# NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

**FINAL PRESENTATION**

**Michigan Technological Univ.**
**Advisor: Dr. Dave Wanless**

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# Team Introduction

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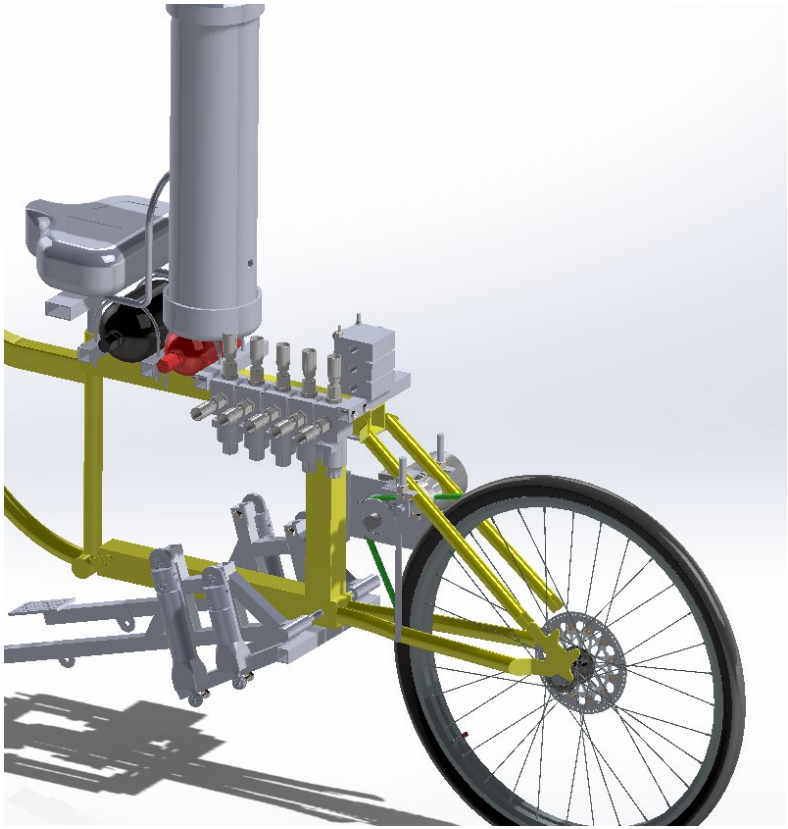
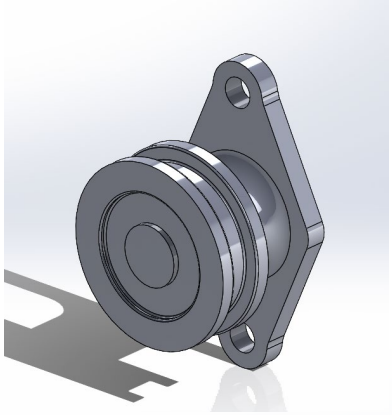
# Key Design Choices

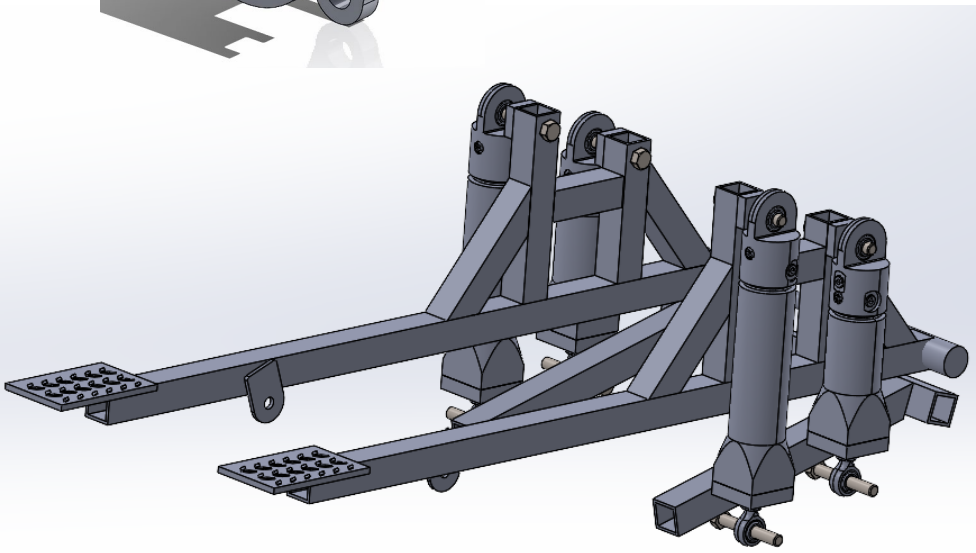
- Pump Action Pedals
- Dual Rim Pulley System
- Motor Mount
- Accumulator attachment
- Relief/control valve attachment
- Tensioner

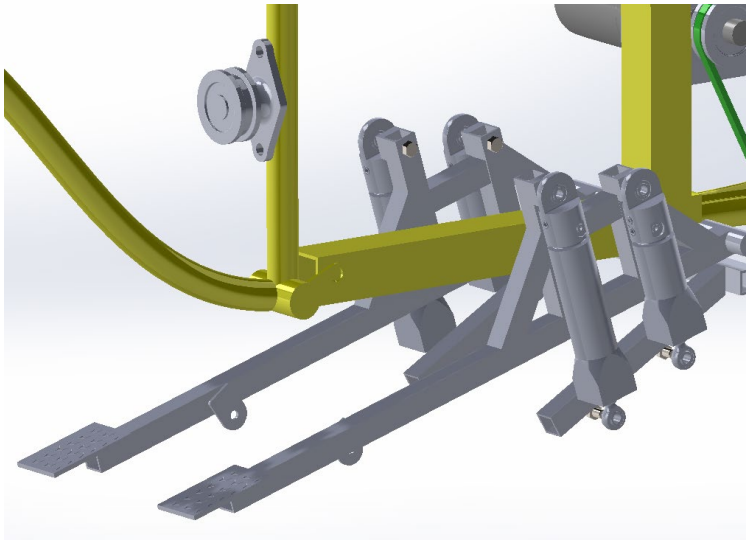


# Pedal Design

- Small piston 3.8 inches from axis of rotation
- Pedals are 28” long from axis
- Aluminum square stock for lightness
- Steel wire on a pulley for pedal return

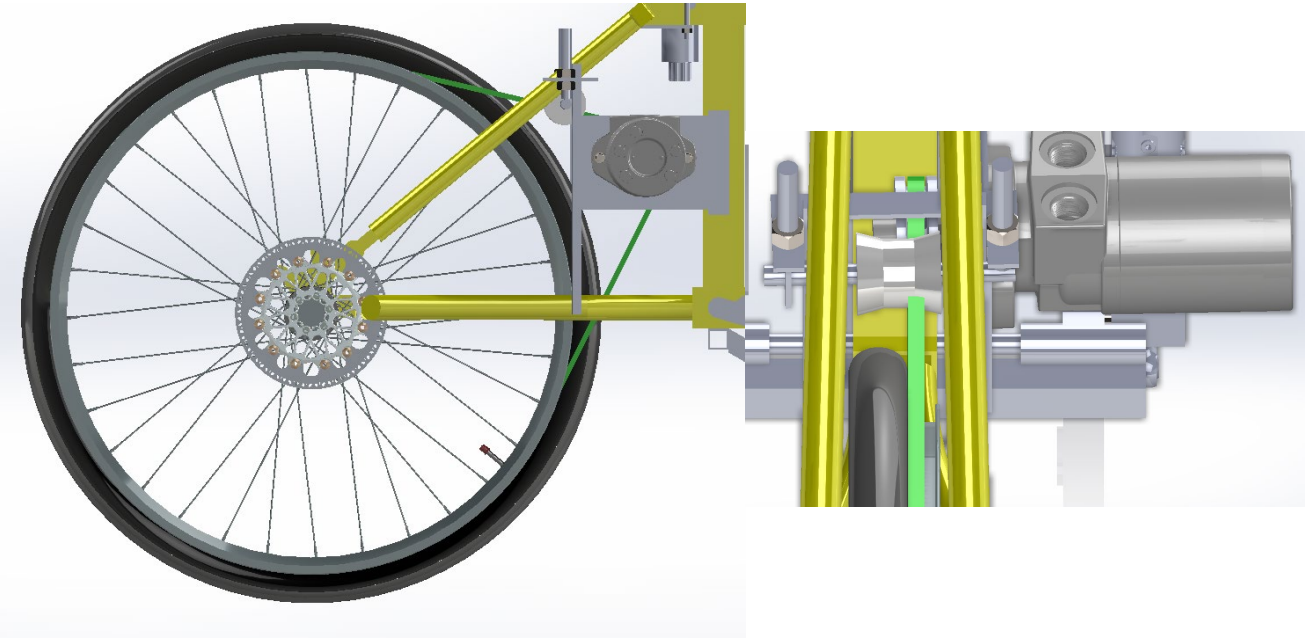






# Dual Rim Pulley Design

- Two 26” rims tig welded together
- 0.35” thick belt to motor
- Position of motor based off location of the belt rim

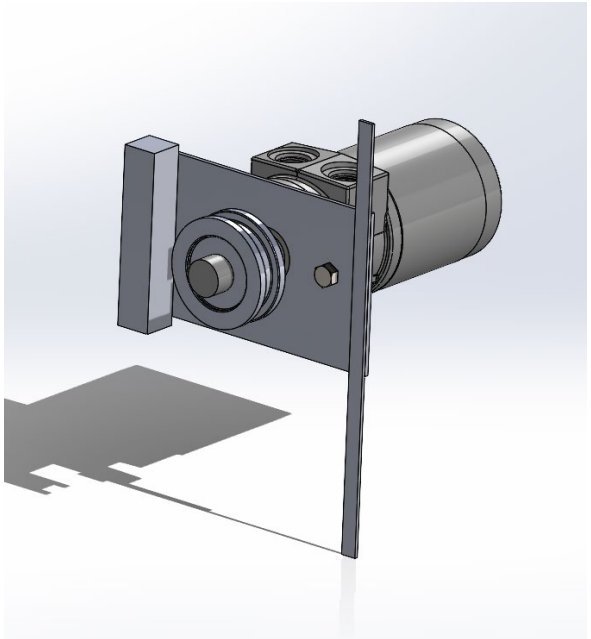


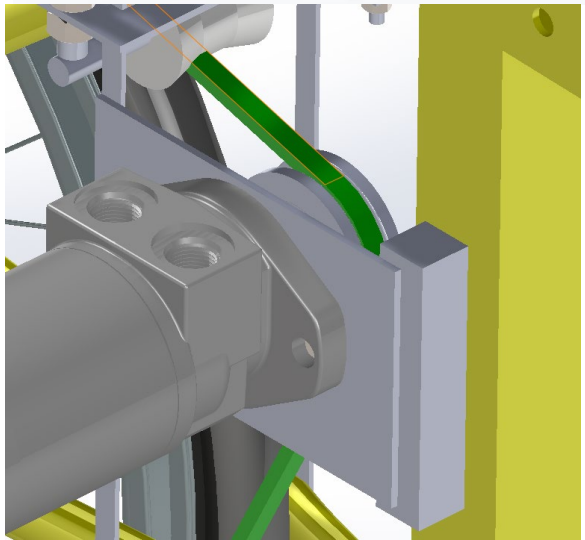
# Motor Design

- Casappa gear motor
  (0.683 $in^3$/rev at 100% efficiency, 26.25 in. lbs, 115.86 rpm, 0.3805 gpm)

- Pulley attached to Motor that drives the belt (3in pulley)

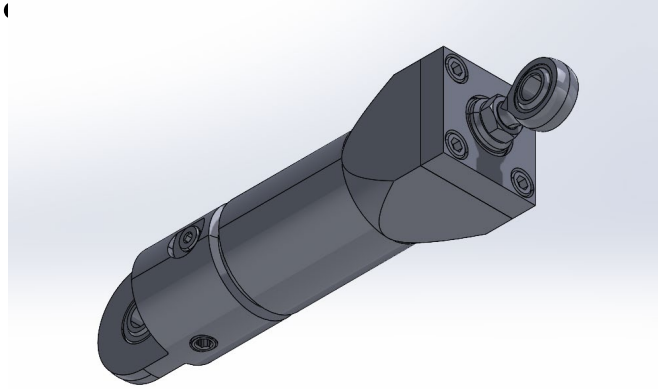
- Welded Motor Mount and custom bracket





# Cylinder Design

- Cylindrical pistons are used to utilize leverage and linear motion
- Different size pistons used as gearing
- Electronic control gear selector
- Stroke is 2.5” for small and 5” for large pistons
- Displacement is .85 in^3 and 1.7 in^3 for small and large respectively
- Cylinders manufactured by Jarp Industries



# Electronic system

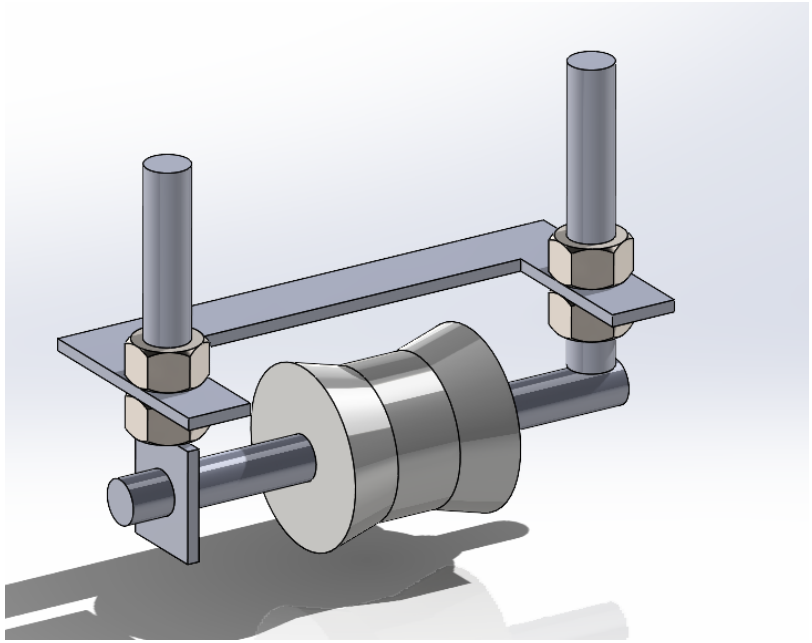
- Envision PV500 screen (Iowa Fluid Power Supplied)
- Envision MC2 controller
- Barksdale Bps3000 pressure sensor
- Balluff BSP pressure sensor
- Two Milwaukee M18 batteries
- Custom Deutsch connector wiring harness

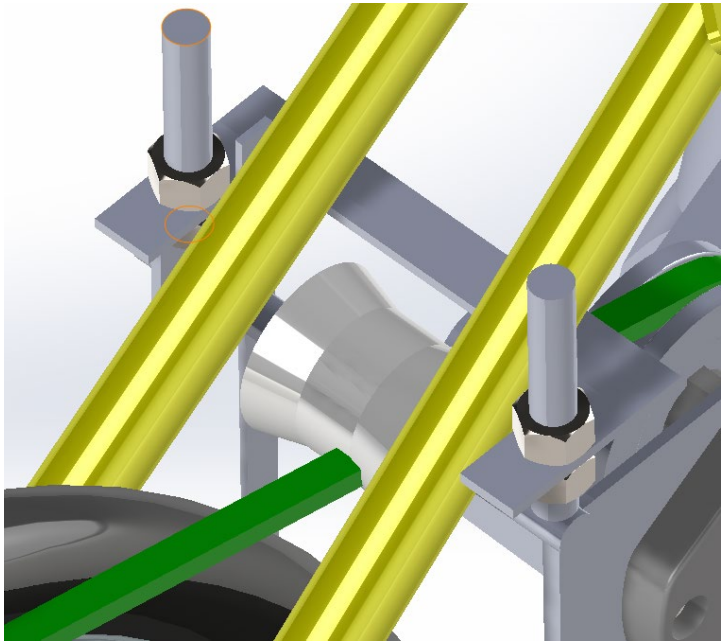
# Electronic Programming

- An touchscreen design solved problems from previous years (manual valves)
- Powervision used to program the screen
- CoDeSys used to program the controller
- Different buttons for specific modes
- Separate logic for gears and modes

# Tensioner Design

- Chamfered nylon
- welded threaded rods to tension
- Attached to Motor Mount (weld)

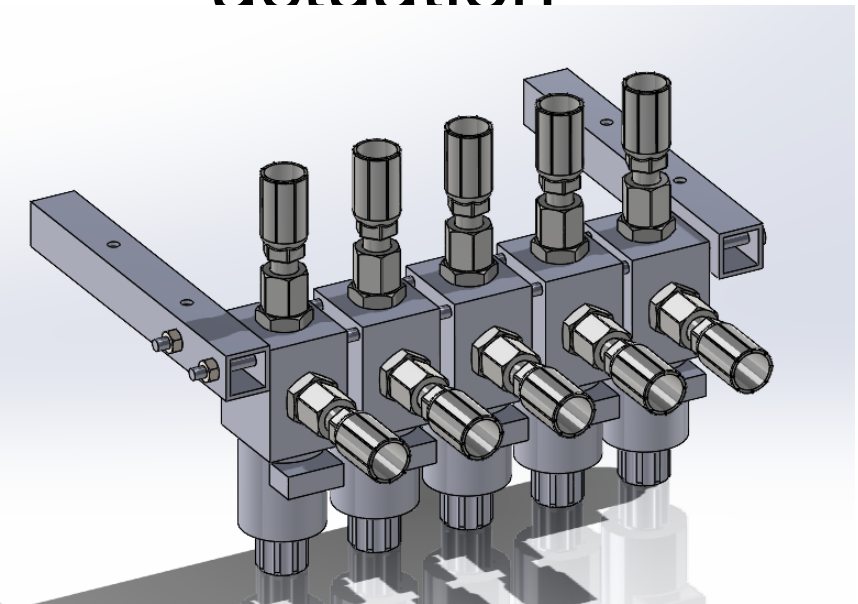


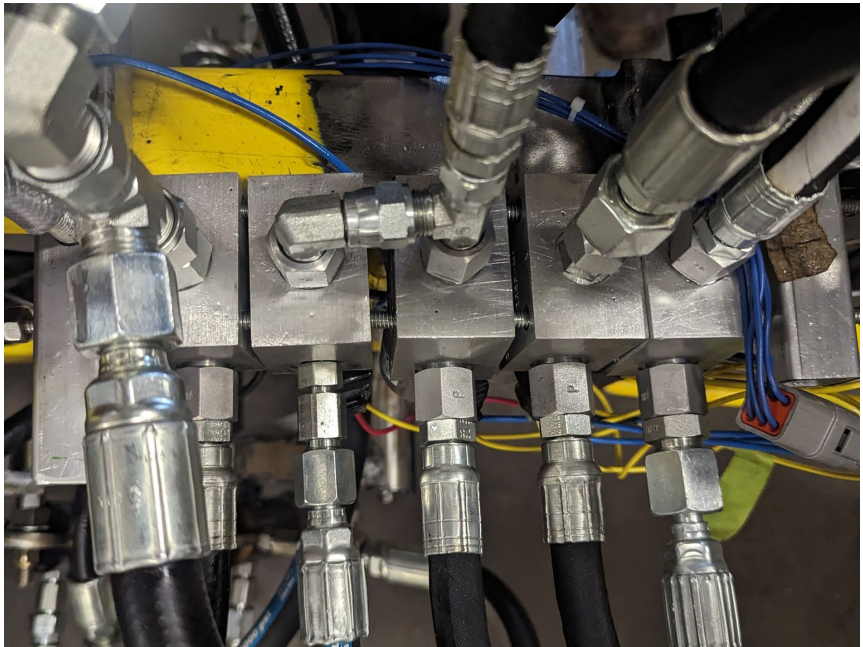


# Valve Selection

- Sun Hydraulics cartridge valves and manifolds

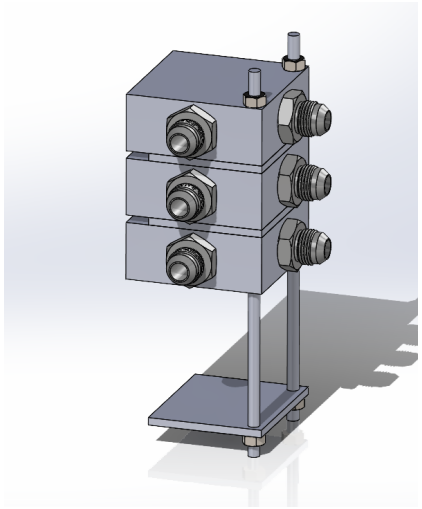
- 14 V solenoid actuation

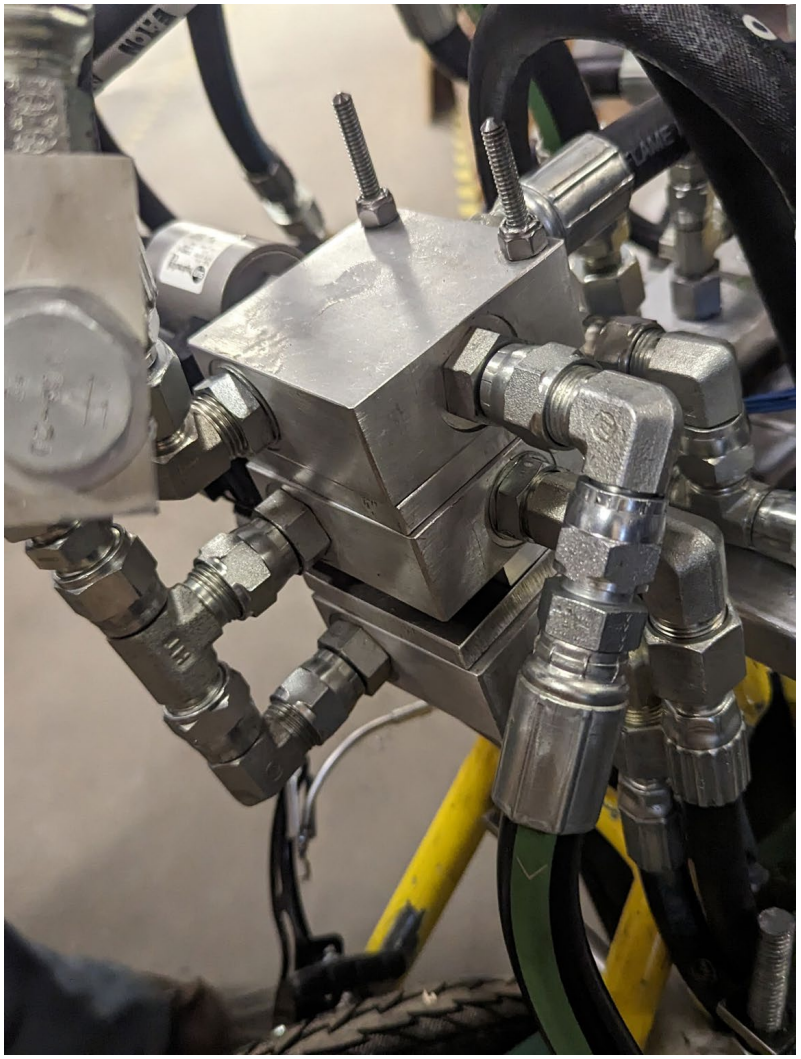




# Valve Mount Design

- Two manifold banks
- Threaded rods through manifolds
- Nuts clamp the manifolds to the frame
- Attached to a back plate or the accumulator mounts

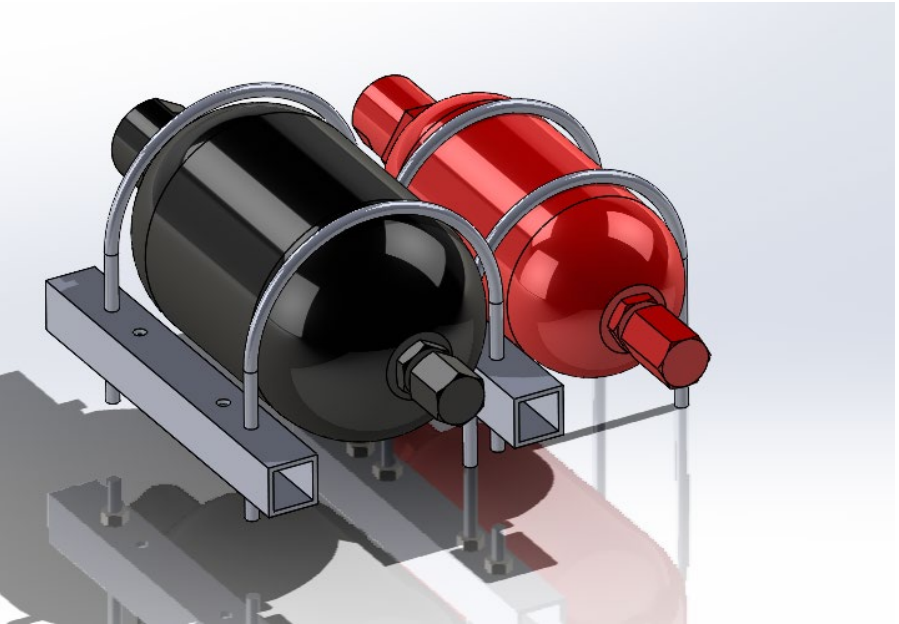


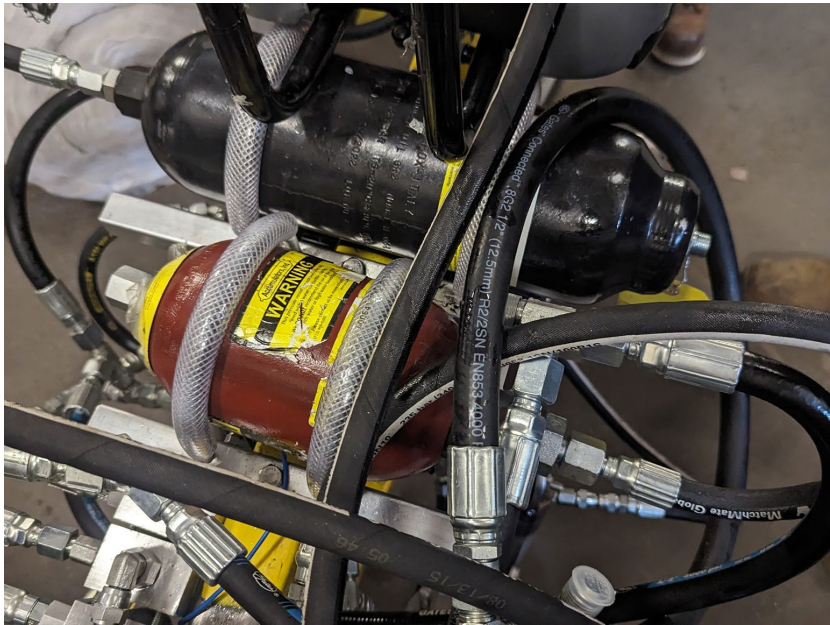


# Accumulator Design

- Bent threaded rod attached to 1x1 aluminum square tubing for mounting

- 2 accumulators (1.89 liter & .945 liter)





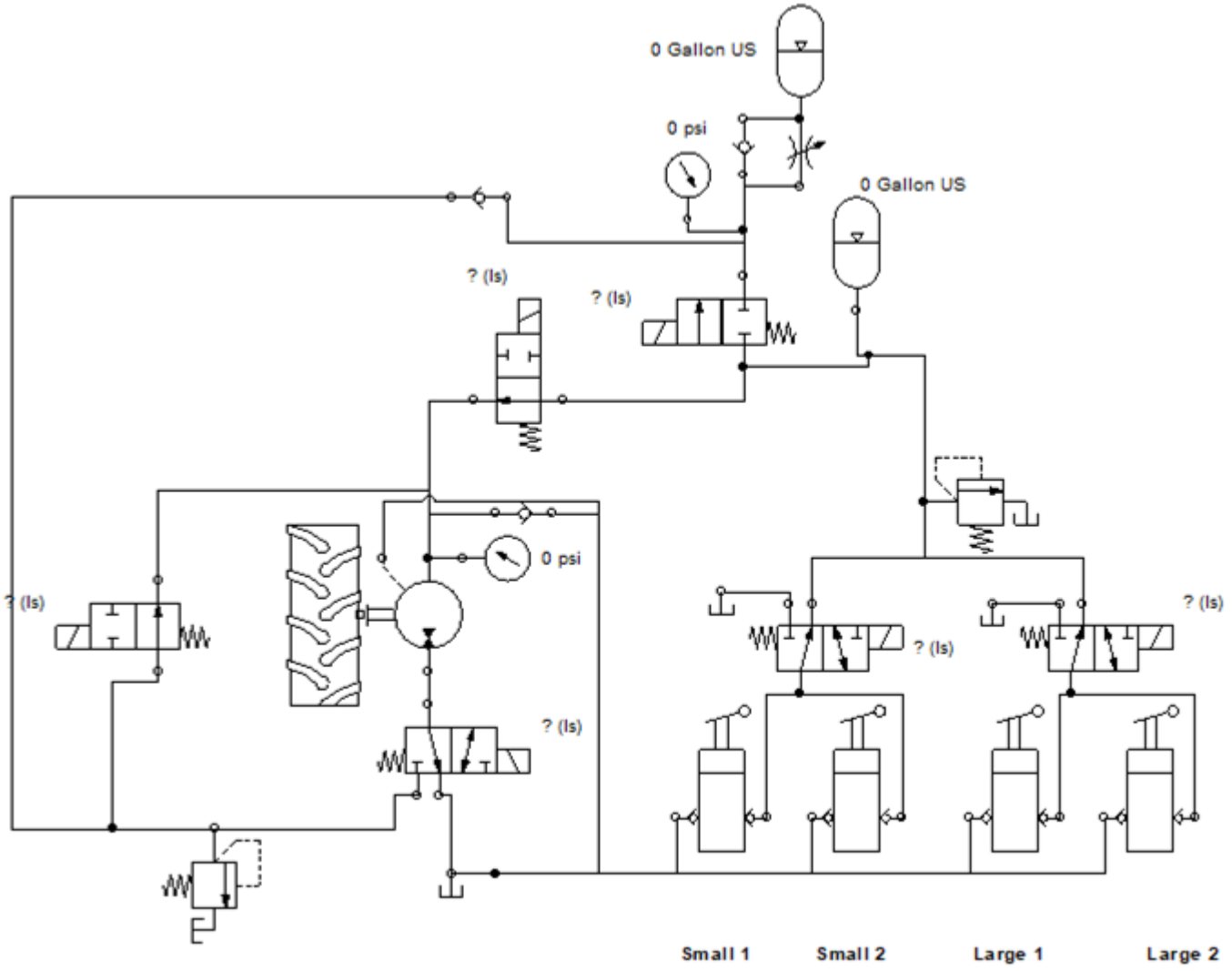
# Vehicle Construction/Final Vehicle

- Primarily done on our own, with tools and materials from the MTU MMET Shop
- Original plans were much different from the final outcome

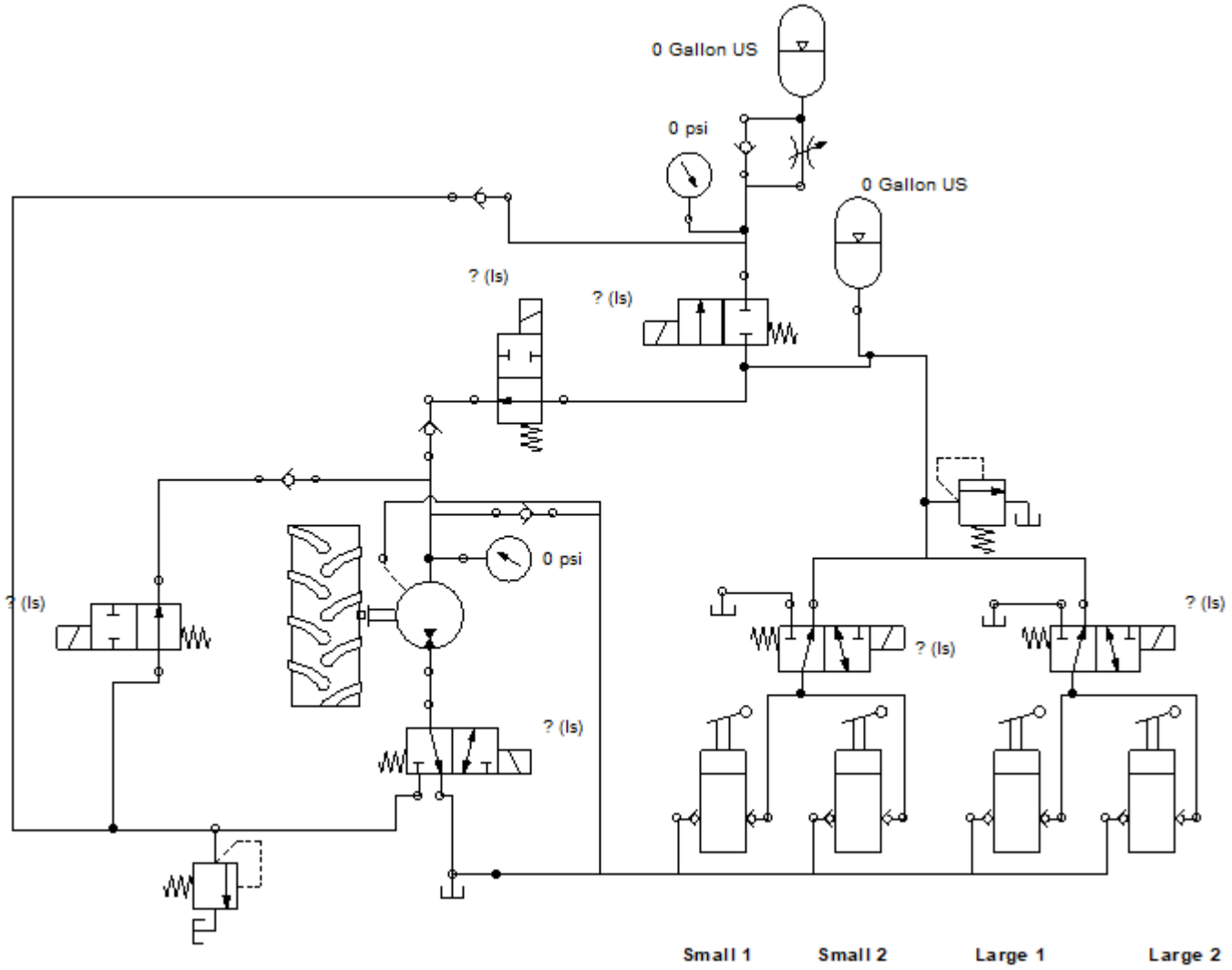
# Vehicle Testing

- Initial testing was done to check for piston function
- Piston to motor fluid movement check
- Connection and hose failures
  - Calculations and earlier tests show it will work

# Rigged Schematic



# Competition Schematic



# Lessons Learned

- Start designing and planning sooner
- Go through hose and valve connections early
- How to deal with last-minute issues
- Small errors can change an entire design
- Proper fittings for circuit & components

# Thank You

- Josh Scarbrough IFP
- Joe Jackan from Jarp Industries
- Ernie Parker
- Dave Wanless
- MTU MET department