NFPA

Fluid Power VEHICLE Challenge

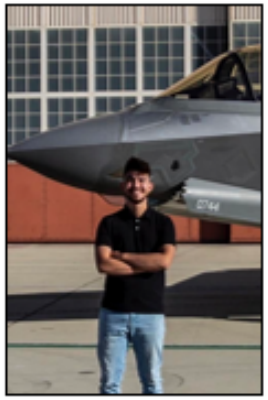
NFPA
Education and
Technology
Foundation

FINAL PRESENTATION
Cal Poly FPVC
Jim Widmann
4/11/2024

OUR TEAM

Mason Gray

Mechanical Engineering



Christian Ferrandino

Mechanical Engineering

Ryan D'Amour

Mechanical Engineering

Alberto Acho Lopez

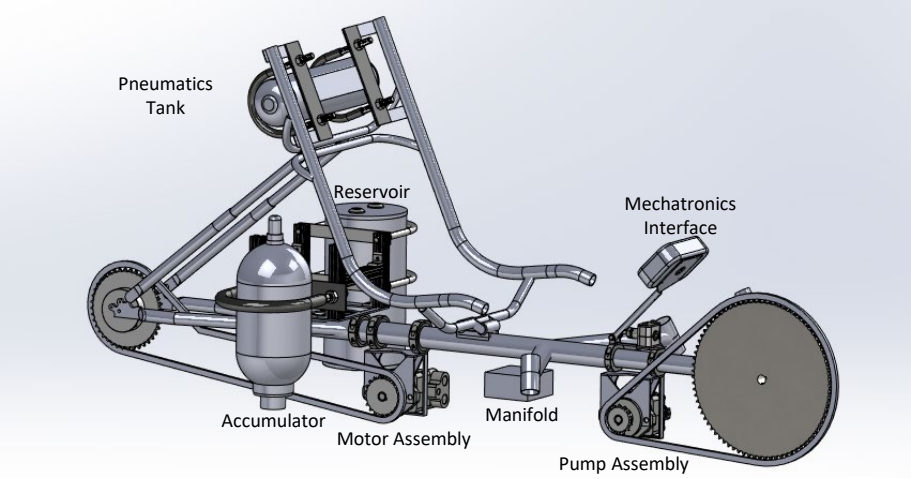
Mechanical Engineering

Johnathan Dietz

Mechanical Engineering

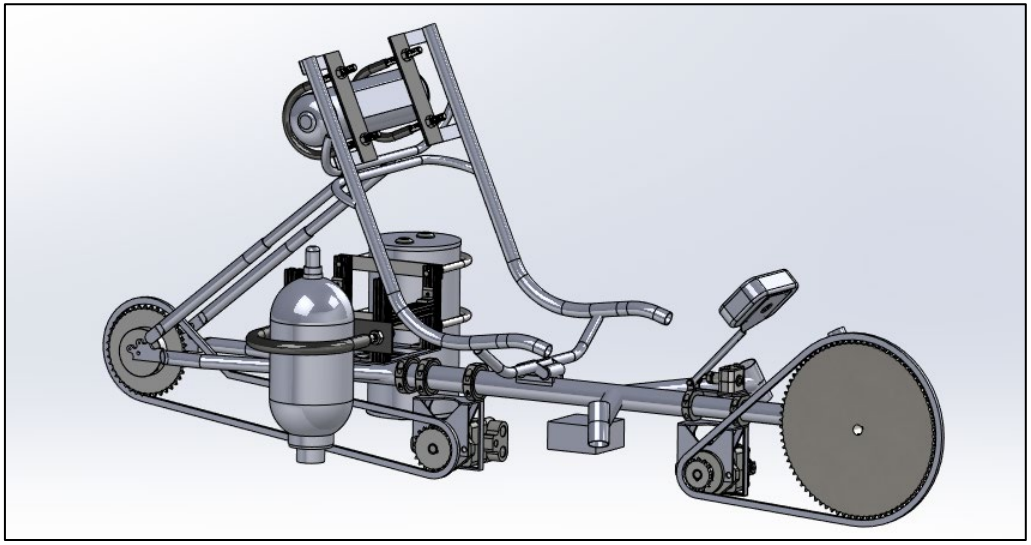
Full Vehicle

SolidWorks Model

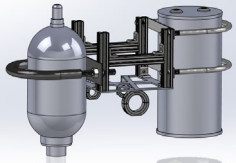


Finished Build

Mounting Design

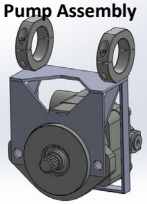


Reservoir & Accumulator Assembly



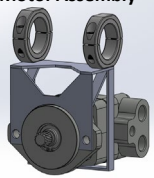
21 lbs. tanks & 8 lbs. mount

Pump Assembly



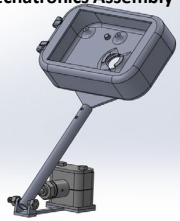
10.36 lbs. pump & 1.8 lbs. mount

Motor Assembly



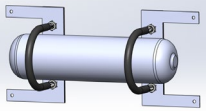
10.36 lbs. pump & 2.3 lbs. mount

Mechatronics Assembly



0.87 lbs.

Pneumatic Tank Assembly

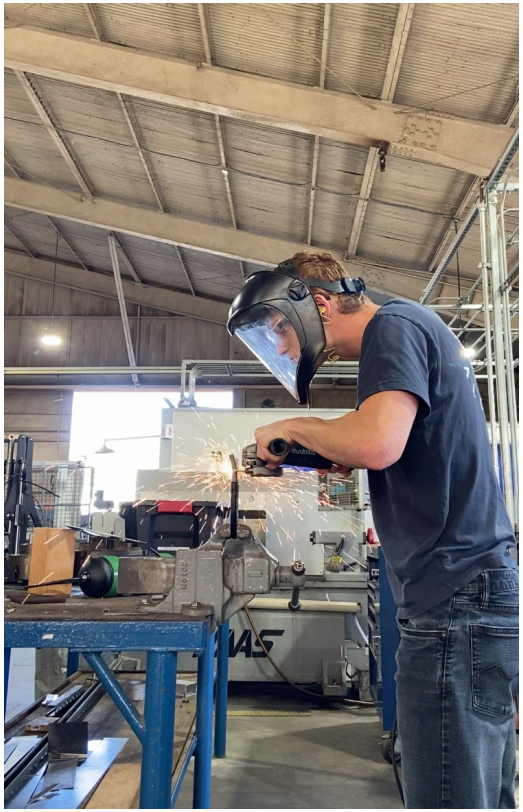


8 lbs. tank & 4 lbs. mount

Chains & Sprockets

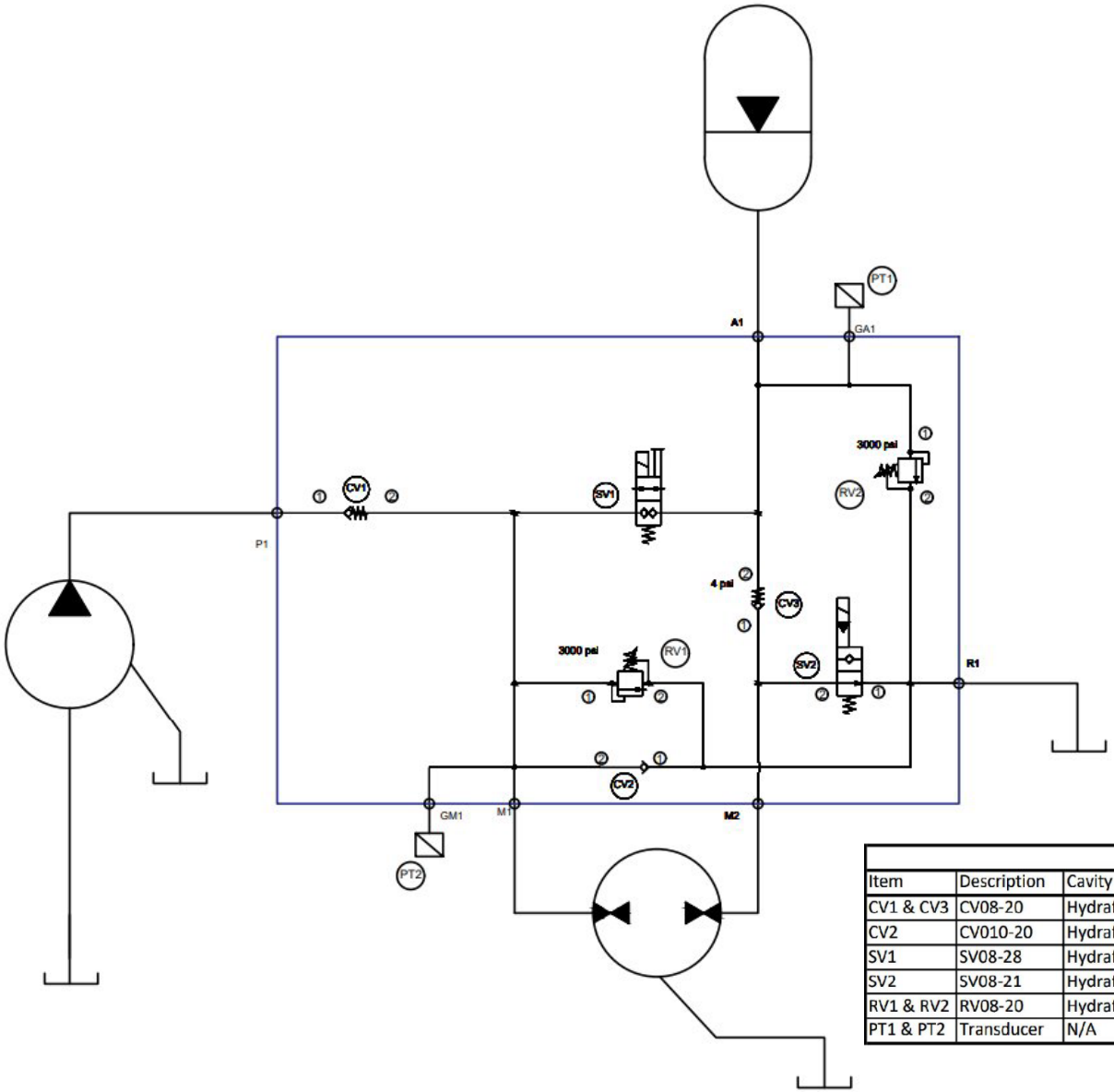
14.44 lbs.

Mounting Build/Installation



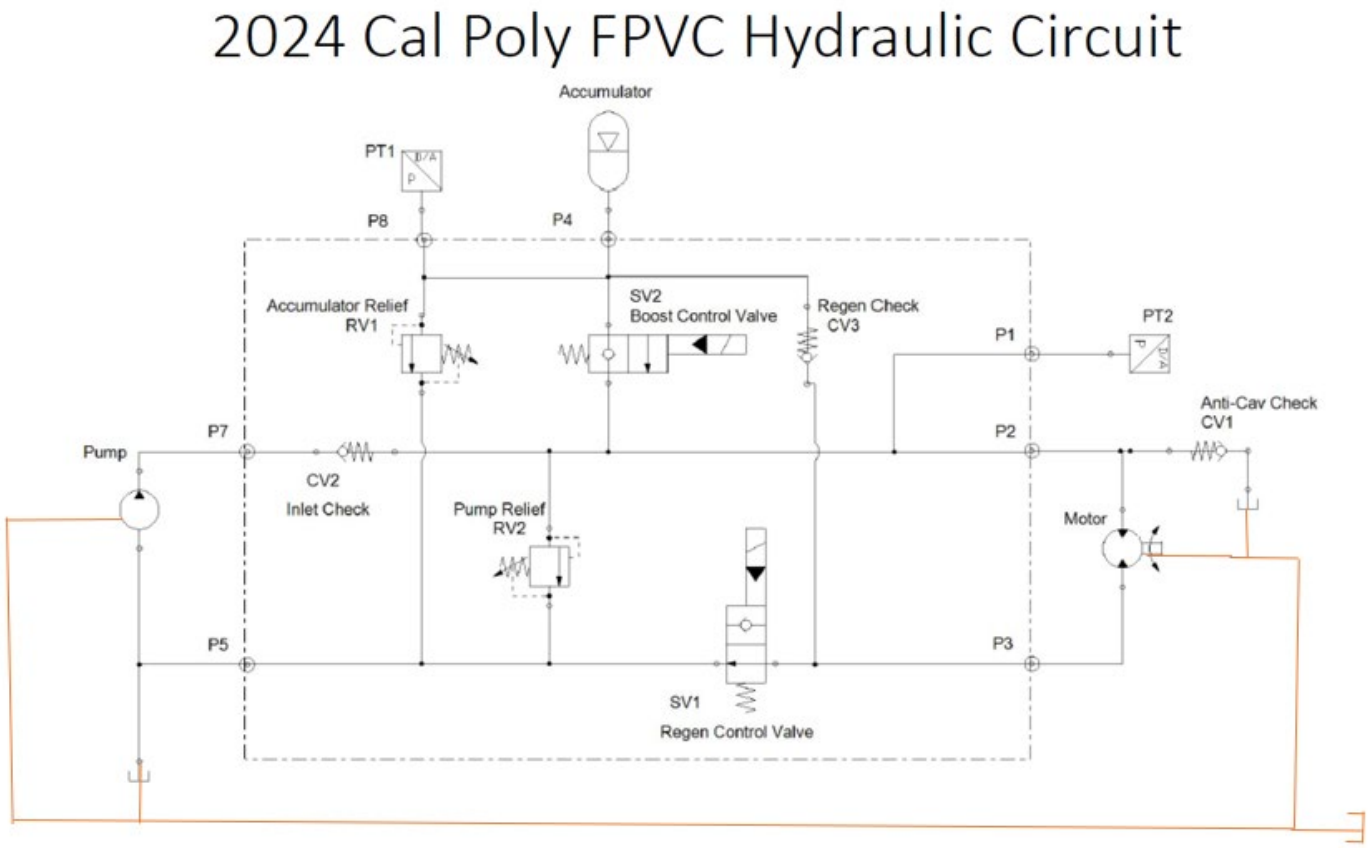
Hydraulic Circuit

2023 Cal Poly FPVC Hydraulic Circuit Design

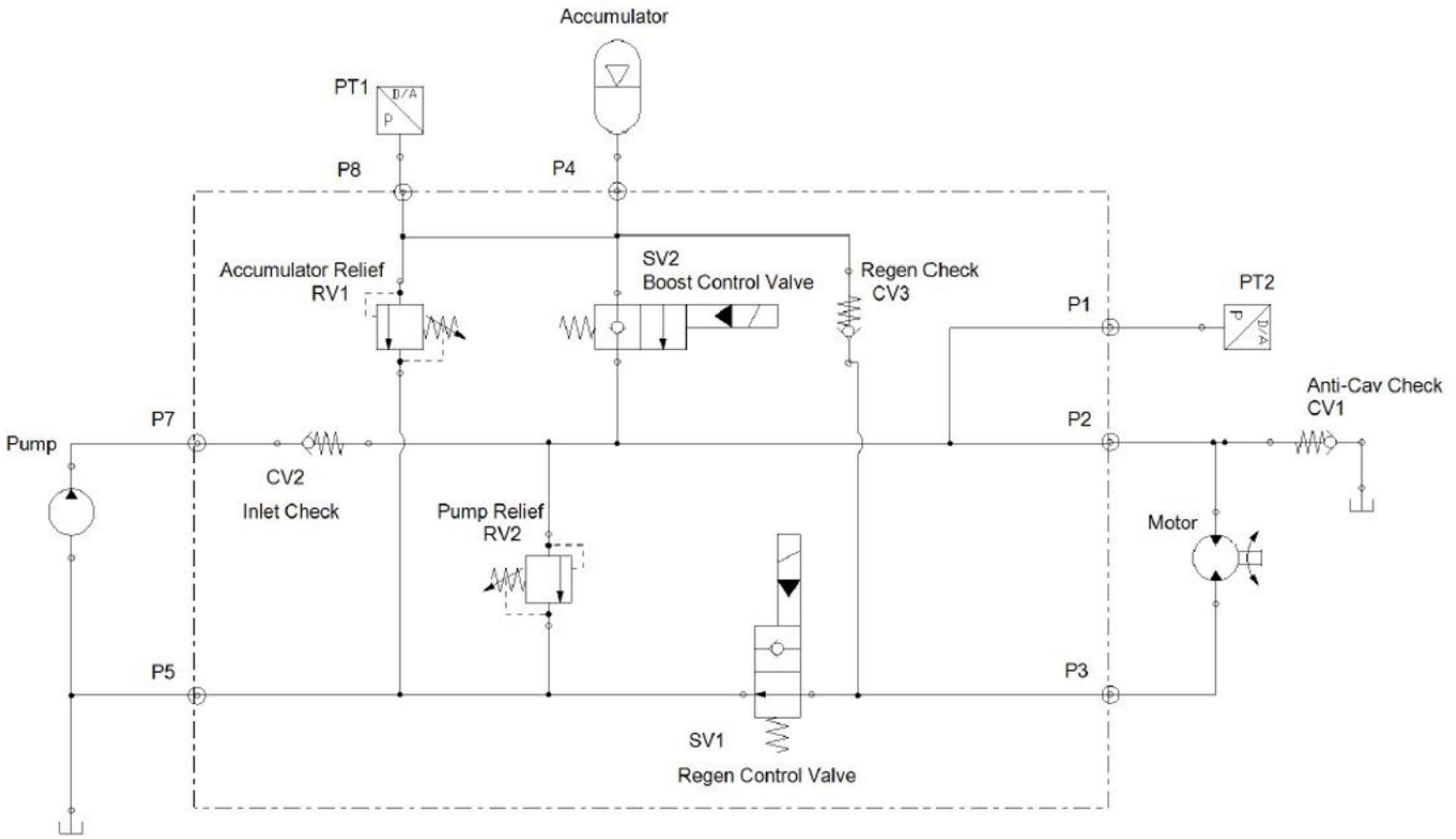


Cal Poly FPVC Valves			
Item	Description	Cavity	Note
CV1 & CV3	CV08-20	Hydraforce VC-08-20 or Equivalent	Cavity Only, Using cartridge from previous year
CV2	CV010-20	Hydraforce VC-08-20 or Equivalent	Cavity Only, Using cartridge from previous year
SV1	SV08-28	Hydraforce VC-08-20 or Equivalent	Cavity Only, Using cartridge from previous year
SV2	SV08-21	Hydraforce VC-08-20 or Equivalent	Cavity Only, Using cartridge from previous year
RV1 & RV2	RV08-20	Hydraforce VC-08-20 or Equivalent	Cavity Only, Using cartridge from previous year
PT1 & PT2	Transducer	N/A	Attaches to a SAE-6 port

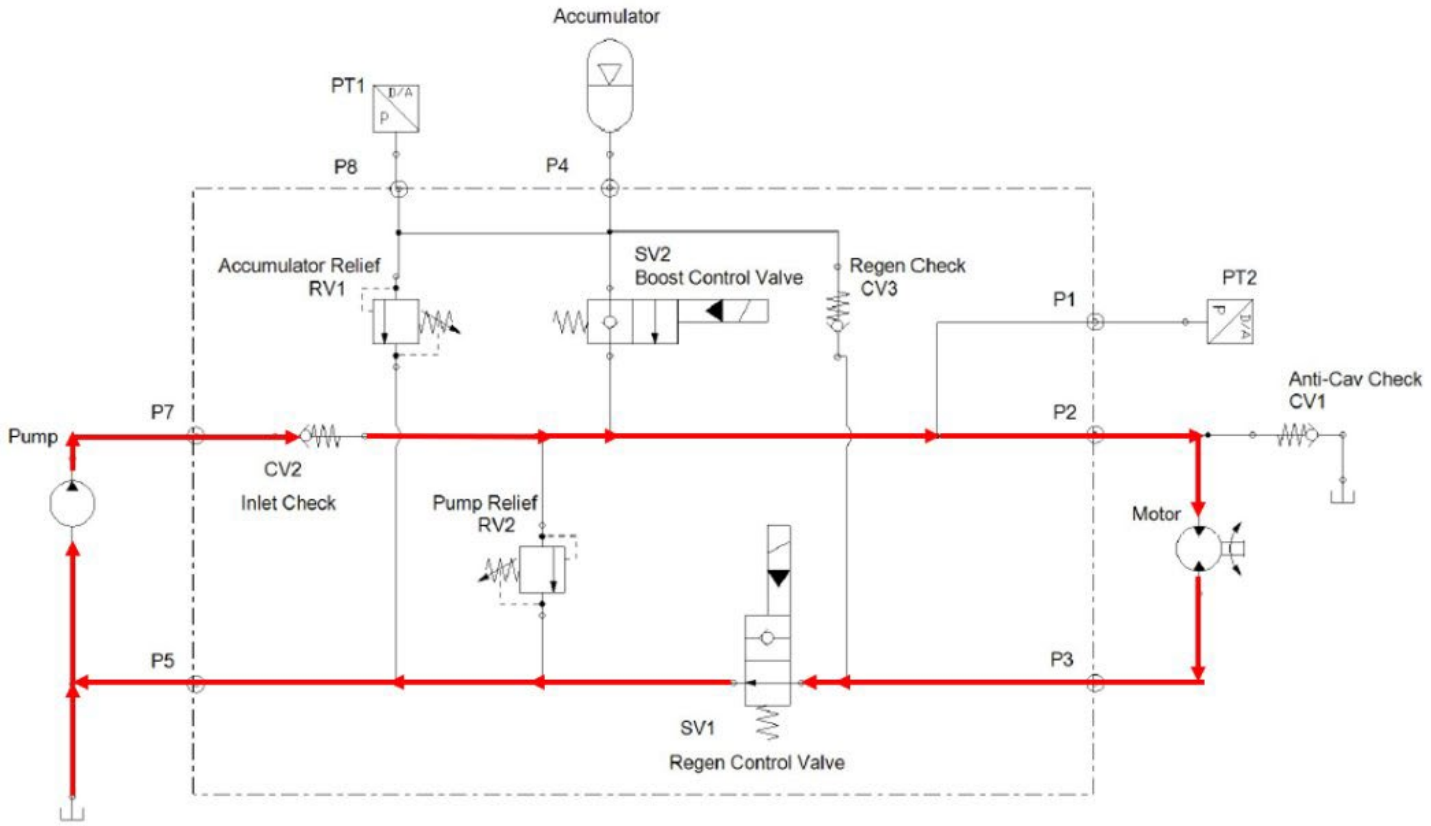
Hydraulic Circuit



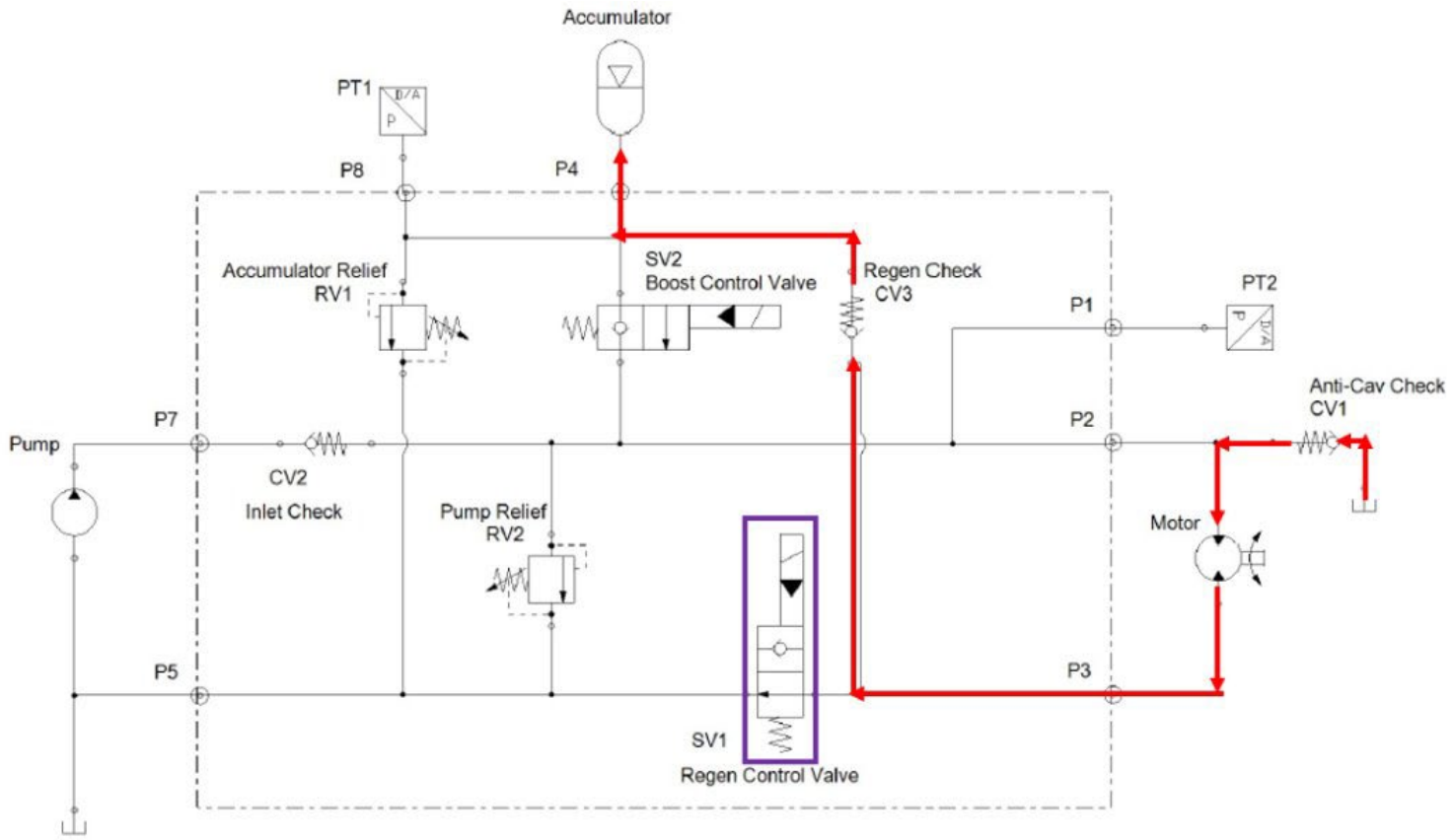
Hydraulic Circuit



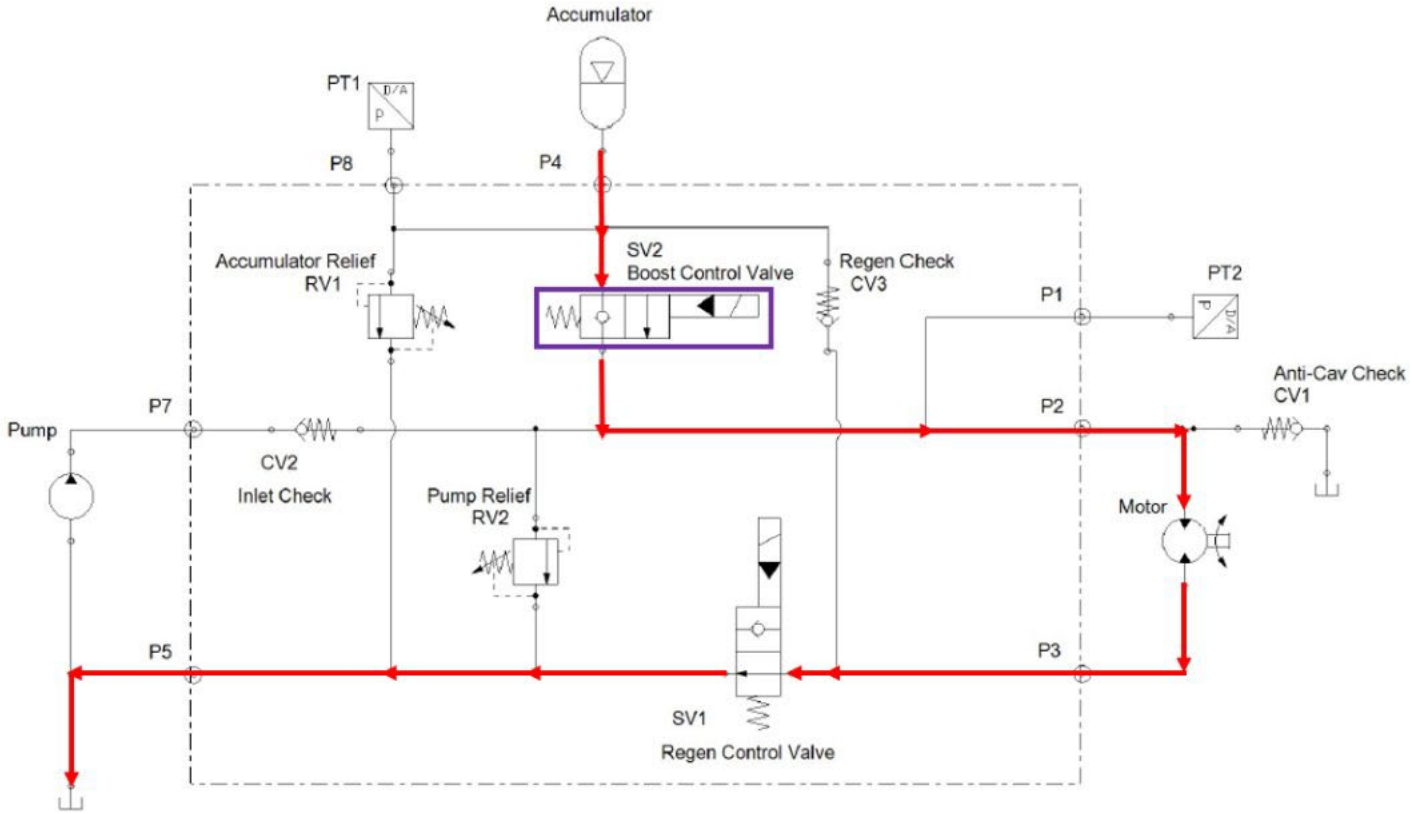
Direct Drive



Accumulator Charge



Accumulator Discharge



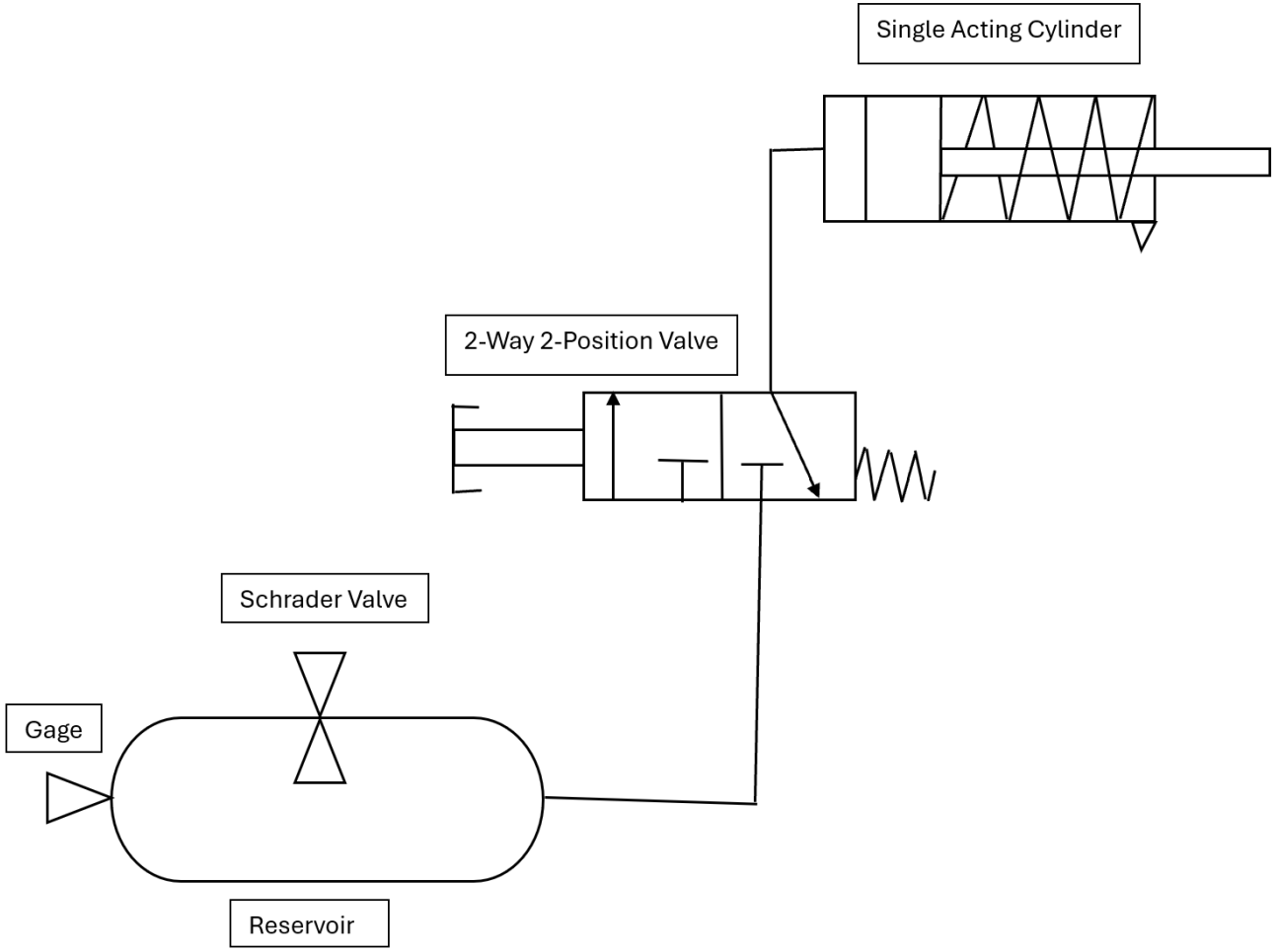
Hydraulic System

Hydraulics Troubleshooting

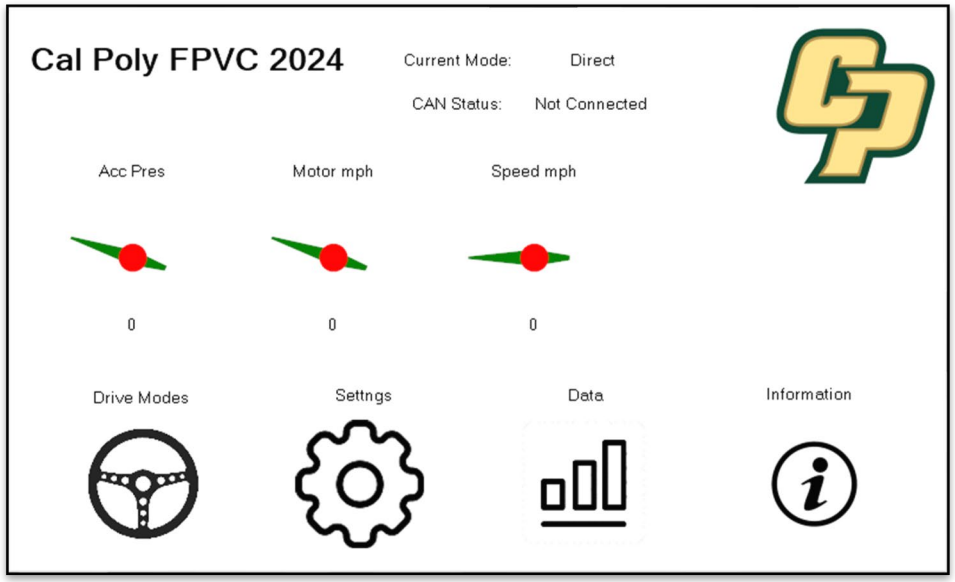
- Lack of pressure buildup in direct drive

Pneumatics

Pneumatics Schematic

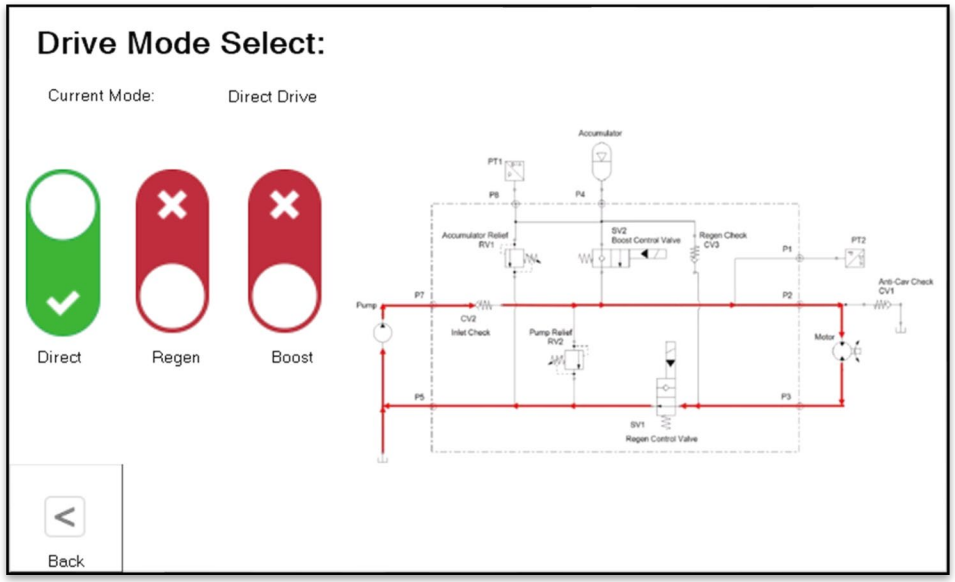


Mechatronics



- Home screen
- Important data
  - Speed
  - Pressure
- Easily accessible controls

- Drive mode Selection Screen
- Hydraulic circuit diagram
- Secondary Screen



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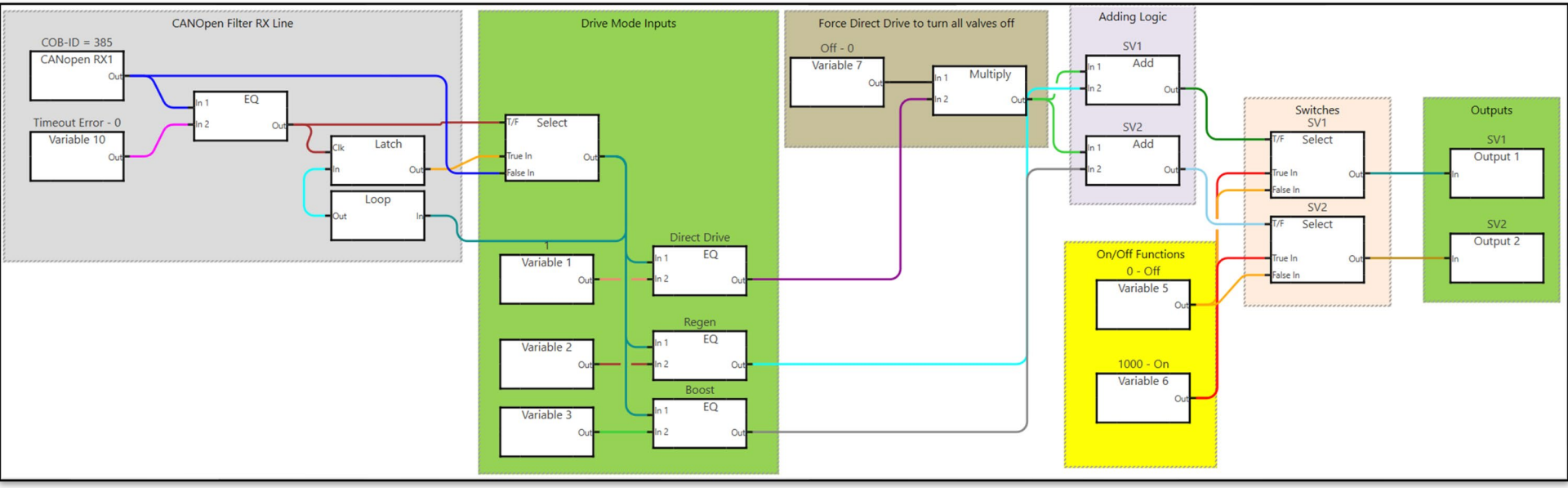
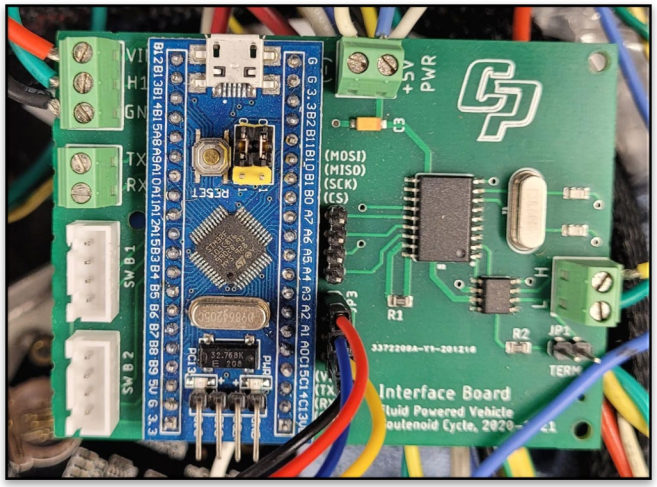
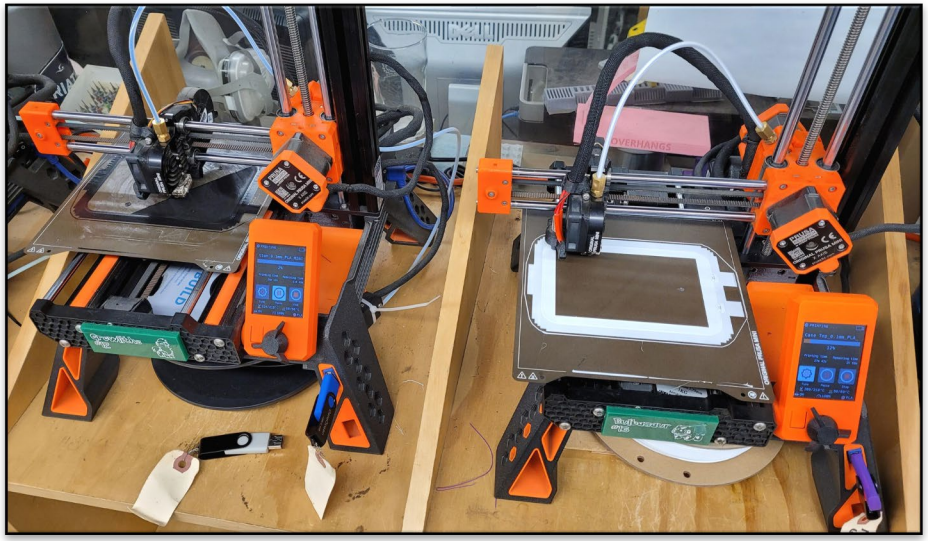


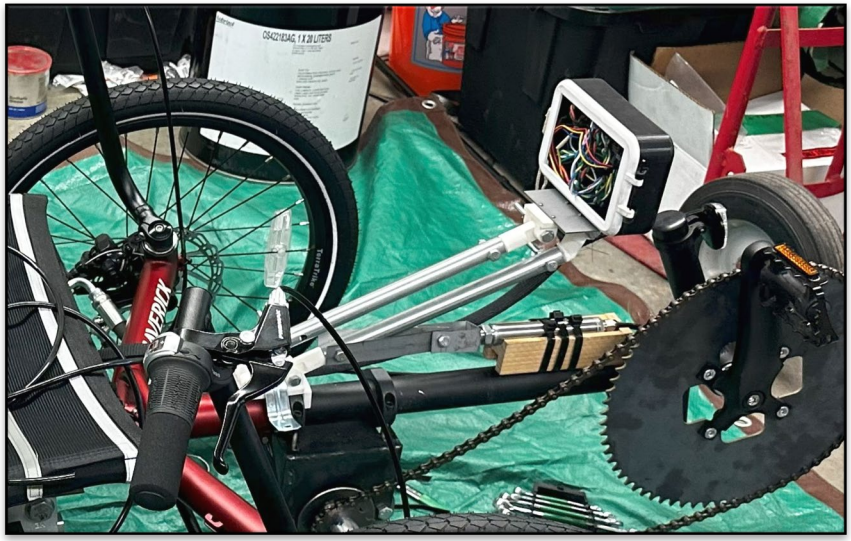
- Simplified Logic in HydraForce Impulse
- Two Outputs are the solenoid valves in the manifold
  - SV1 is normally open
  - SV2 is normally closed

Mechatronics

- STM32 Blue Pill
- Screen housing on a pneumatic mount
- Hall Effect Sensor







Testing Phase:

Test	Results	Improvements
Endurance Race	Test: We drove one mile Mile time: 10:42 Average speed: 5.9 mph (Last year's model: Average Speed: 0.716 mph)	Chain tension on the bike is important during the direct drive.
Sprint Race	Fastest 500 ft that we travelled 39 seconds	More pressure the better the bike performs. Faster acceleration and top speed.
Efficiency	Boosted with 1700 psi, 2000 psi, 2500 psi. Corresponding distances were 500 ft, 600 ft, and 800 ft. 10 – 15% efficient	Pressure higher than 2000 psi gives more distance per psi than under 2000 psi. So more pressure is better

Lessons Learned

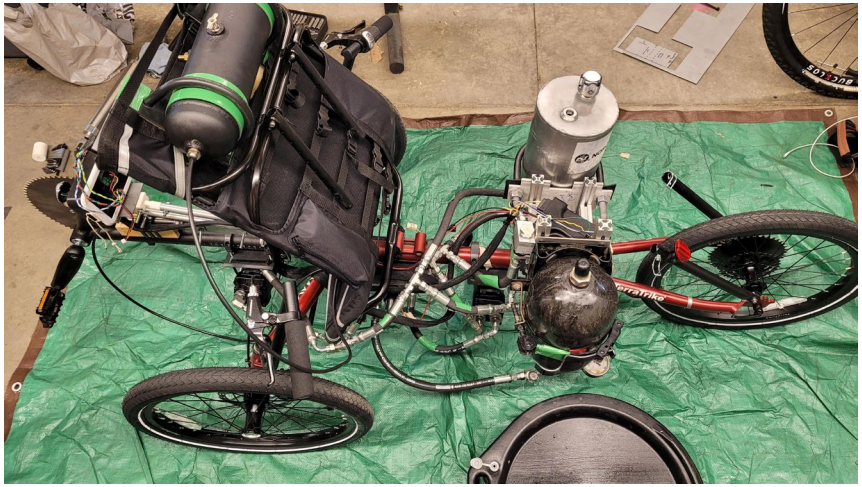
- Tasks will take longer than you think
- An organized workspace makes working on the vehicle much easier
- Oil cleanup
- Expect delays when ordering parts
- Chain tensioning in power transfer system
- Removing air from hydraulic lines
- Pump & motor mount integrity is crucial
- Don't be afraid to ask for help

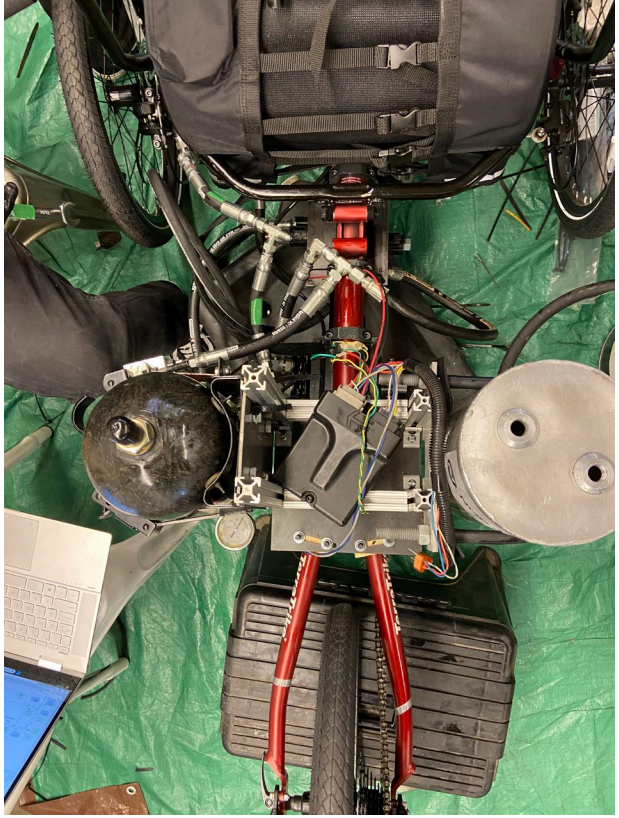
Recommendations

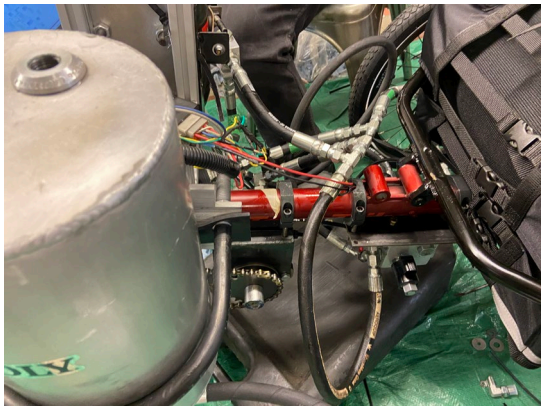
- Major improvements can be made to gearing of power transfer system
- Implementation of proportional control solenoid valve for accumulator discharge
- Hard lines should be implemented in hydraulic tubing
- Optimize pre-charge settings
- Improve mechatronics user interface

Questions?

NFPA Fluid Power Vehicle Challenge







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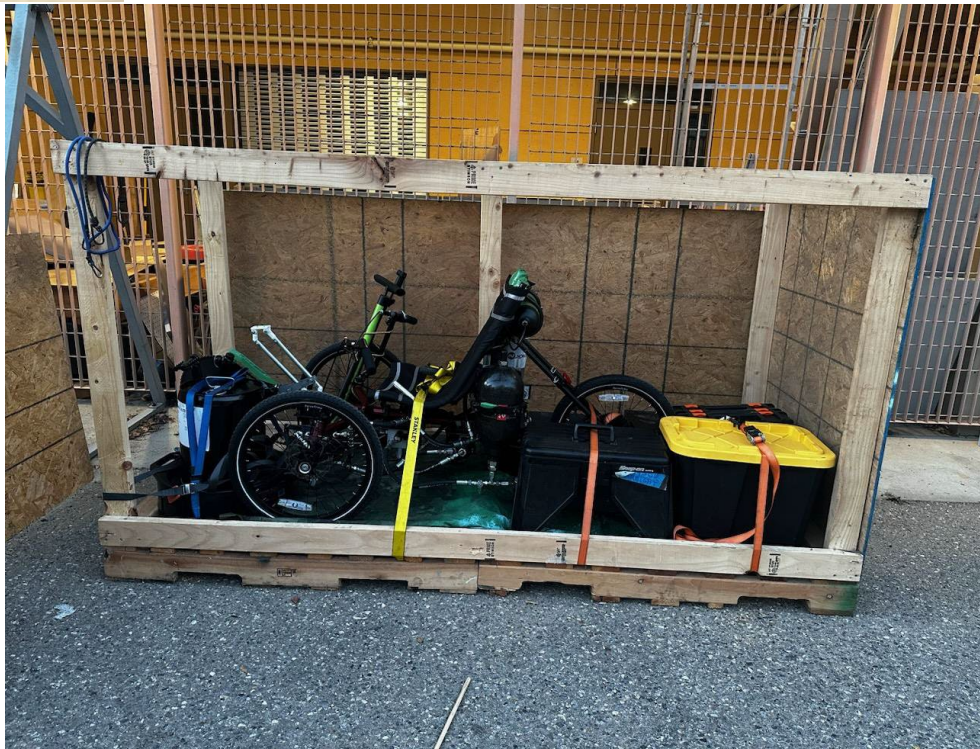

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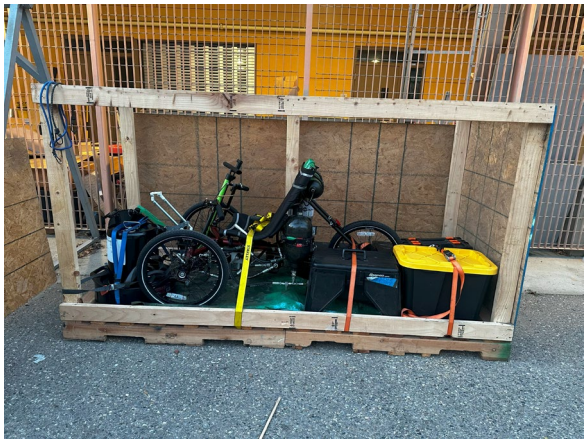
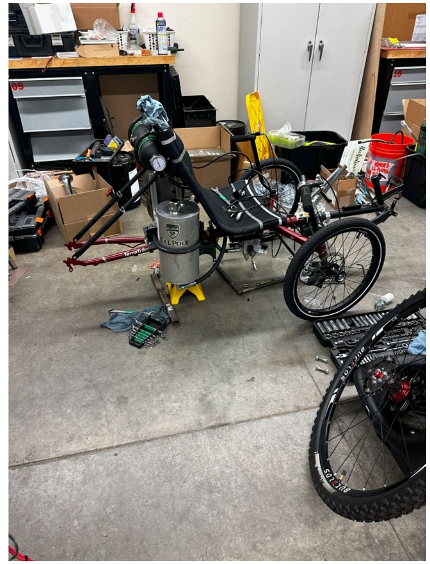
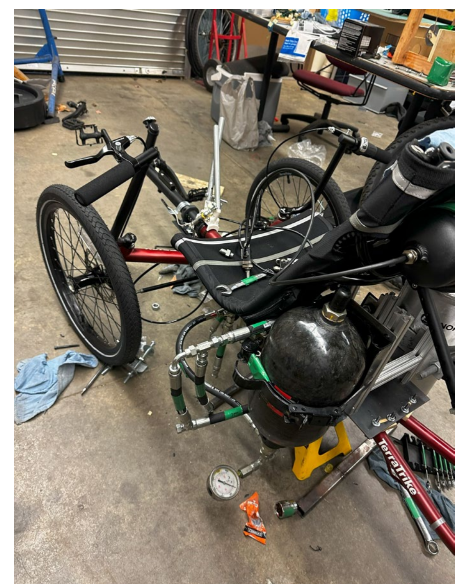


NFPA Fluid Power





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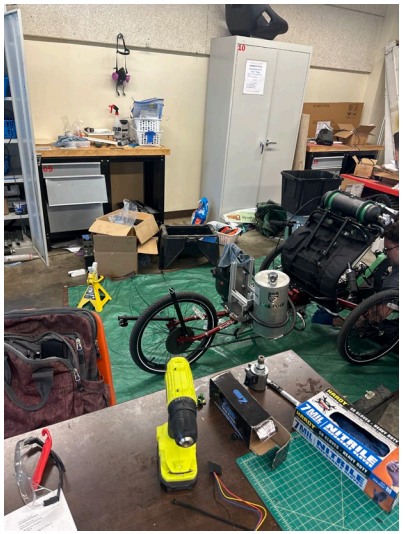

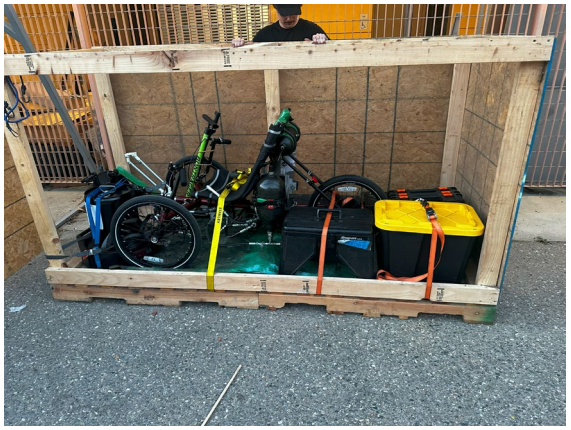

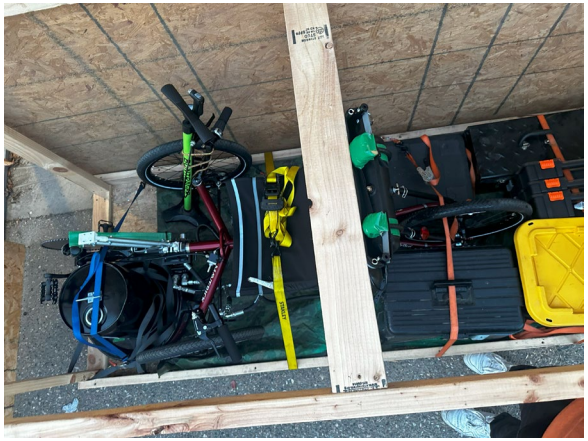

NFPA Fluid Power Vehicle Challenge

Rubric

- Informational Only

FINAL PRESENTATION	Poor	Moderate	Good	Very Good	Excellent
Vehicle construction was completed on time and performed mostly by the team members.	1	2	3	4	5
Vehicle testing was performed, and improvements were made based on the results.	1	2	3	4	5
Final vehicle brought to competition appears reliable, safe, and of quality craftsmanship.	1	2	3	4	5
Lessons learned are clearly stated and appropriate to the design/build experience described.	1	2	3	4	5
Presentation clearly demonstrates an **understanding of how design choices contribute** to vehicle performance.	1	2	3	4	5
Returning teams must include prior year's hydraulic and pneumatic circuit design schematic and show how the current year's schematic is different.					

Informational Only
Delete for Final Presentation

- Refer to the FPVC assessment rubric for specifics.
- All team members are expected to contribute during the presentation
- The Final Presentation is expected to be of high quality, well-rehearsed, touching on the high-level aspects of the project. Avoid getting too far “into the weeds.”
- This will be combined with the Vehicle Design Review.
- Length: Strictly adhere to a 15-minute presentation.
- Judges will allow for 10 minutes of Q&A, but no more than 25 minutes will be allotted for the presentation and the Vehicle Design Review.

Agenda
Informational Only

- Team Introductions (include photo)
- Vehicle construction
  - Completed on time and performed mostly by the team members.
- Vehicle testing
  - Was performed and improvements were made based on results
- Final vehicle brought to the competition
  - Appears reliable, safe and of quality craftsmanship
- Lessons learned
  - Are clearly stated and appropriate to the design/build experience described
- Presentation
  - Clearly demonstrates an understanding of how design choices contribute to vehicle performance
  - Returning teams must include prior year's hydraulic and pneumatic circuit design schematic and show how the current year's schematic is different.