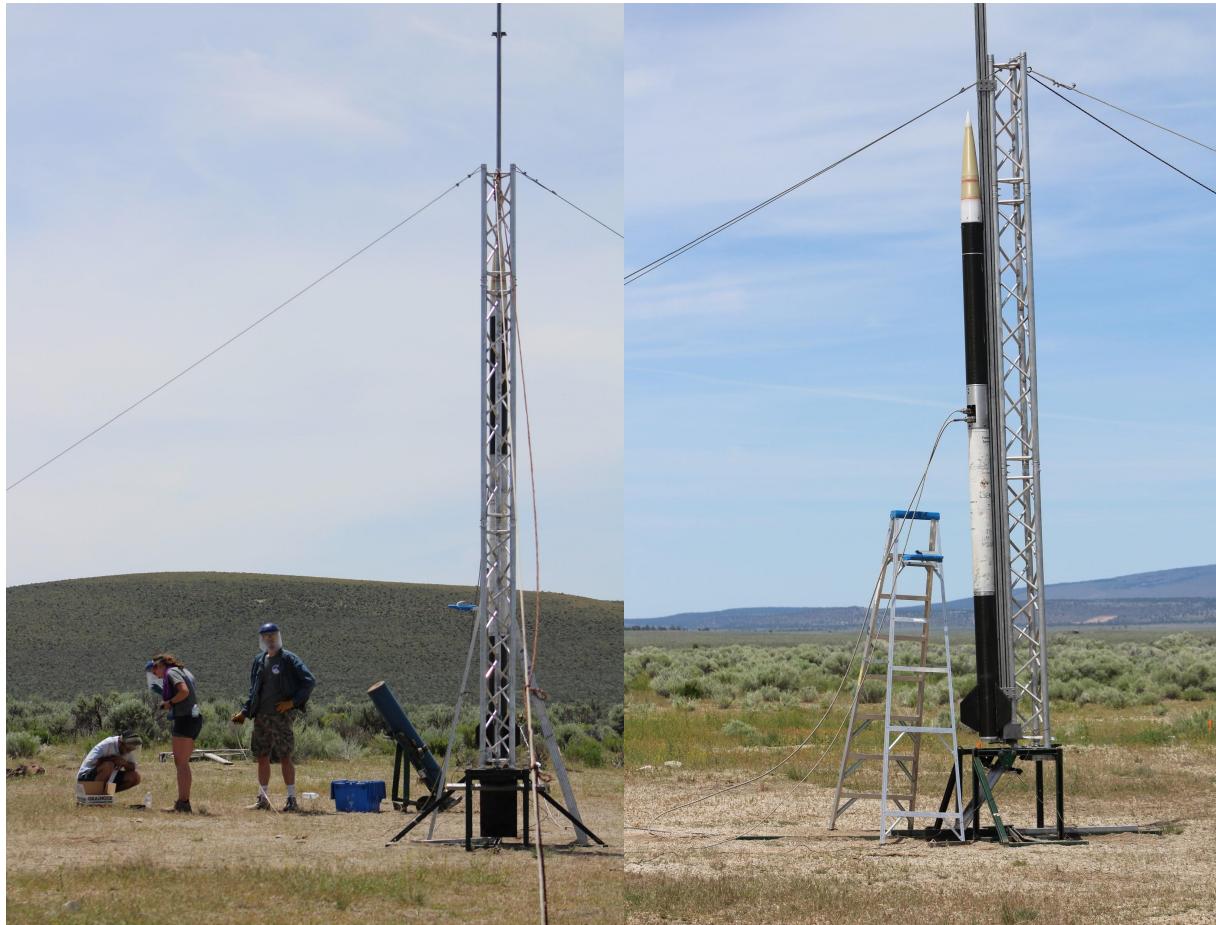
Safety Considerations for Hybrid Motor Systems

Team 09 Project Technical Presentation to the
2018 IREC

Overview

- History
- Oxidizer Cleanliness
- Remote Fill
- Propellant Umbilical
- Actuated Valve
- Future Work

History - 2016 Team



2016 Manual Fill and Disconnection

History



2016 Diaphragm Injection

History

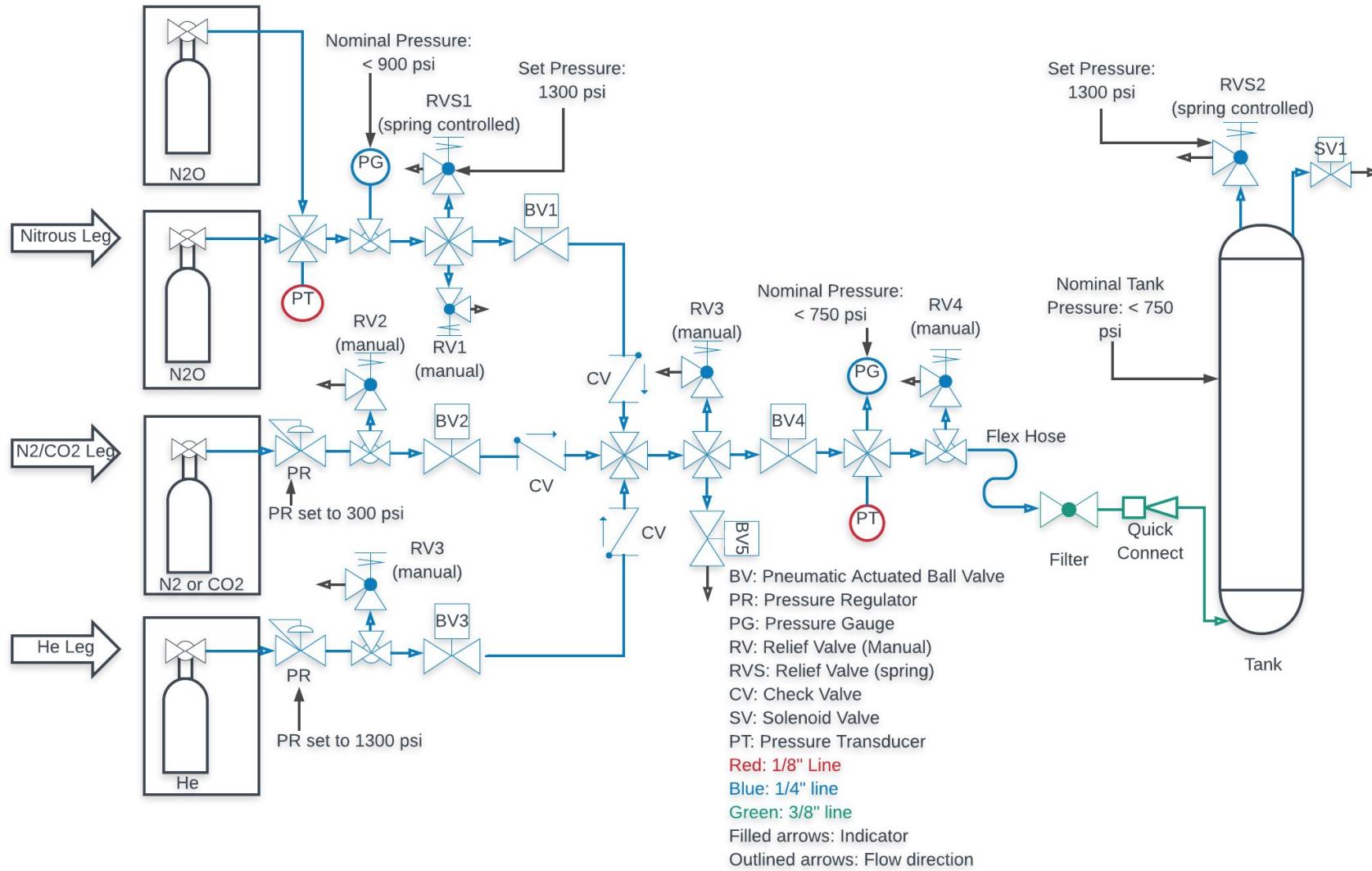


2016 Test Flight Results

Cleaning Procedures

- Clean all pieces that contact the oxidizer
- Pour Vertrel MCA into the assembled system and blow through with nitrogen to clear the system of contaminants
- For smaller pieces: clean the pieces with the Vertrel MCA cleaning solution and a microfiber cloth
- When handling Vertrel MCA, personnel must wear nitrile gloves, safety glasses, and respirators

Remote Fill System



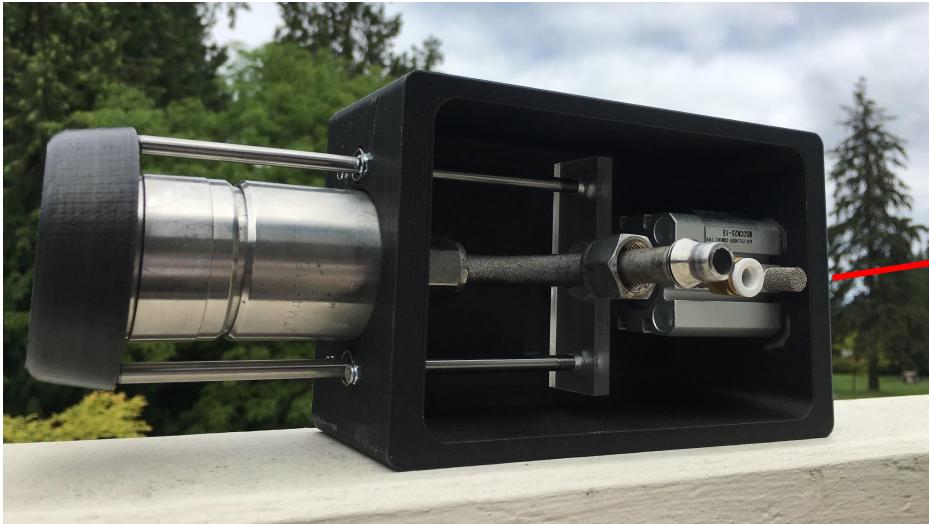
Remote Fill Failsafes

Event	Failsafe
Pneumatics lose pressure	Valves spring-return to safed positions with oxidizer tank venting
Fill computer loses power	Valves spring-return to safed positions with oxidizer tank venting
Fill computer loses connection	Vent procedures are immediately initiated

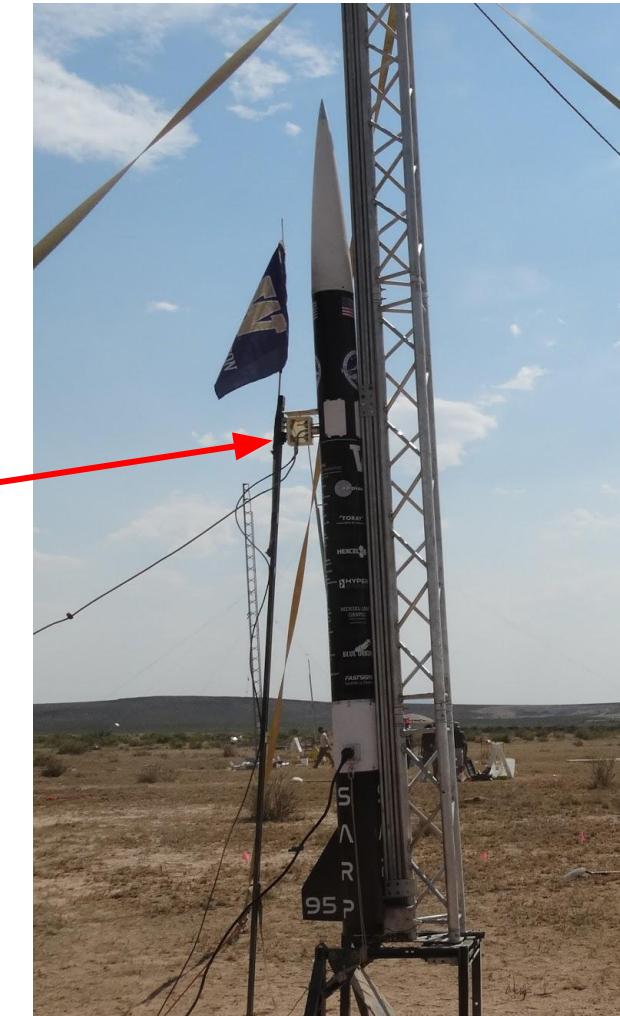


2018 Remote Fill Stand

Propellant Umbilical



2018 Propellant Umbilical



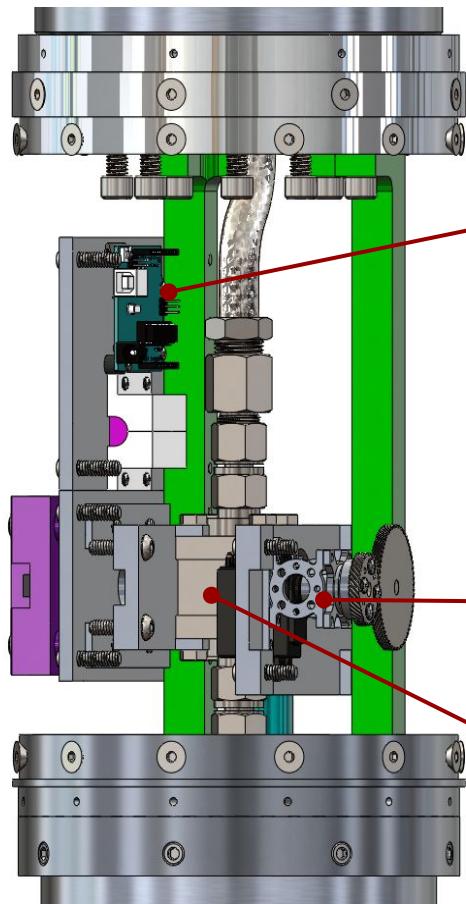
2017 Propellant Umbilical at IREC

Propellant Umbilical Failsafes

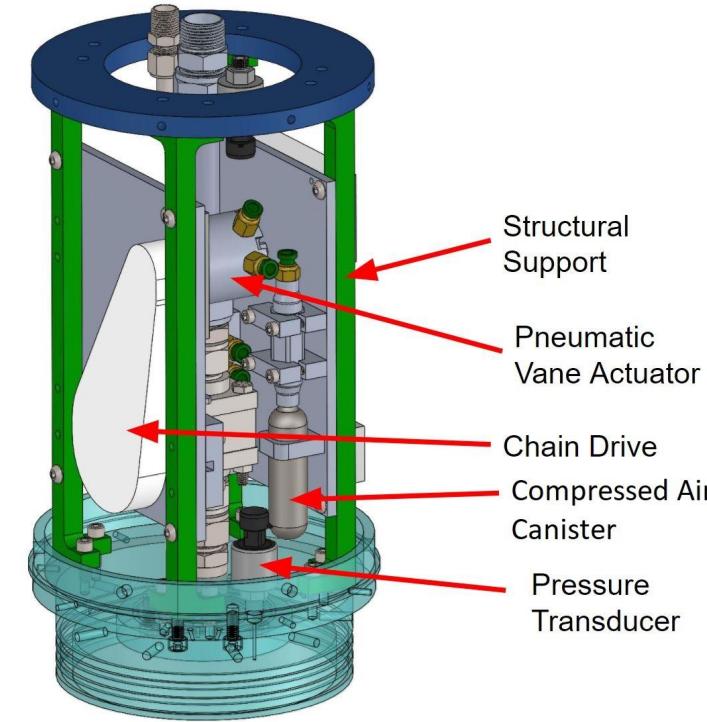
Event	Failsafe
Unable to actuate umbilical (pressure/power loss)	Plumbing stand still connected to vehicle, can vent remotely.
Early actuation of umbilical	Can emergency vent through onboard vent valve or main ball valve.
Accidental actuation	Requires key switch to be turned while two buttons are pressed simultaneously. Plumbing stand must be in the correct state to actuate.



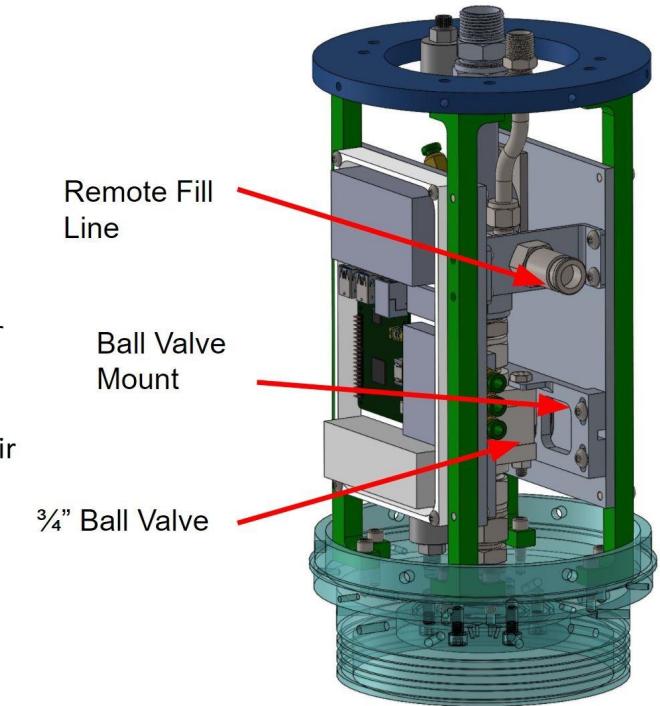
Actuated Valve



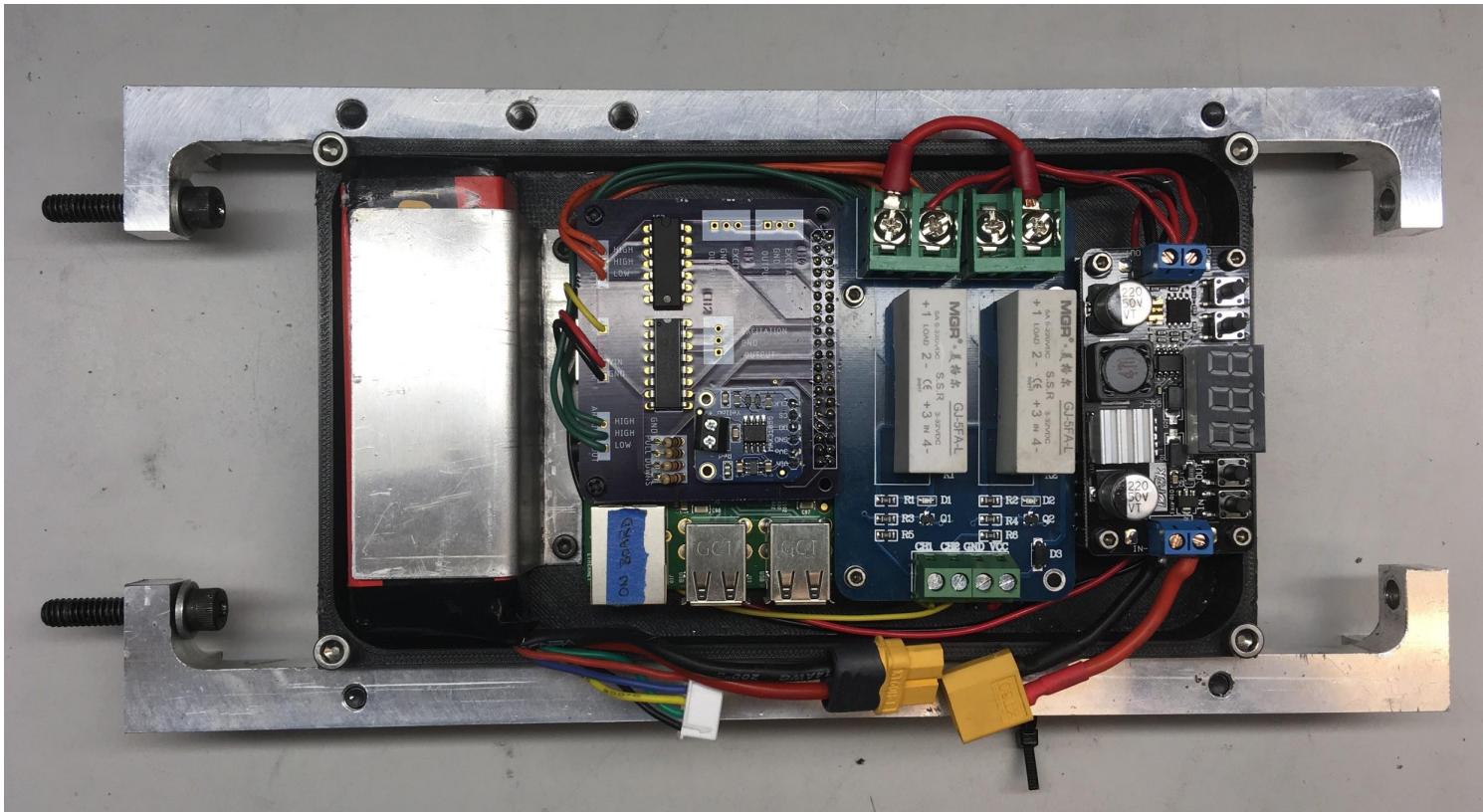
2017 Actuated Valve



2018 Actuated Valve



Actuated Valve



On Board Valve Actuation Electronics

Actuated Valve Failsafes

Event	Failsafe
Igniters Controller is unable to turn on	On Board RPi will be unable to light igniters and will end valve control script
On Board battery dies	Command will know immediately; vent through remote fill system
EM interference	Requires encoded signal sent between Arduino and RPi to actuate valve
Pneumatic valve controller has no air	Pressure gauge is read prior to leaving the launch pad; pressure transducer reports pressure throughout remote operations



Future Work

- Increased hardware redundancy
- Develop reconnection of propellant umbilical
- Redundant networks
- Physical redundancy of actuated ball valve
- Overall network status information at command



Questions?

