NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

Final Presentation

Purdue University Northwest Team

Rick Rickerson & Prof. Ali

4/2/18

PURDUE UNIVERSITY NORTHWEST

Photo of Vehicle

2018-19 PNW Team

Students

- Jacob Deakin
- Mohamed Nasr
- Charles Badillo — MET
- Brian Long
- Sean Slouber
- Ali Alsultan — ECET

Advisors

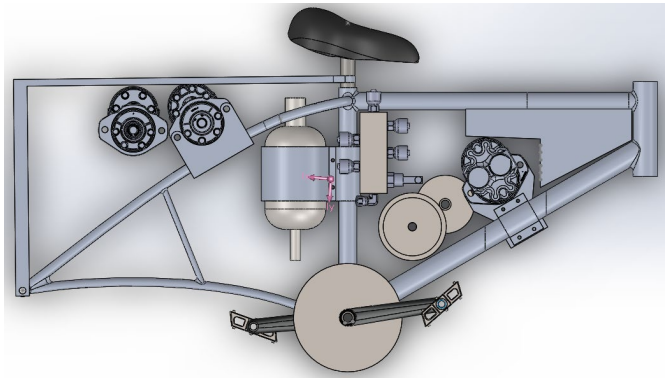
- Prof. Ali
- Prof. Higley
- Rick Rickerson

Problem Statement

- A working vehicle must be created that converts mechanical/human power to fluid power to move a bike for 3 different races while adhering to all the NFPA competition rules.

Midway Review

- Extended the back wheel 6” for accumulator
- Add a clamp to make the pump more adjustable
- Gear up the pedals to obtain a higher RPM
- Design a custom reservoir for the bike
- Design an adjustable clamp for the accumulator
- Motor/ Pump mounts made for adjustability
- Ensure design is balanced



Changes from Midway Review

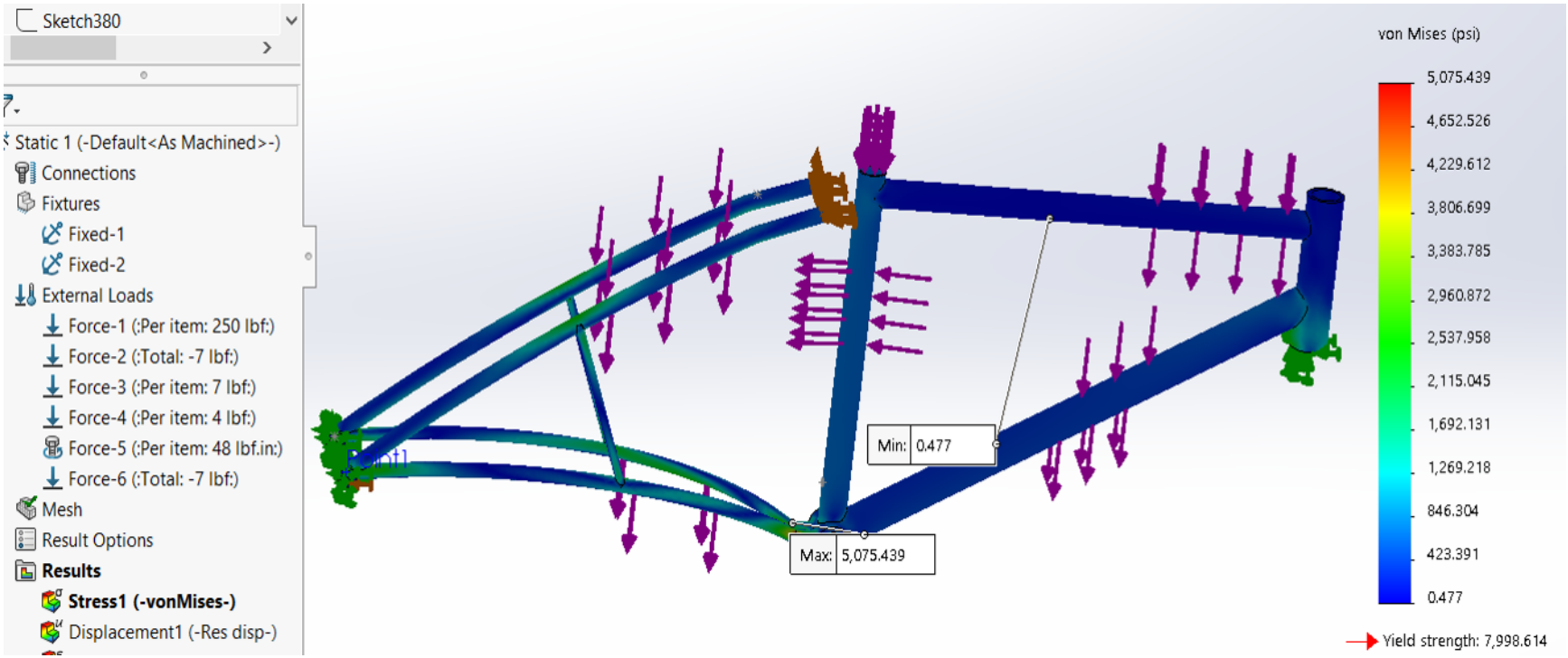
- No charging from low pressure
- Using a belt and chain for main pump
- Welding regenerative pump bracket
- Using solenoids instead of ball valves
- Used more compact line bodies
- Modified brackets (motor, reservoir)

Changes from Midway Review

- Making back wheel adjustable for chain tension and alignment
- Switched to stainless steel hoses
- Changed gear ratio
- Installed two downpipes for returns
- Added a baffle to the reservoir

Midway review

- Original frame FEA stress
- 6 forces loaded to frame

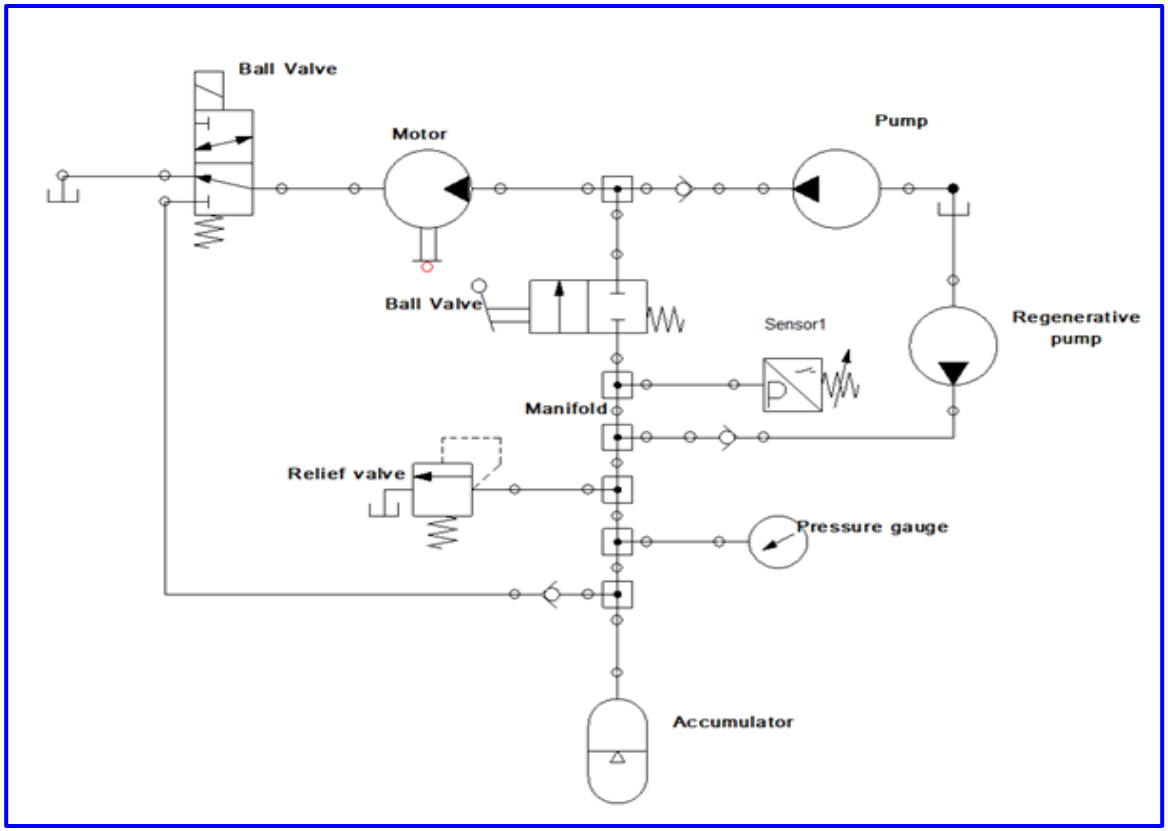


Changes Because of Testing

- Elimination of 3-way ball valve from circuit
- Regenerative braking gear ratio
- Added a chain tensioner (regen braking)
- Nitrogen precharge for accumulator

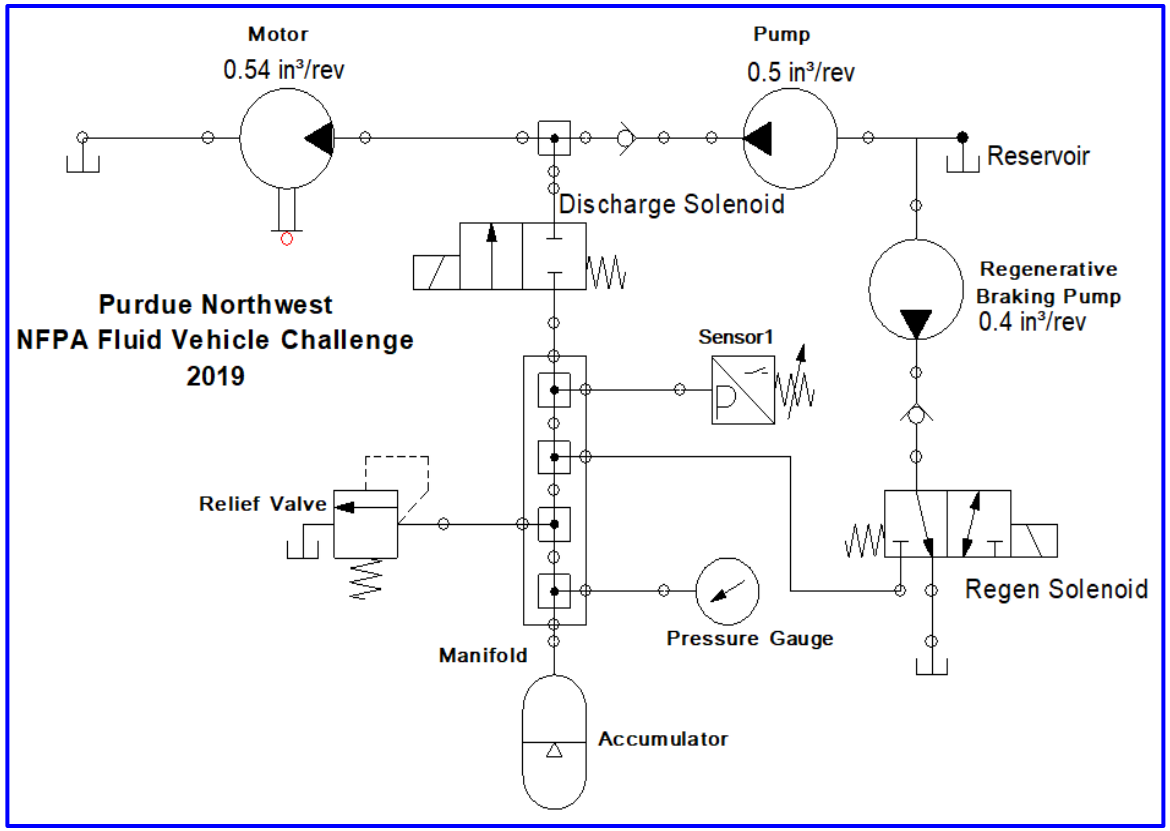
Midway Circuit Design

- .54 in^3/ rev motor
- .5 in^3/ rev main pump
- .4 in^3/ rev regen pump
- 2 3-way ball valves
- 1 quart accumulator
- 1 pressure relief valve
- 1 manifold
- 3 check valves
- 1 pressure gauge



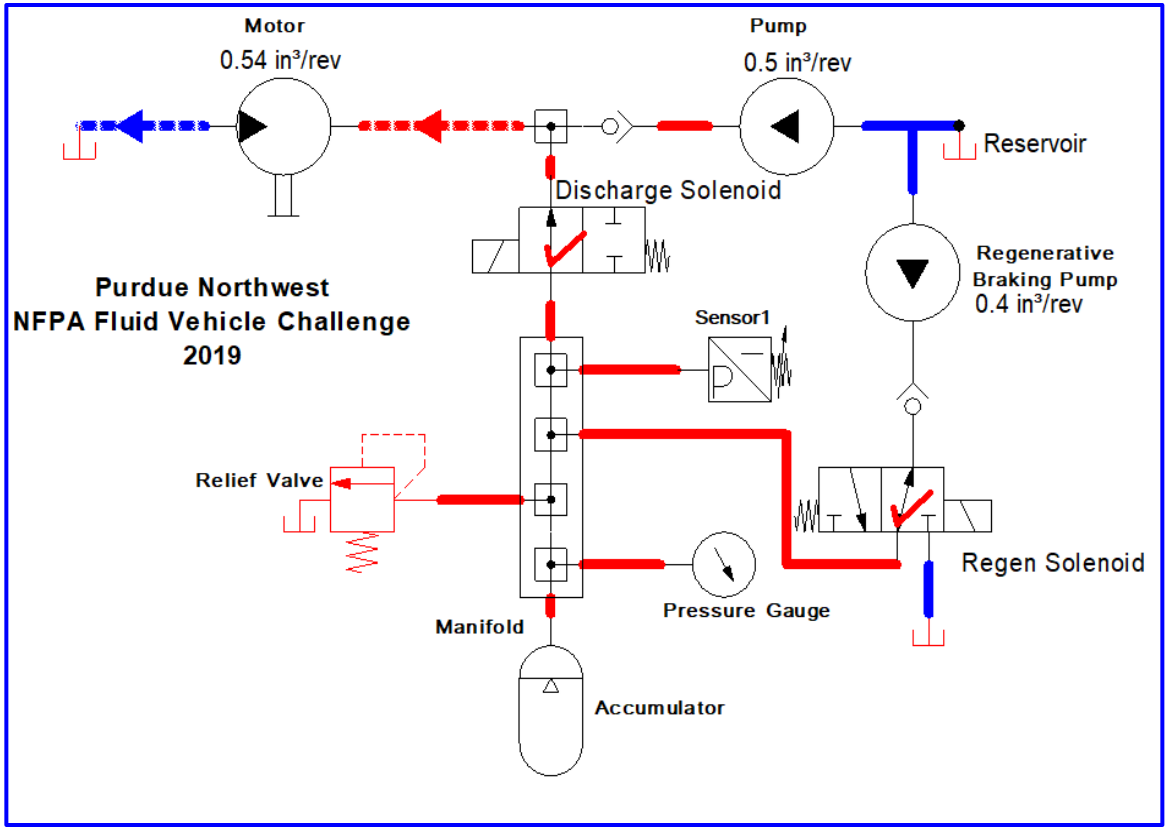
Final Circuit Design

- .54 in^3/ rev motor
- .5 in^3/ rev main pump
- .4 in^3/ rev regen. pump
- 2 solenoids
- 1 quart accumulator
- 1 pressure relief valve
- 1 manifold
- 2 check valves
- 1 pressure gauge



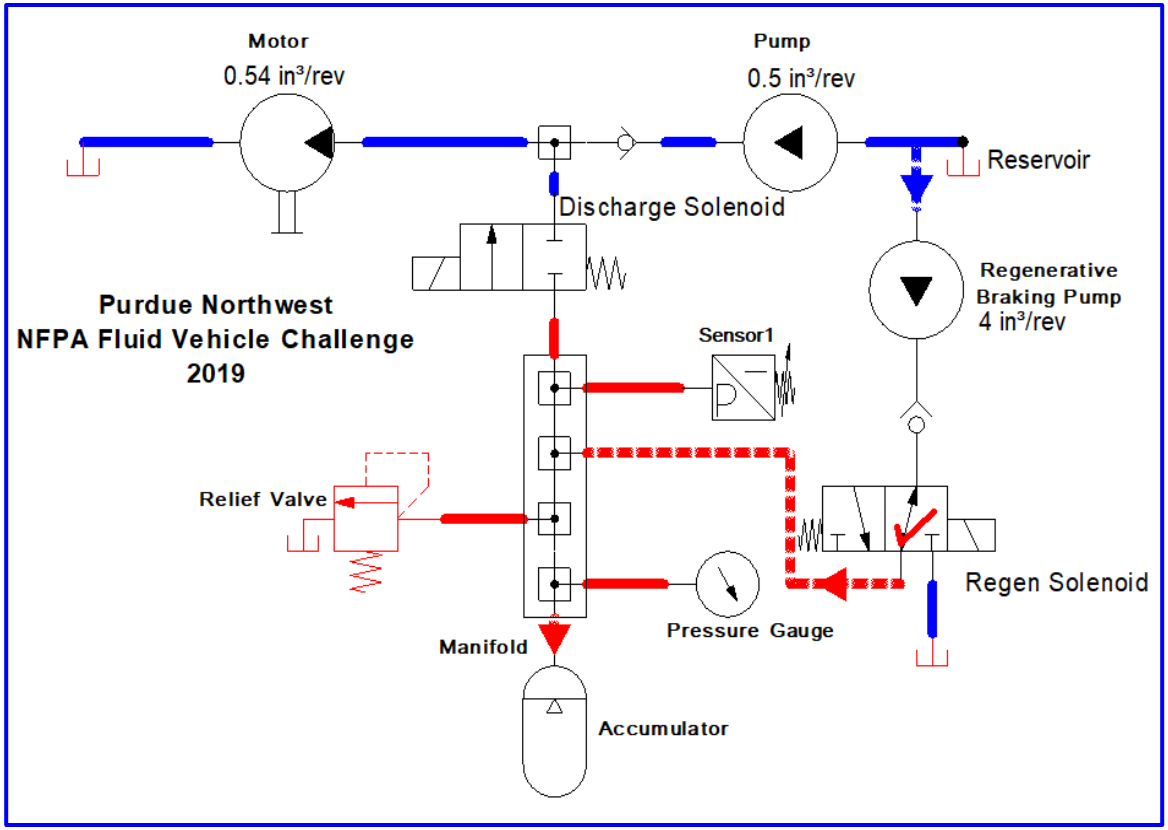
Direct Drive Circuit

- Pulls fluid from reservoir with pump
- Fluid then powers motor and returns back to reservoir



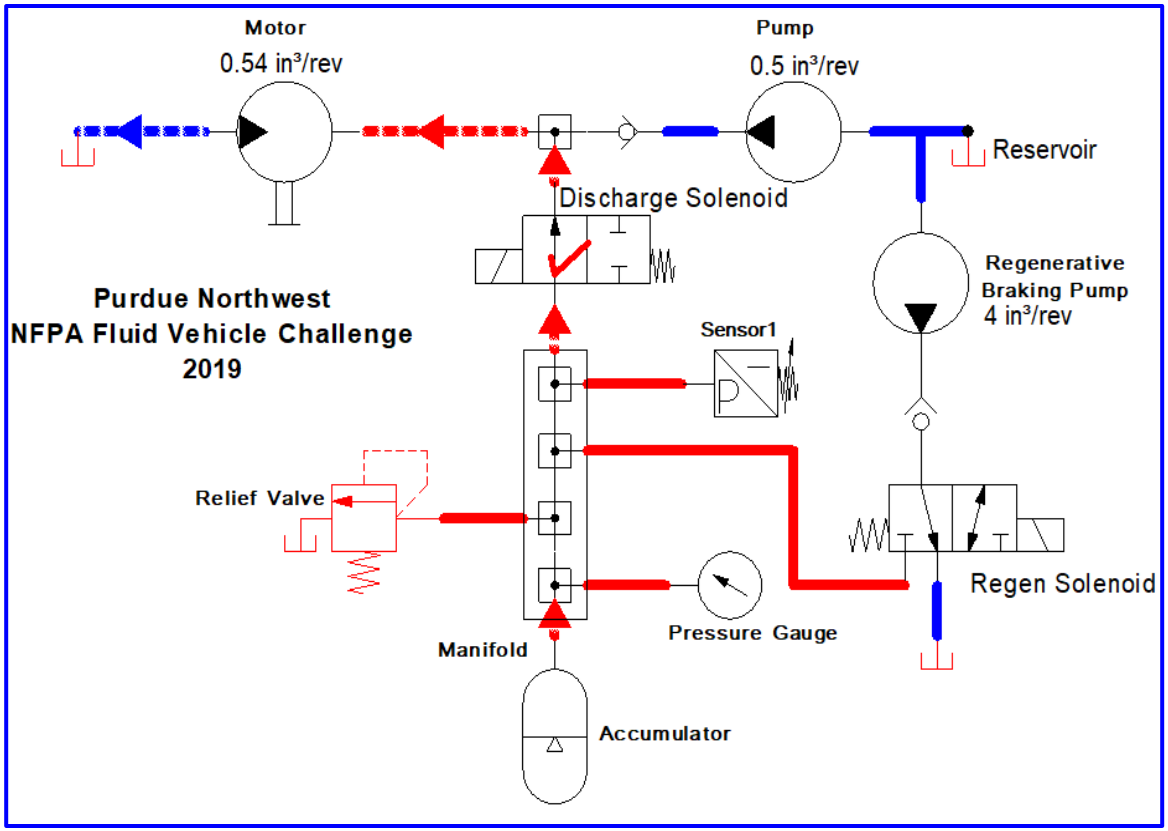
Regenerative Braking Circuit

- Uses regenerative pump to push fluid into accumulator from reservoir by opening solenoid
- Charges accumulator to store energy

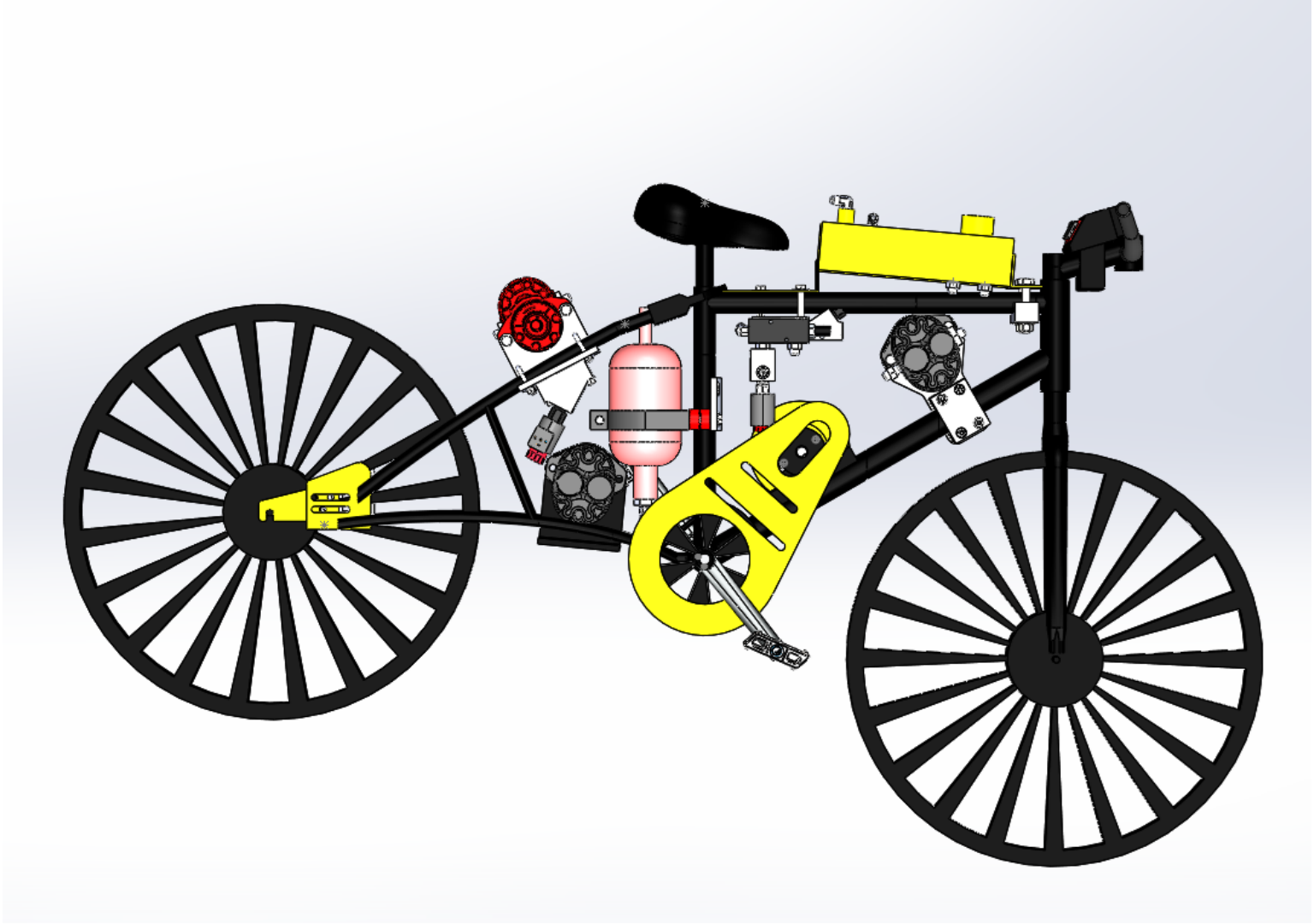


Discharge Circuit

- Open discharge solenoid
- Fluid then flows from accumulator to power the motor
- Fluid then returns to reservoir

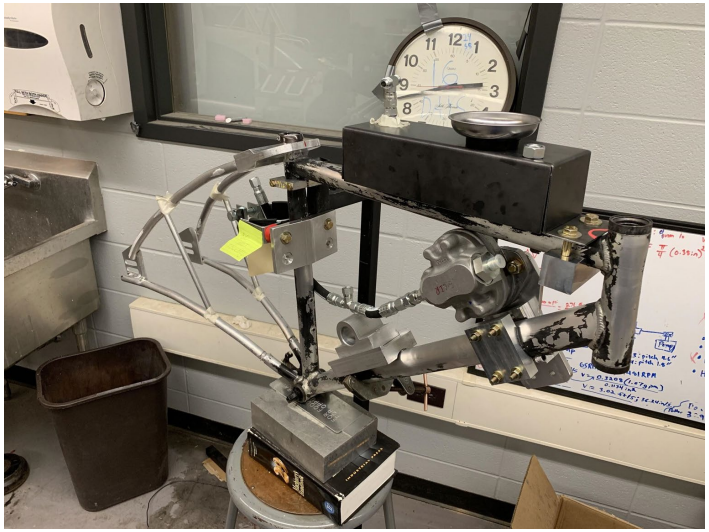


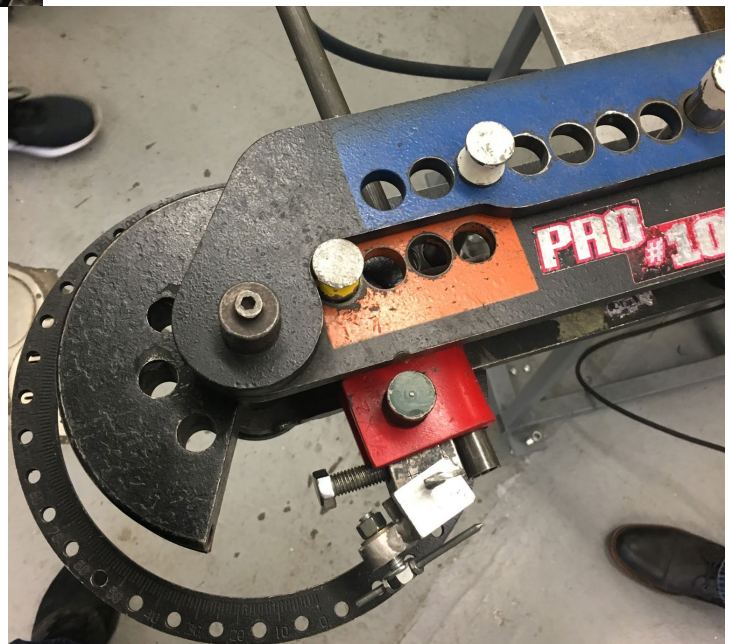
Solidworks Design

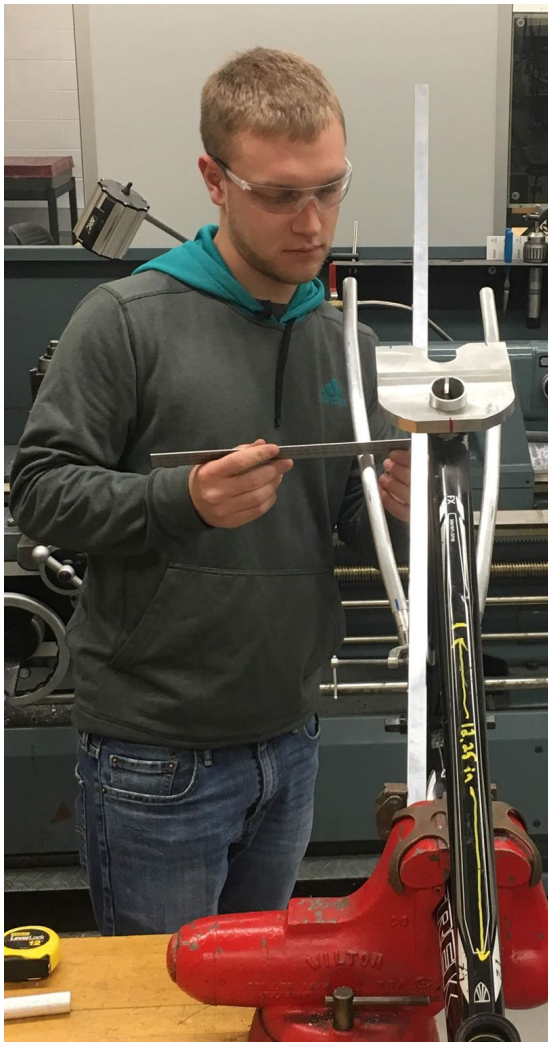


Constructing the Bike

NFPA Fluid Power Vehicle Challenge







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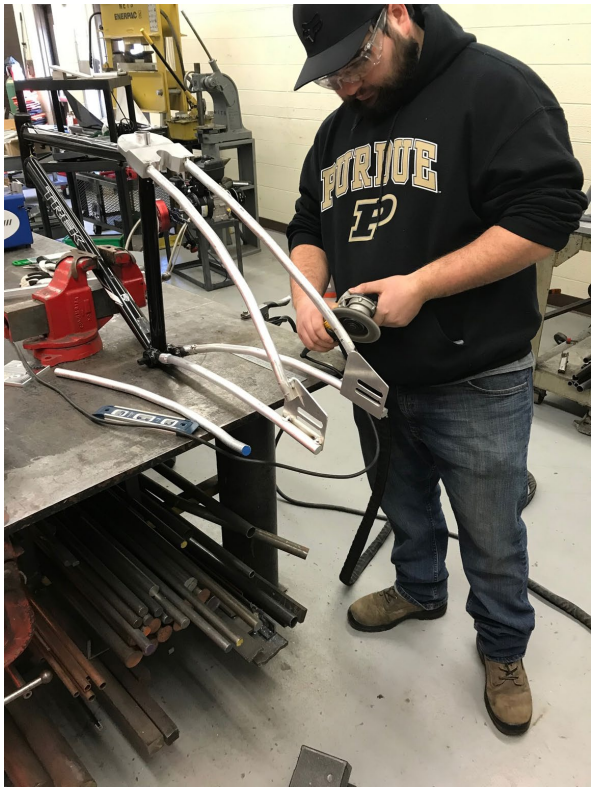

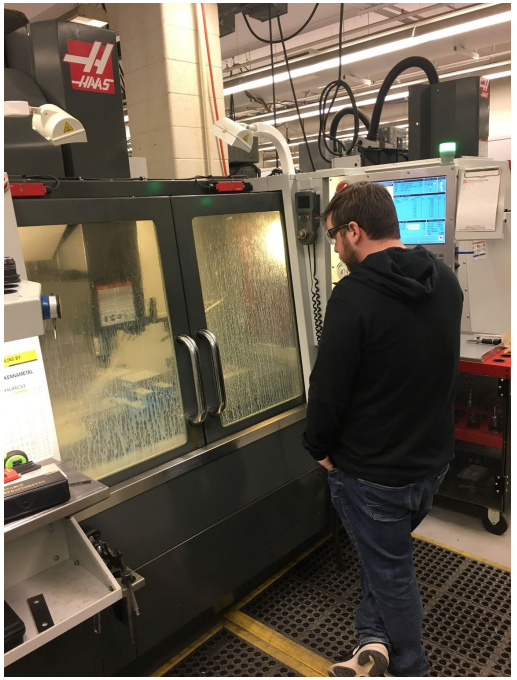

Testing the Bike

https://youtu.be/t-fn6ncMSuE

Lessons Learned

- Hydraulic circuit design
- Time management with ordering parts
- Teamwork
- The different types of fittings
- Problem solving

Questions & Comments