NFPA Fluid Power VEHICLE Challenge

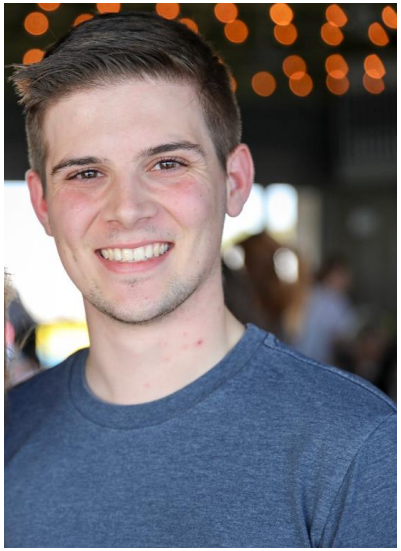
NFPA Education and Technology Foundation

Final Presentation
University of Louisiana at Lafayette
Advisor: Yasmeen Qudsi
April 15, 2021

UNIVERSITY of LOUISIANA LAFAYETTE

Meet the Team

John Parker Furman
Team Captain
Communications



Christopher Bertrand
Pneumatics
Finances

Jacob LaBerteaux
Electronics
Documentation

Tristan Jeansonne
Hydraulics
Manufacturing

Faculty Advisor: Yasmeen Qudsi, UL Lafayette Dept. of Mechanical Engineering
Industry Mentor: Aaron Darnell, Danfoss Power Solutions

Problem Statement

Create a functional fluid powered vehicle to compete in the FPVC final competition while creating a solid foundation for future UL Lafayette FPVC teams.

Project Objectives

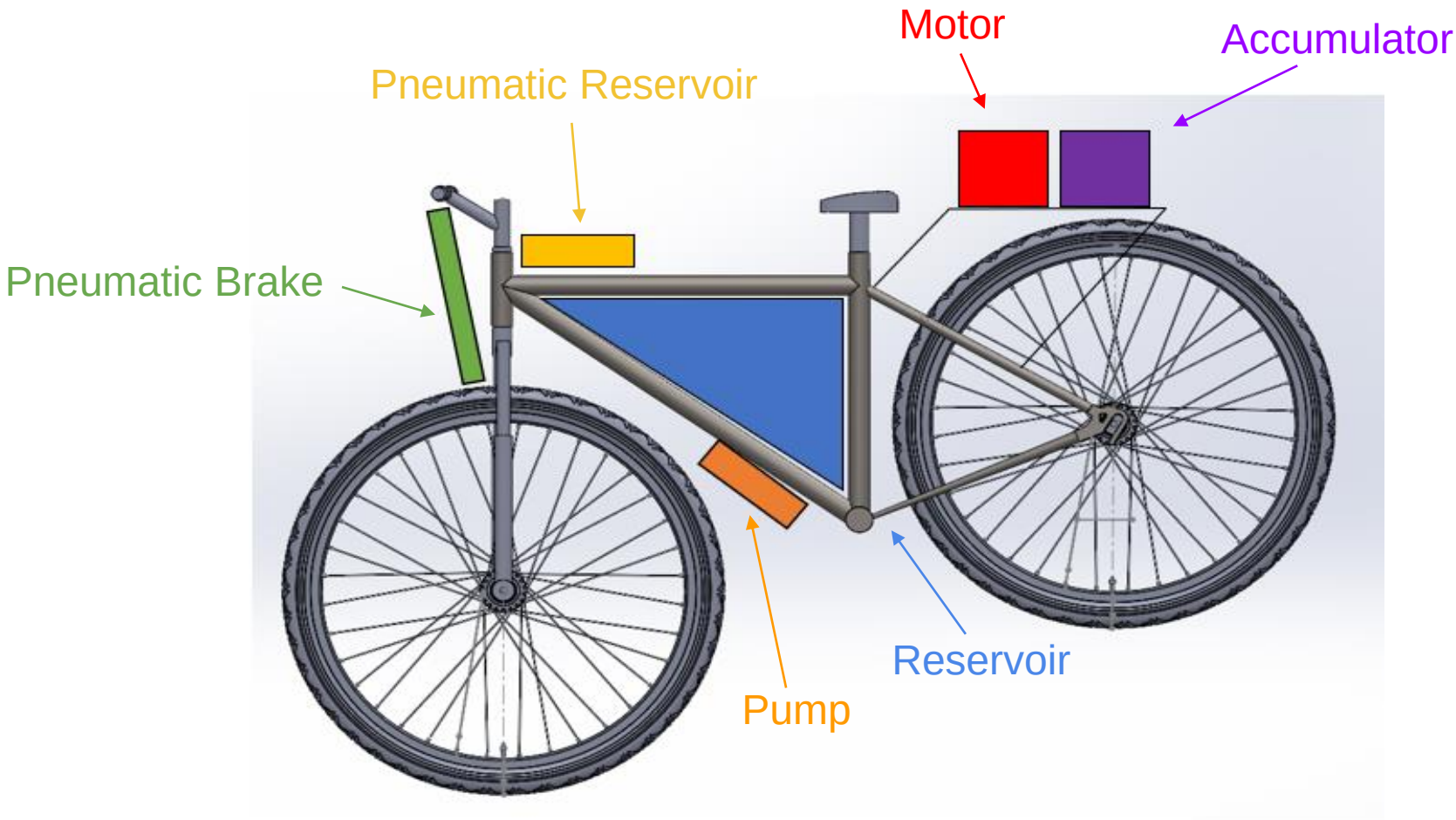
- Remain within budget
- Qualify for final competition
- Keep quality documentation for future teams
- Spread awareness for fluid power
- Use efficient & effective design practices

Design Objectives

- Create a functional vehicle
- Create a safe final product
- Create a vehicle future teams can improve upon
- Keep vehicle weight under 210 pounds
- Create a visually appealing product

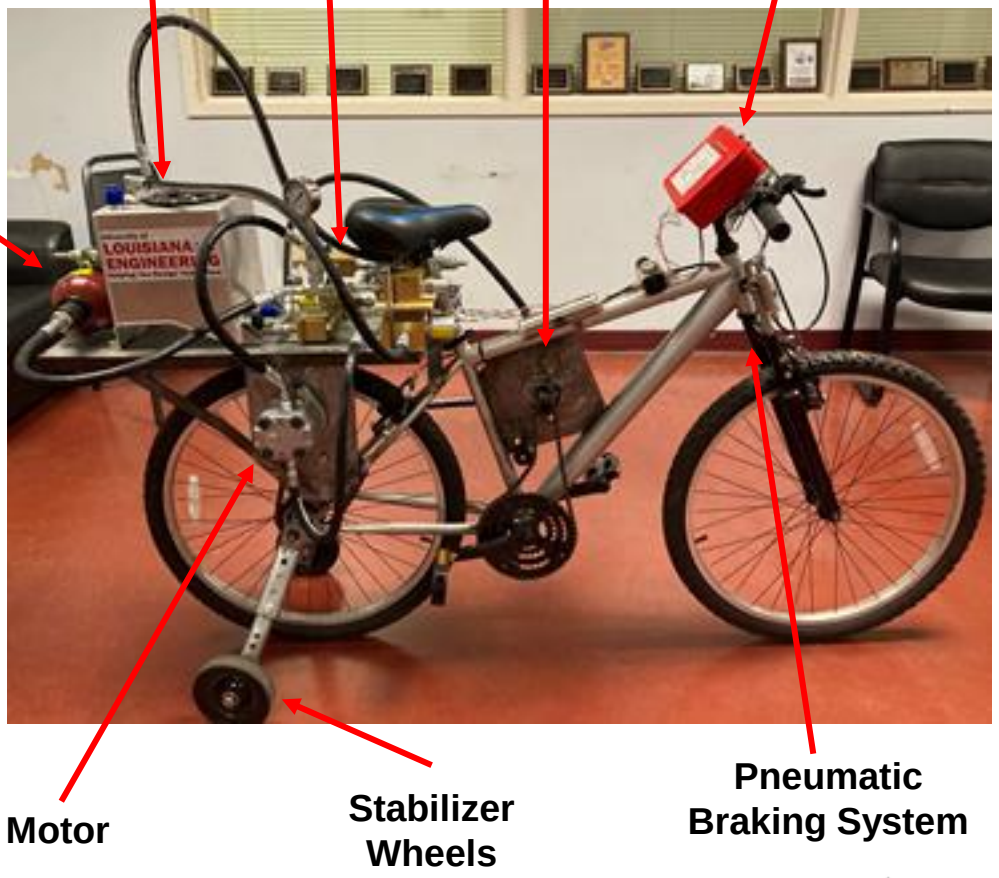
Midway Summary

Midway Vehicle Design

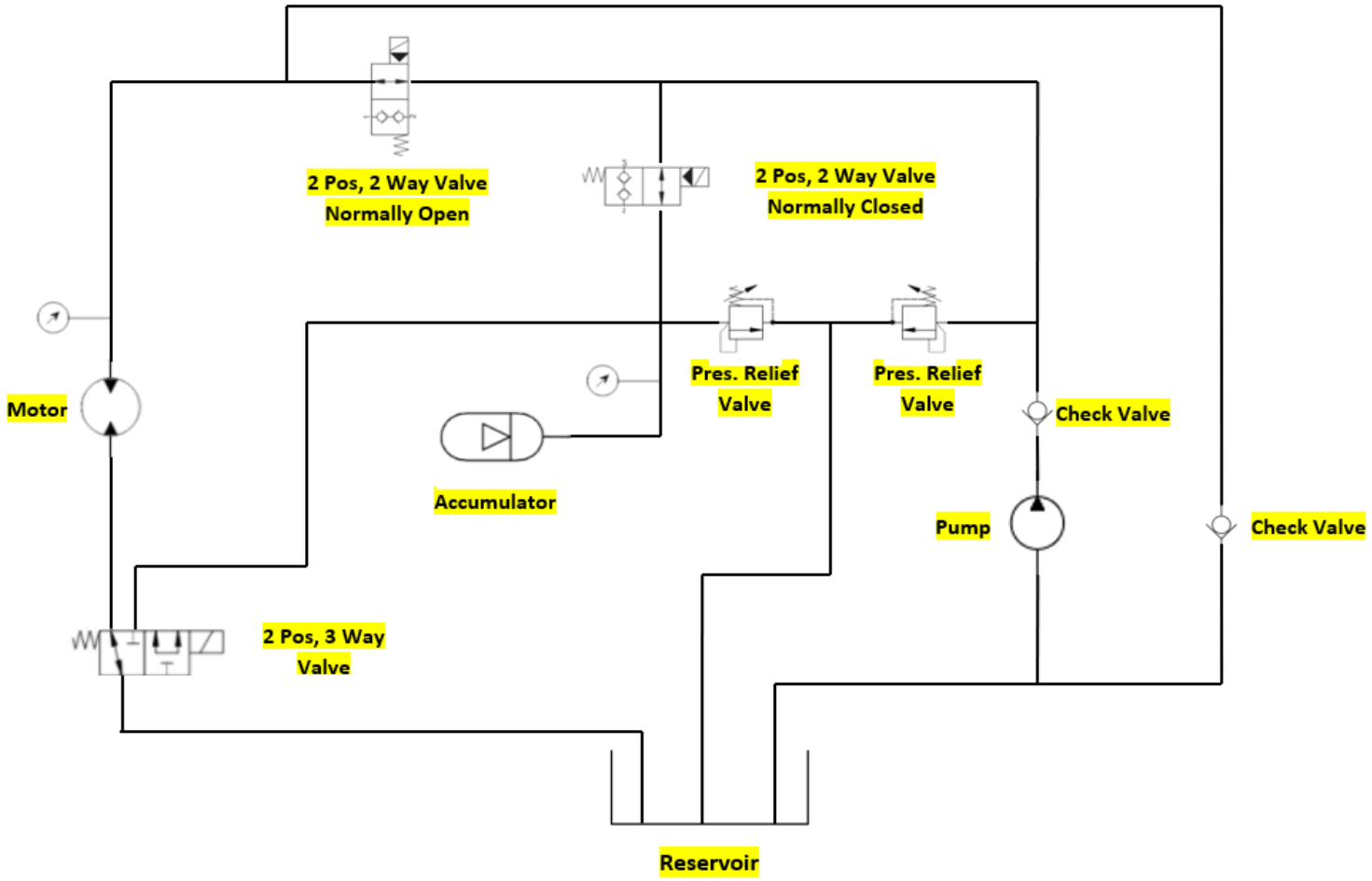


Final Vehicle Design

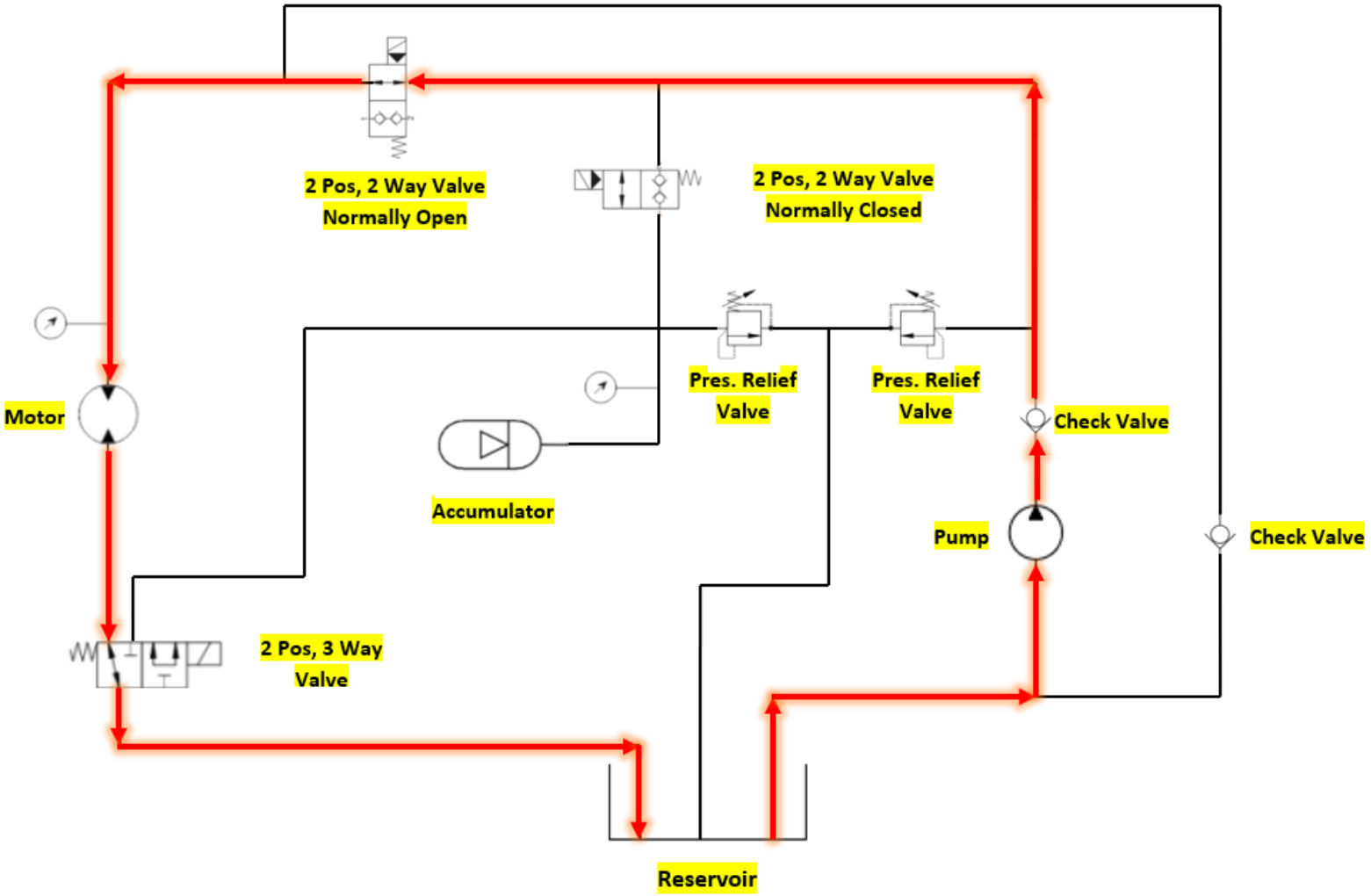
- Repositioned the tank to the rear platform
- All valves were mounted to the rear platform
- The motor was mounted above the back wheel sprocket
- Pump moved to a more central location
- Installed phone mount on handlebars
- Installed stabilization wheels



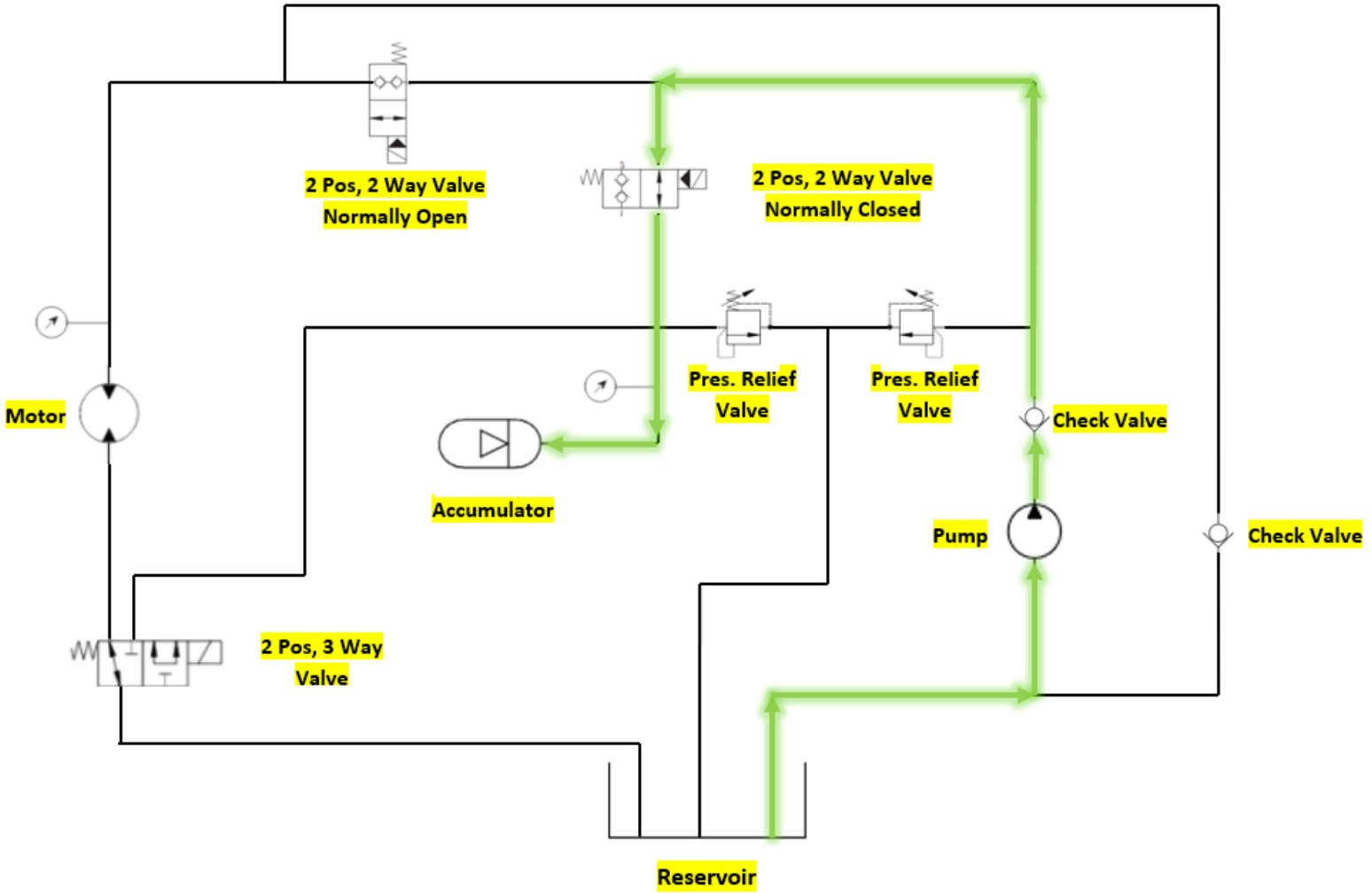
Fluid Power Circuit Design



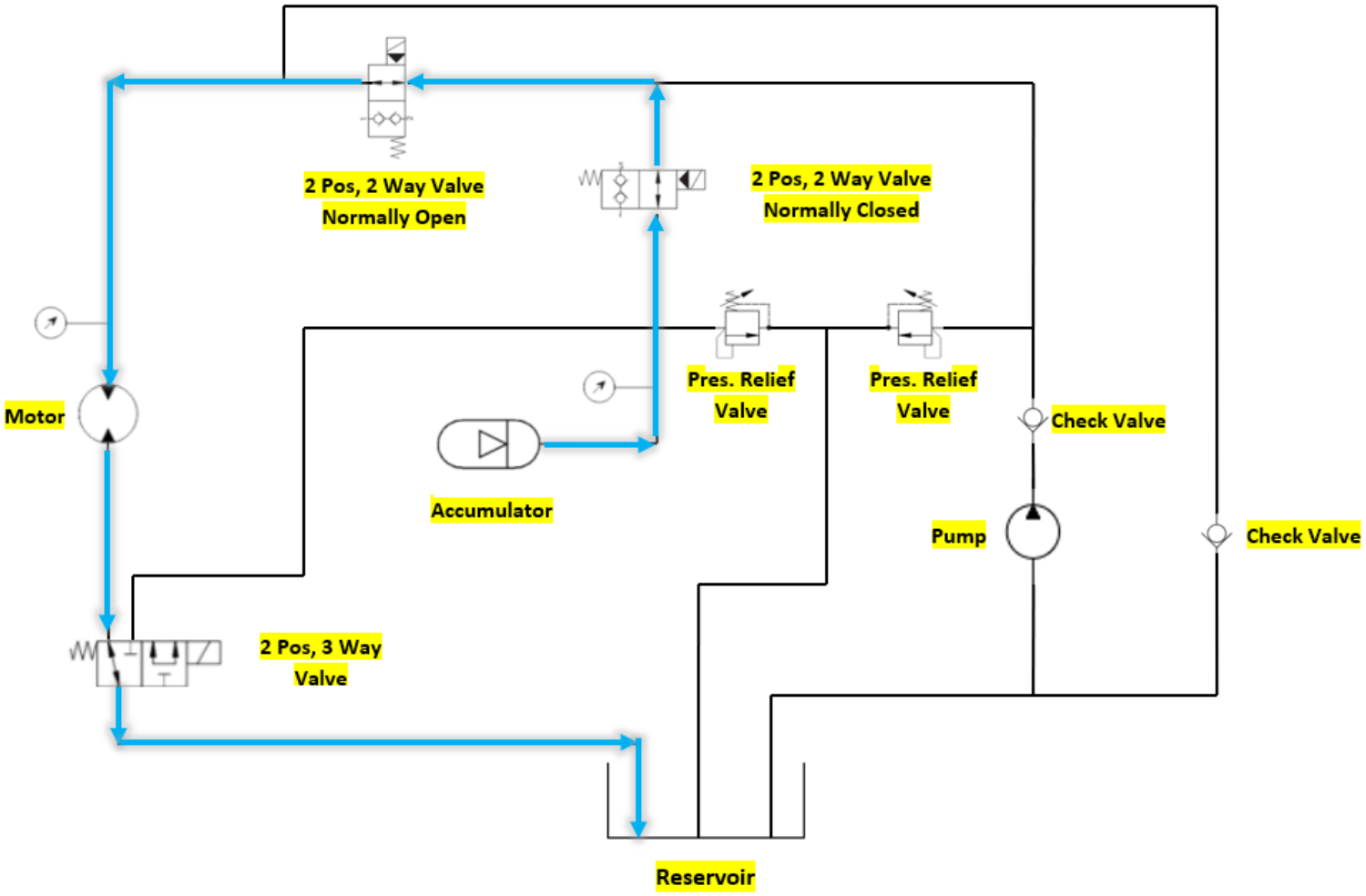
Direct Drive



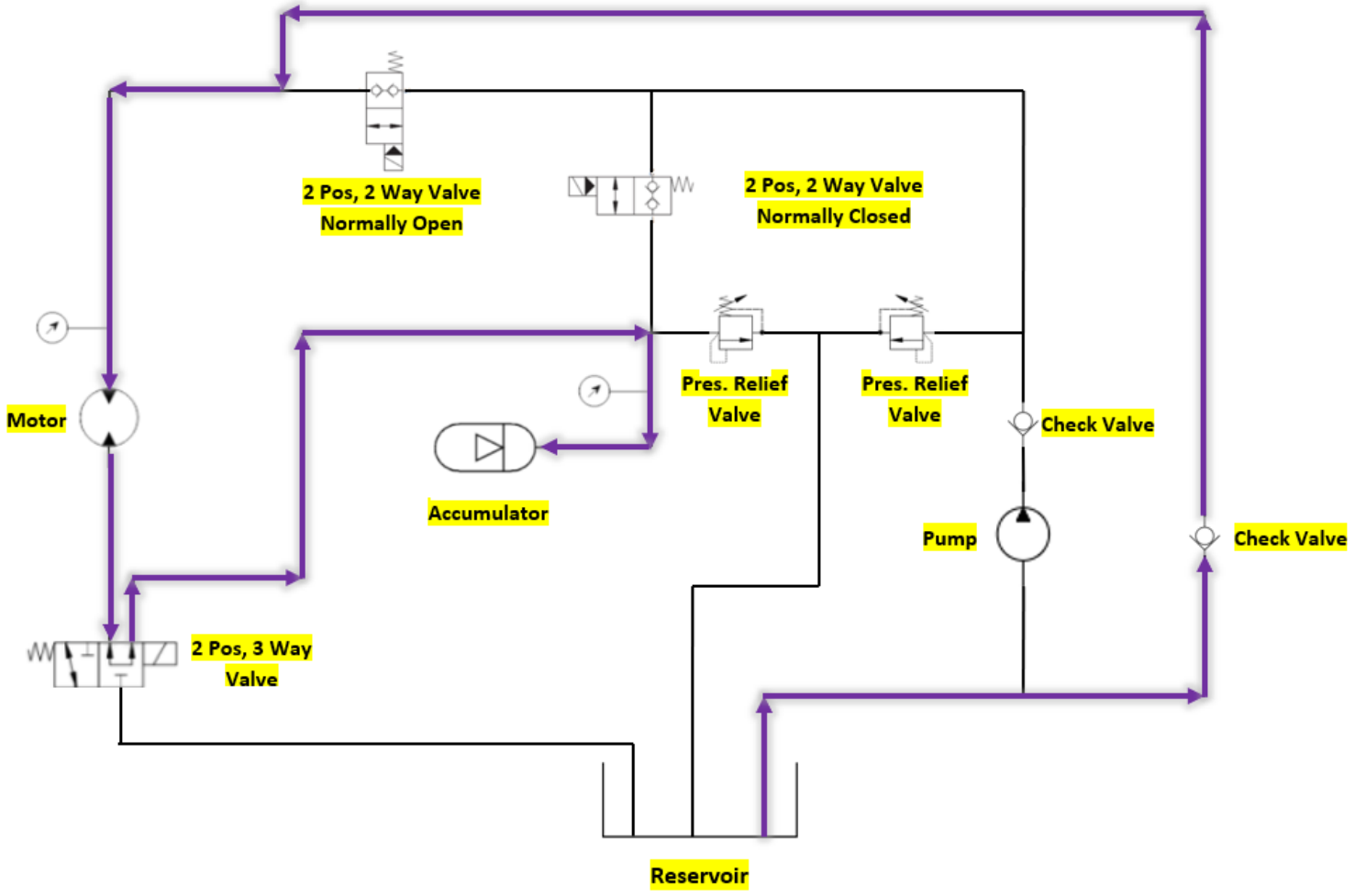
Accumulator Charge



Accumulator Drive

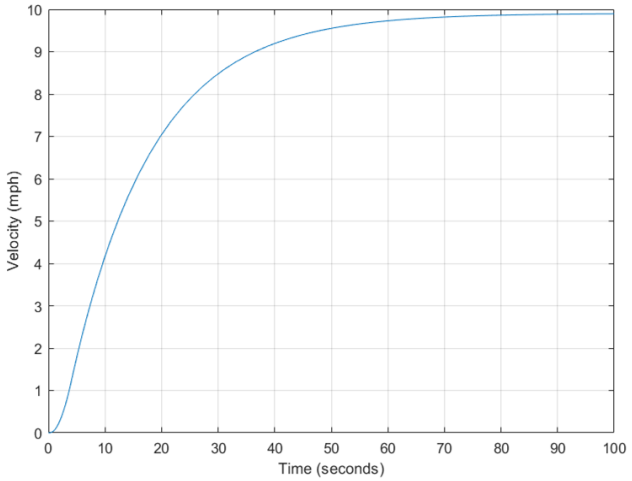


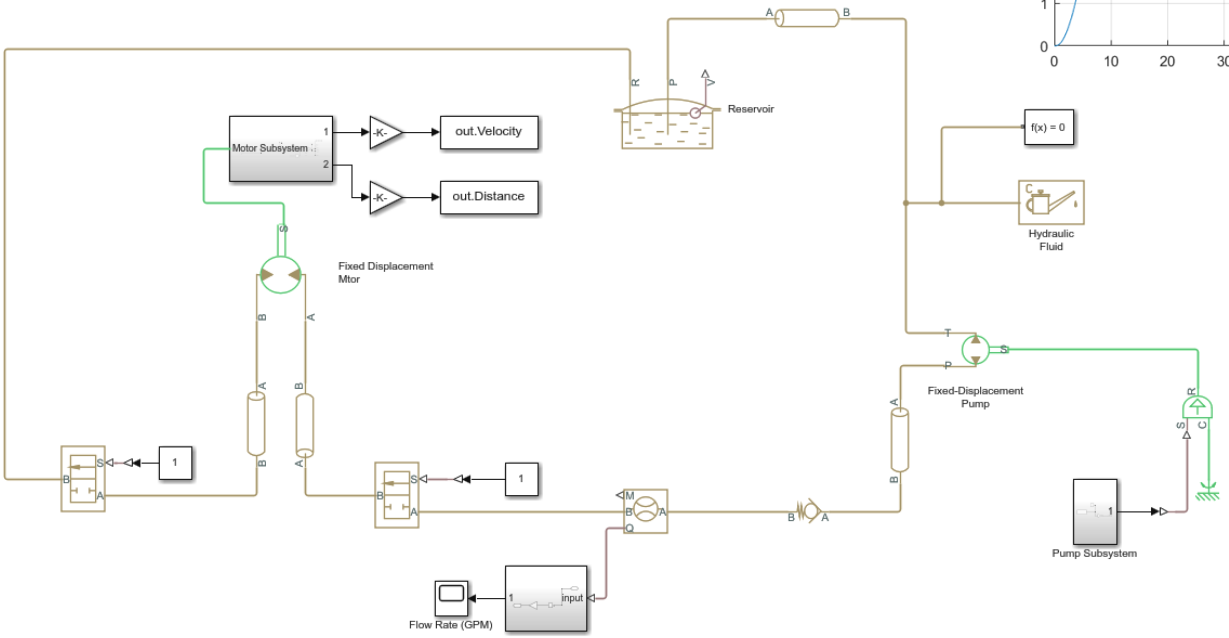
Regenerative Braking



Analysis

- Predicted Performance using Simscape Fluids
  - Tested various gear ratios
  - Observed system flow rate
  - Speed and distance
  - Accumulator pre-charge

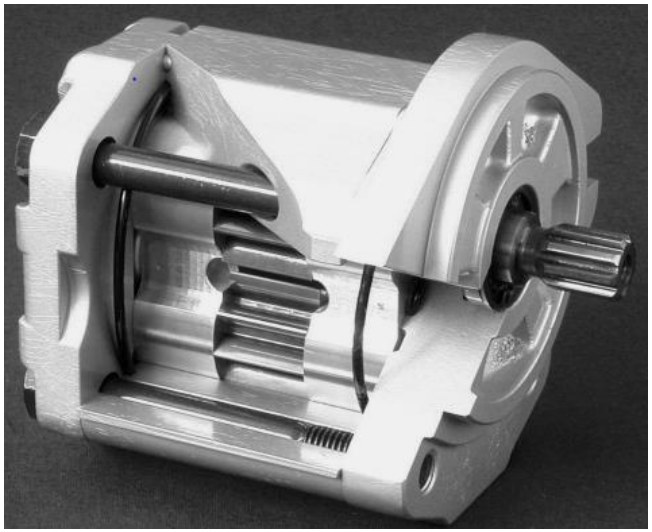




Component Selection

Gear Motor

- 0.513 CID, Keyed Shaft .625”, Bi-rotation



(Danfoss)

Gear Pump

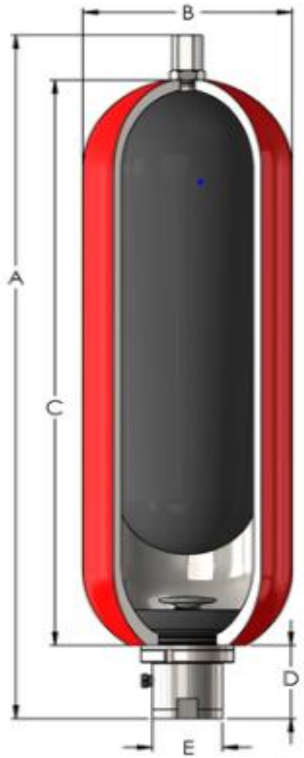
- 0.58 CID, 9 tooth spline, CW rotation
- Fixed Displacement

(Eaton)

Component Selection

Bladder Accumulator

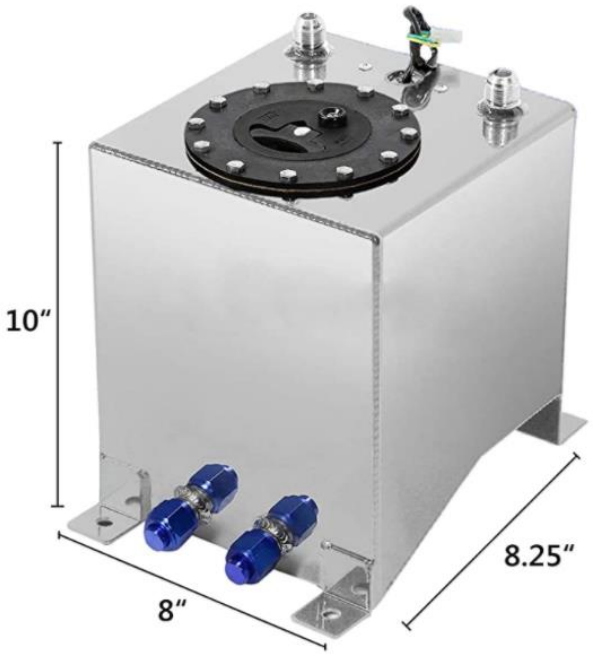
- 1 Quart Volume
- SAE -12 Port



(Accumulators Inc.)

Reservoir

- Prefabricated Tank
- 2.5 gallons

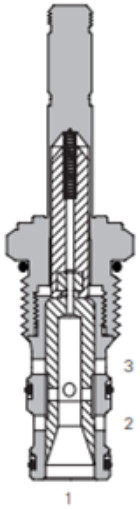


(Superfast Racing)

Component Selection

Valve Type

- Eaton Solenoid Valves with required line bodies
- One 2 pos, 2 way normally closed
- One 2 pos, 2 way normally open
- One 2 pos, 3 way spool
- Two pressure relief valves



(Eaton)

Hoses

- Eaton Aeroquip GH663-6, 3000 psi rated

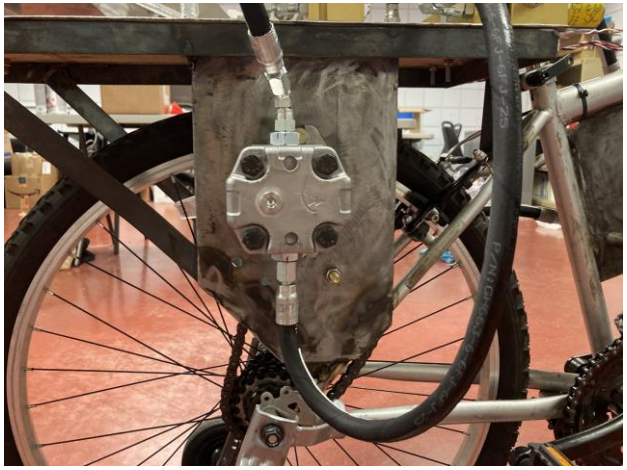
- All hoses are size -6 with required JIC fittings/adaptors

(Eaton)

Vehicle Construction: Rear Platform

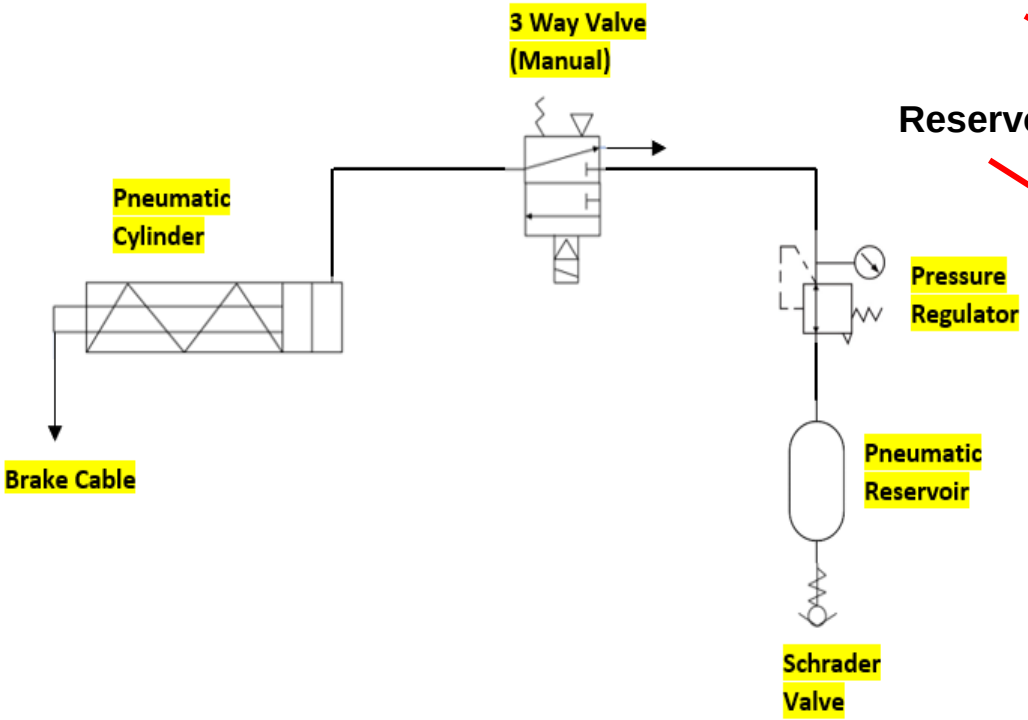
Vehicle Construction:

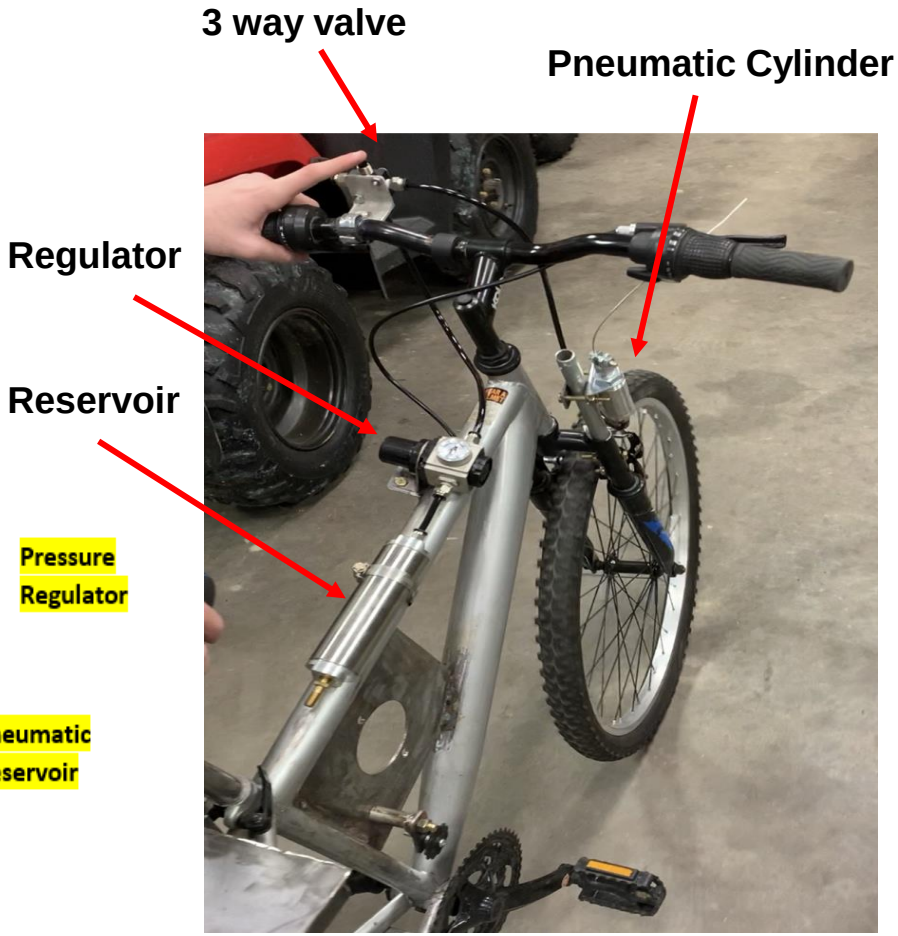
Pump/Motor Mount & Chain Tensioner



Vehicle Construction: Pneumatic Braking

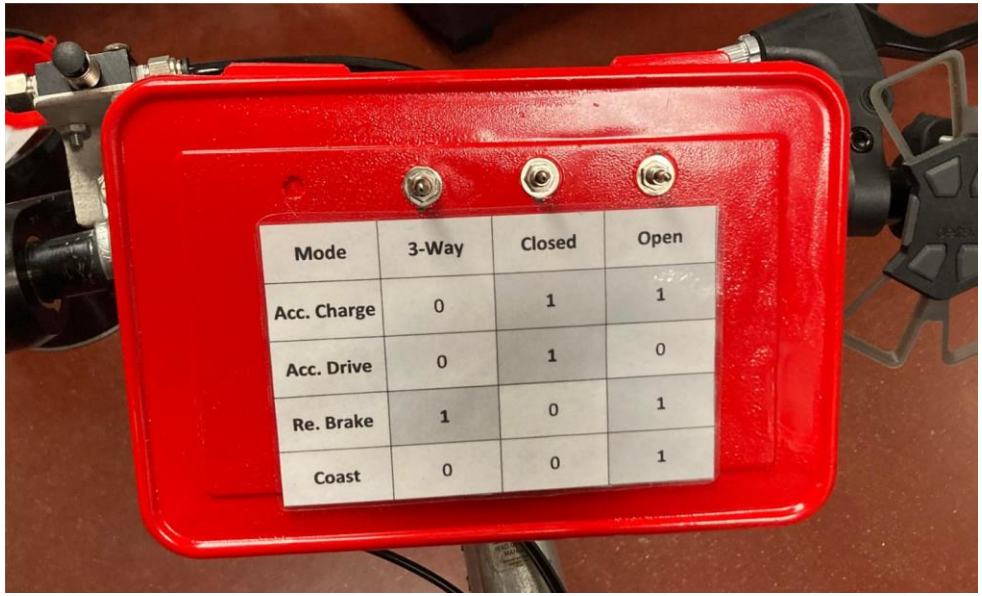
- Approximately 10 actuations
- Adjusted brake pads to reduce clamping force





Vehicle Construction: Electronics

- All wire connections were soldered together or screwed in
- Box was velcroed and zip tied to handlebars
- Changed to a 12V drill battery



Vehicle Performance

- Sprint Race
  - Quickest time: 44.10 seconds
  - Top speed: 11 mph
- Efficiency Challenge
  - Maximum distance: 242.7 feet
  - Rider weight: 150 lbs
  - Vehicle weight: 125.16 lbs
  - System pressure: 2150 psi
  - Nitrogen pre-charge: 200 psi
  - Highest calculated efficiency: 10%
- Endurance Challenge
  - Did not complete due to freewheel mechanism preventing regenerative braking

Lessons Learned

- Order components as early as possible
- Consider a manifold
- Component placement on a two wheel bike is challenging
- Use tubing for a sleek appearance
- Torque requirements
- Replace freewheel mechanism
- People love asking questions about fluid powered vehicles

Acknowledgements

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Thank You for Attending Today's Presentation