NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

Final Review
Cleveland State University
2018-2019 FPVC Team
Advisor: Professor Kozul
April 11-12, 2019

Overview

- Introductions
- Midterm Summary
- Vehicle Construction
- Vehicle Testing/ Improvements
- Lessons Learned
- Final Vehicle
- Questions

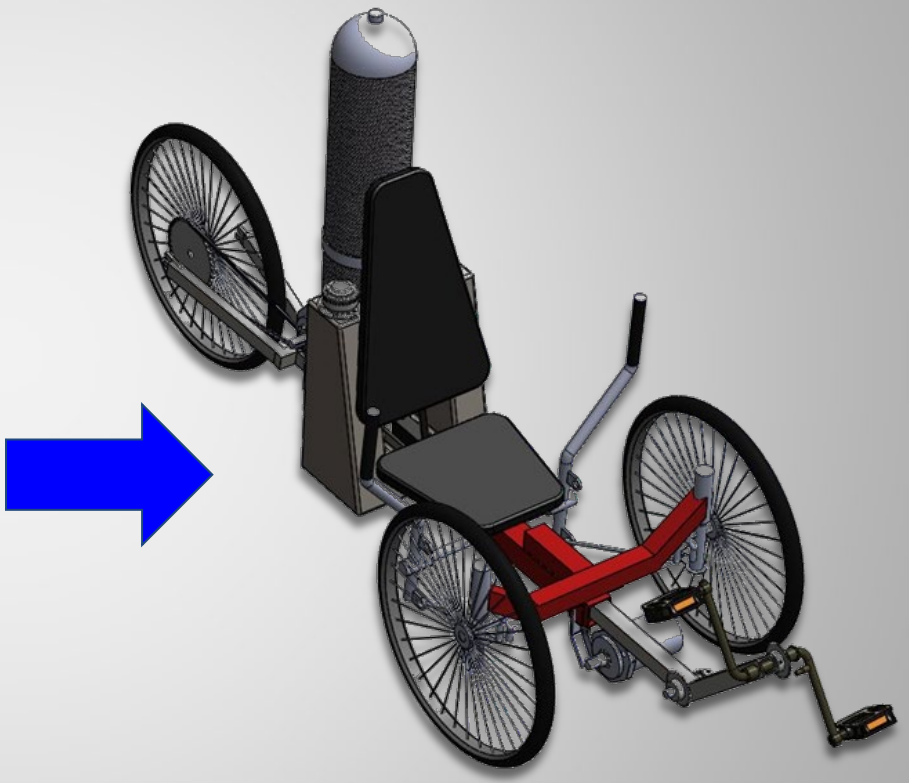
Meet the Team

Midterm Recap

Midterm Summary

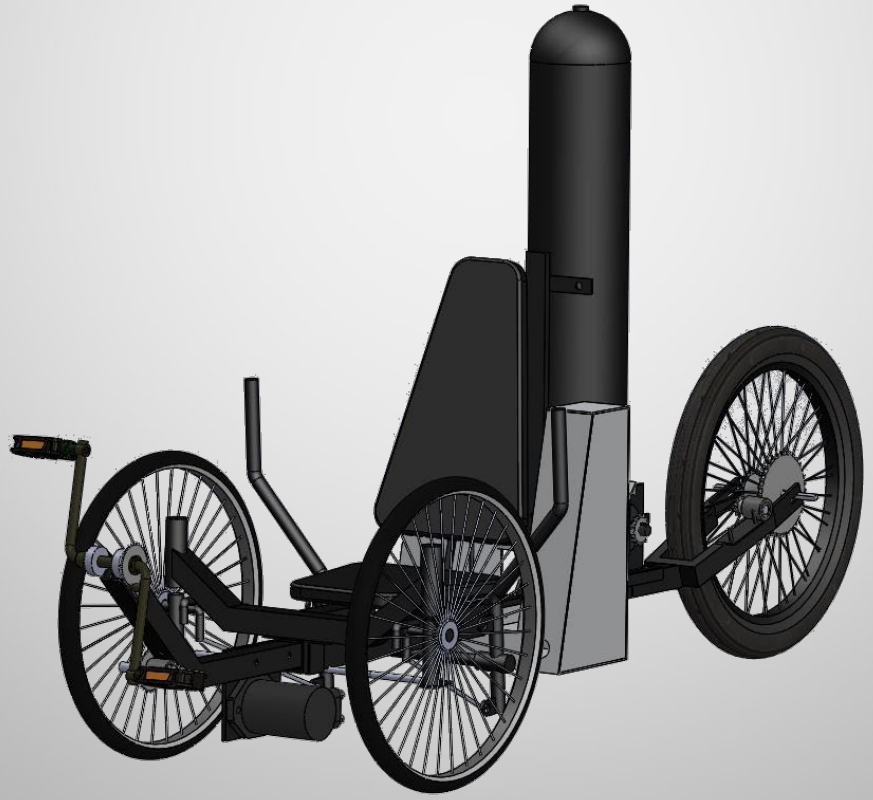
- Design objectives
- Vehicle design
- Fluid power circuit design
- Selection of hardware
- Results/ Analyses

New Design:
Design Objectives



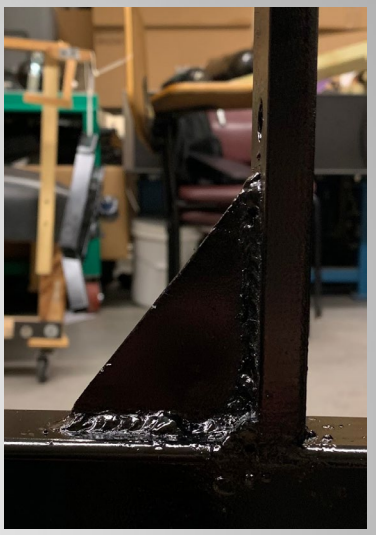
Design Objectives

- Easier to operate
  - **56.43 lbf min force**
- Increase amount of stored energy

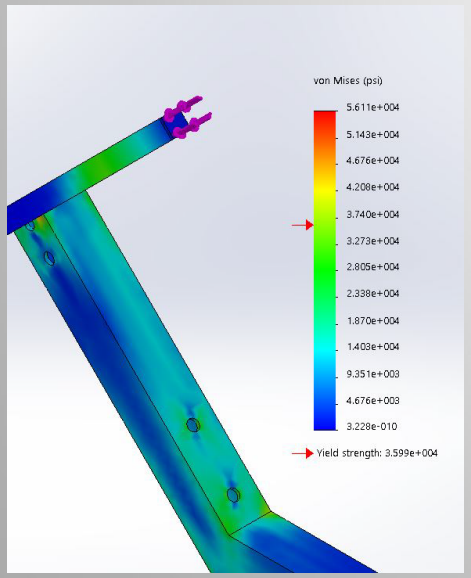


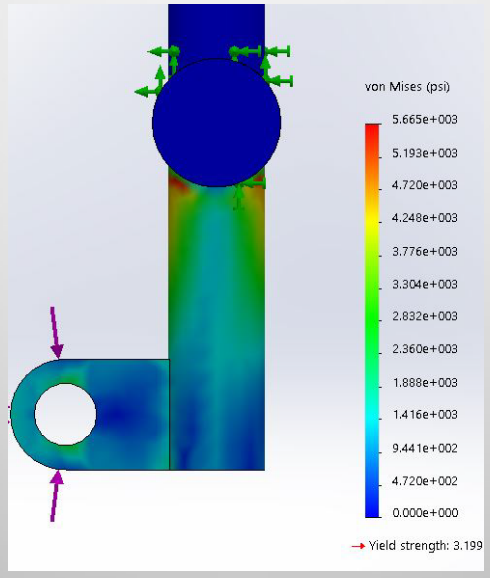
Vehicle Design

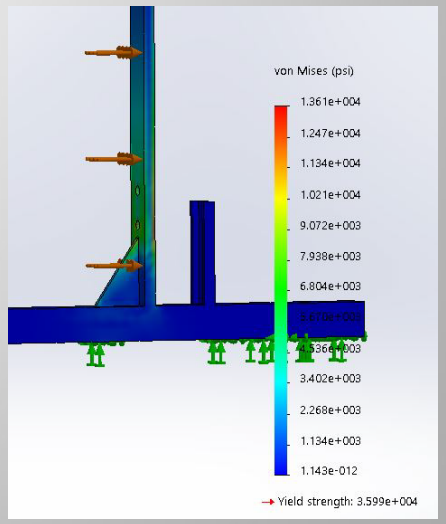
Welds



FEA

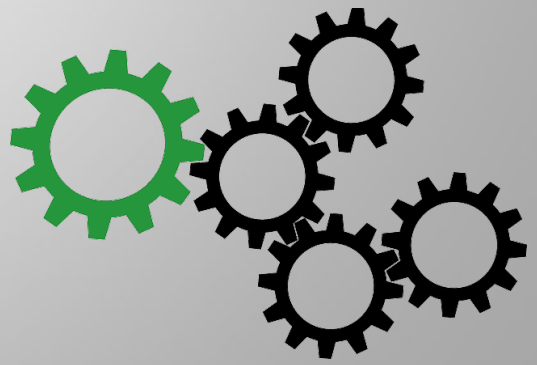




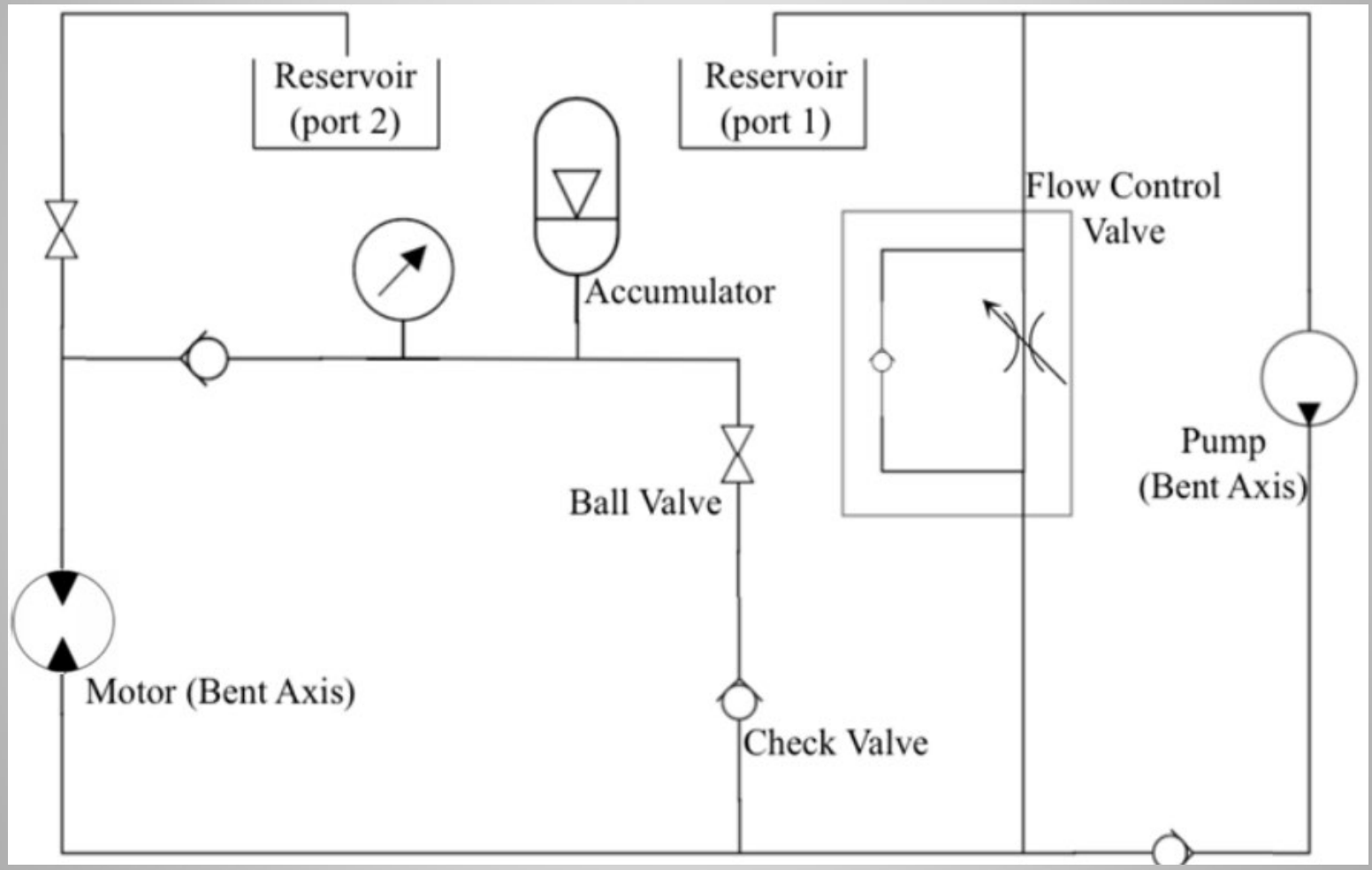


Vehicle Design

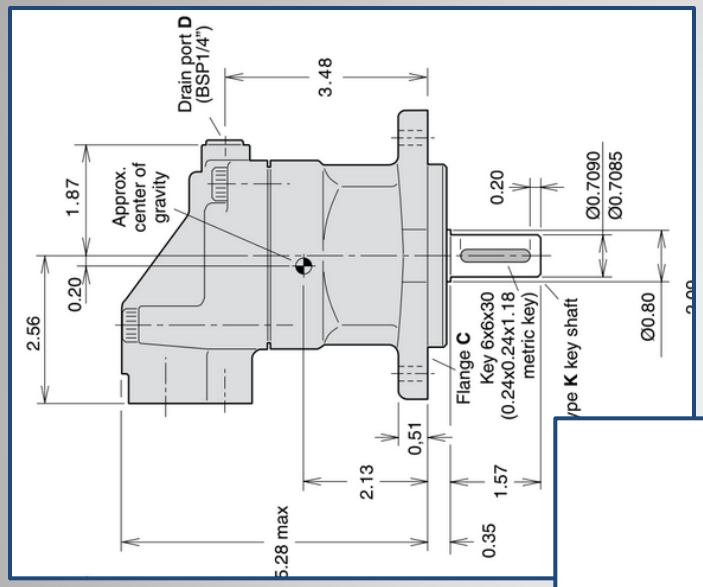
	Nominal Diameter (Inches)	Pitch Diameter (Inches)	No. of Teeth	Shaft Diameter
Drive Sprocket 1 (at Pedal)	4.03	3/8	32	5/8"
Sprocket 2	1.38	3/8	10	5/8"
Sprocket 3	4.03	3/8	32	5/8"
Sprocket 4 (at Pump)	1.38	3/8	10	5/8"



Fluid Power Circuit

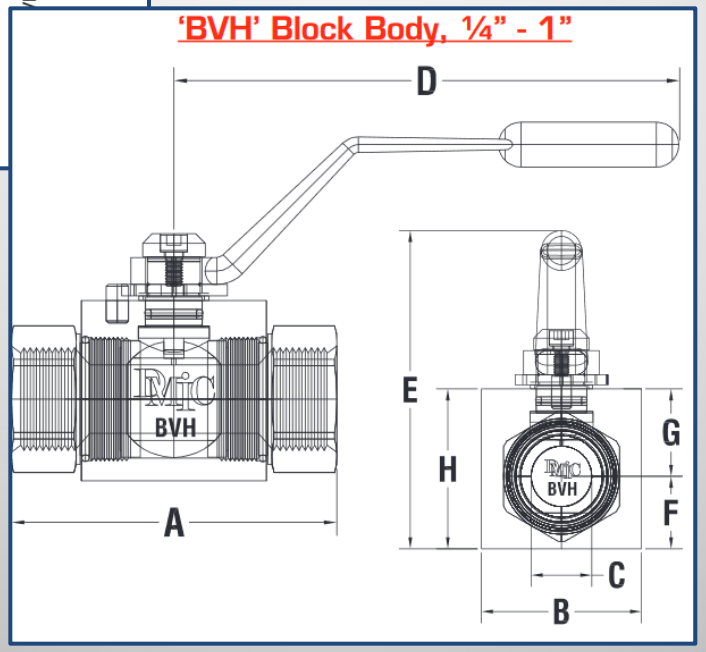


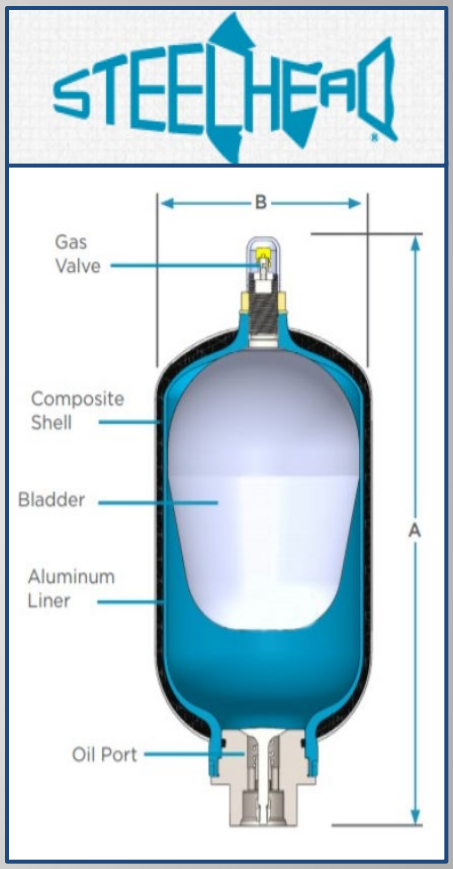
Component Selection:



Bent Axis Displacement Pump

Manual Ball Valve



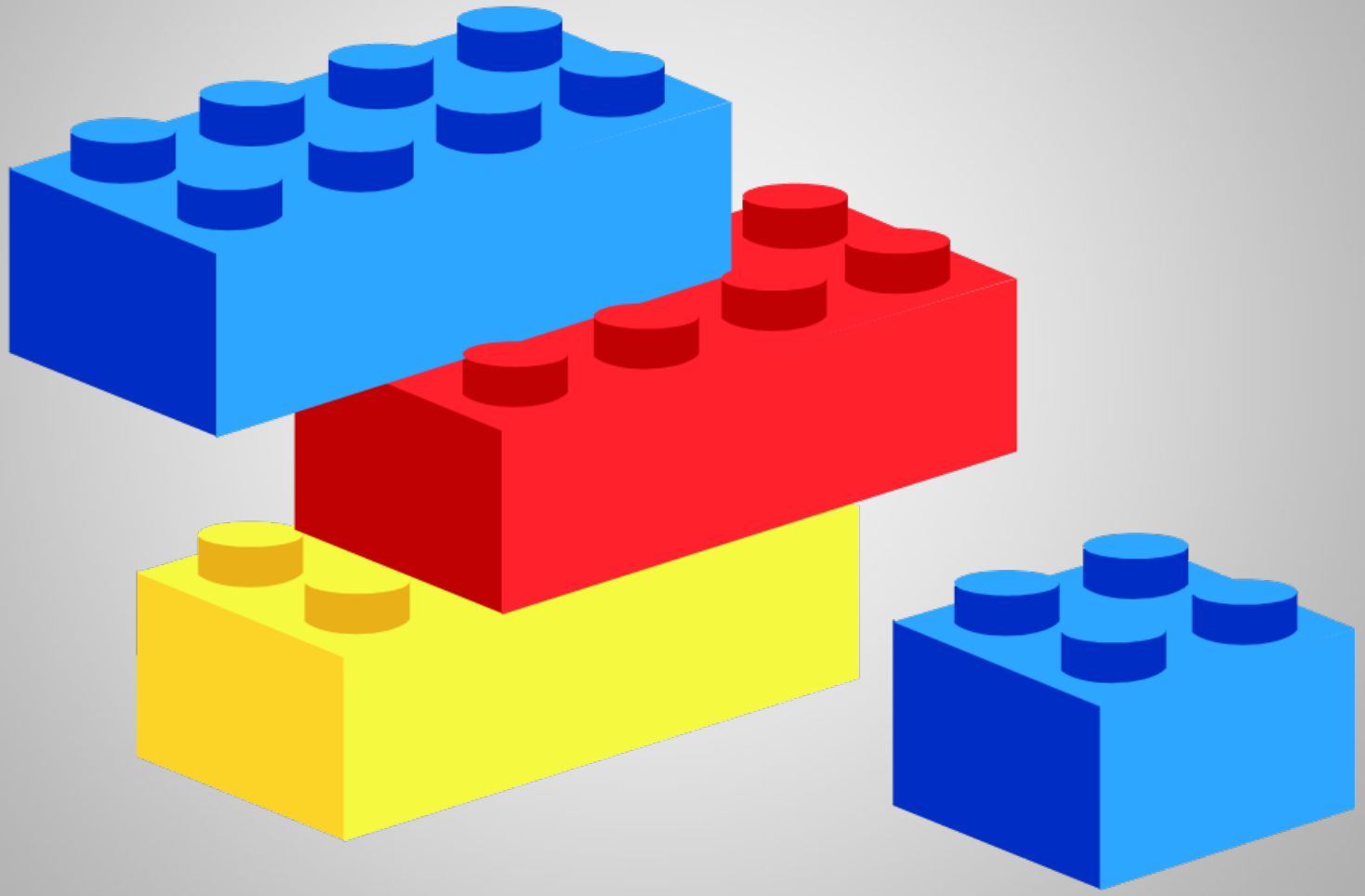


2.5 Gallon Carbon Fiber Accumulator

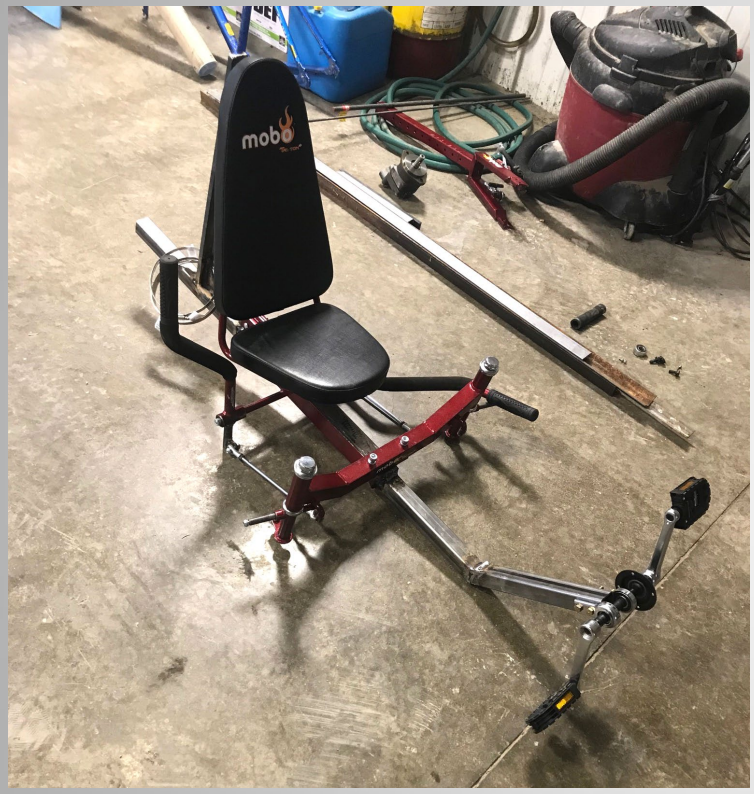
Calculated Results

- Estimated Sprint Time
  - **25.62 seconds** (KE/ Accumulator Power)
- Estimated Distance Traveled
  - **3660.38 ft** (2.5 Gallon)
  - **695.42 ft** (½ Gallon)

Vehicle Construction

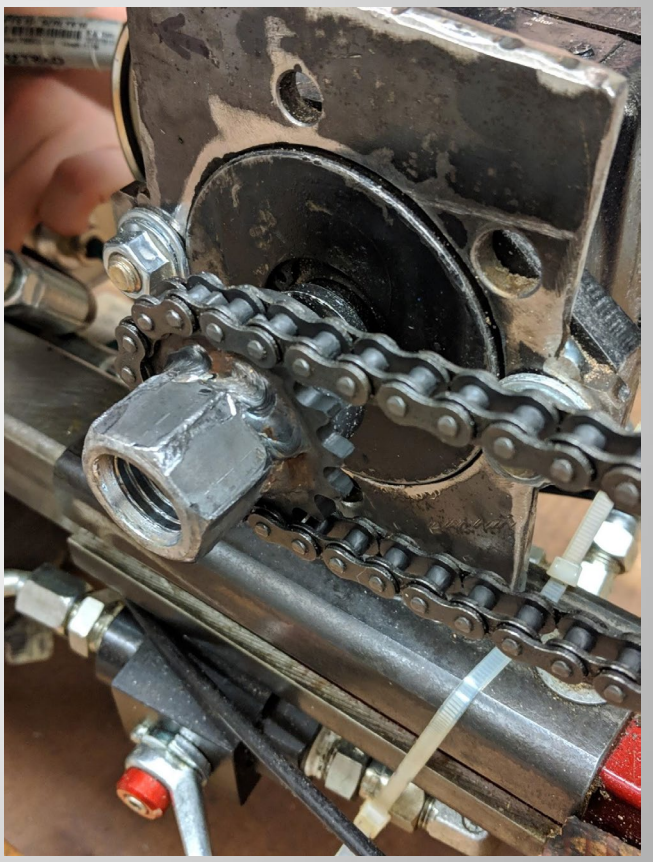


Vehicle Construction



Vehicle Construction

- Charging the accumulator



Vehicle Construction

- Reduction of Fittings

Vehicle Testing/ Improvements

Testing Overview

- Sprint
  - 2.5 Gallon Accumulator
- Efficiency
  - 2.5 Gallon Accumulator
  - ½ Gallon Accumulator
- Endurance
  - 2.5 Gallon Accumulator

Sprint Testing

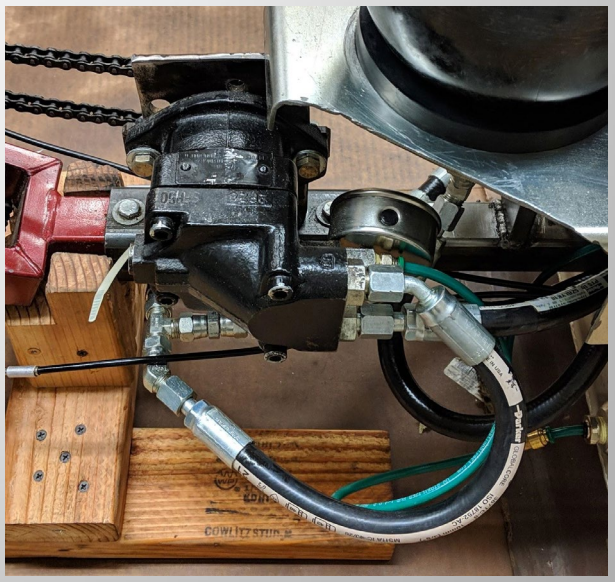
2.5 Gallon Accumulator

Sprint/ Without Quick Disconnects				
Pre-Charge	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Trial 4 (s)
600				19.63
800			18.85	18.5
1000	~29.326	20.46	17.53	17.26

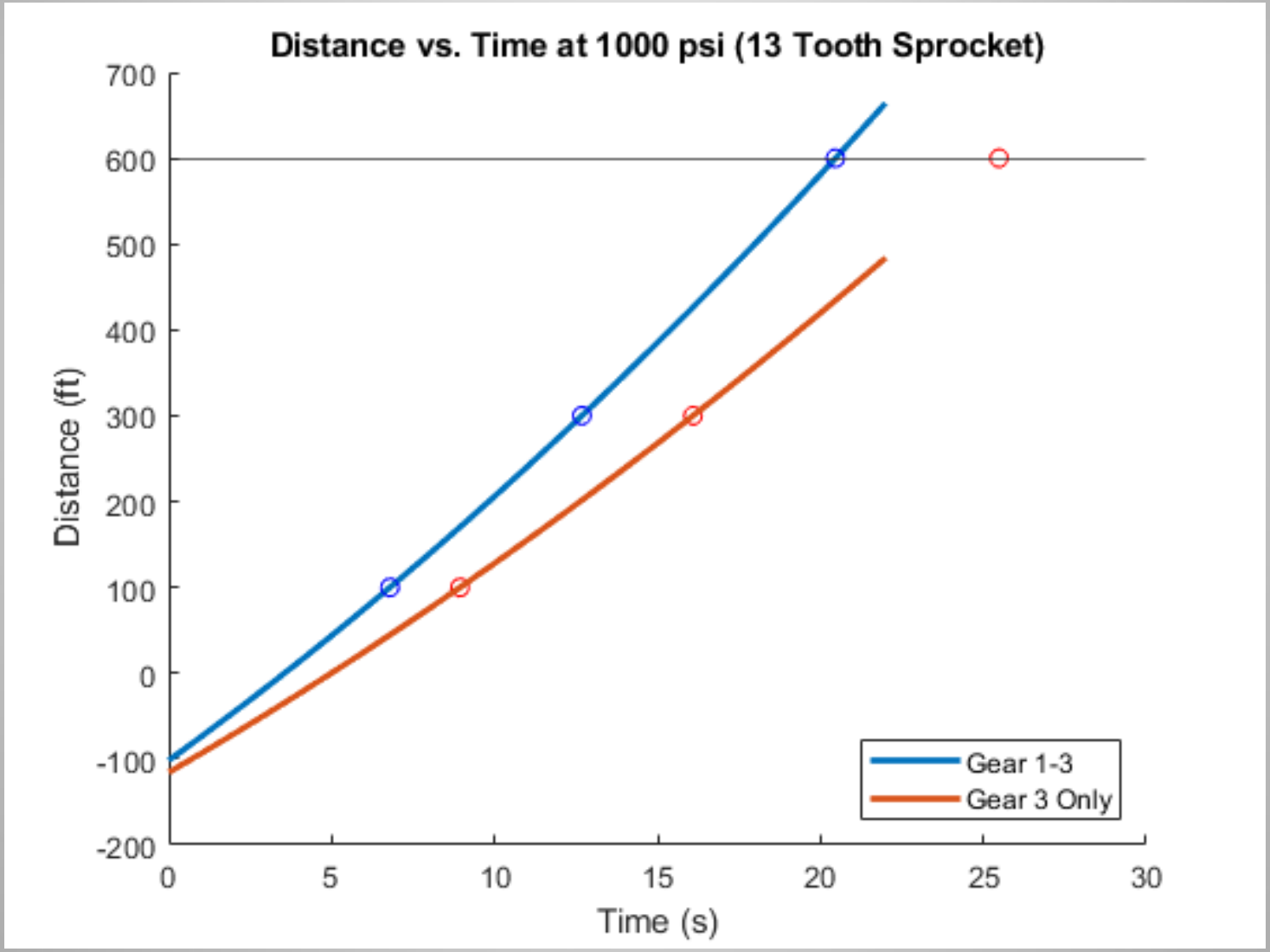
Sprint/ With Quick Disconnects				
Pre-Charge	Trial 1 (s)			
1200	19.24			
1400	19.74			

Bike Improvements

- Increased back end gear ratio
- Motor orientation
- Fixed back end fork
- Moved idler
- Moved bearing housings



Improved Results



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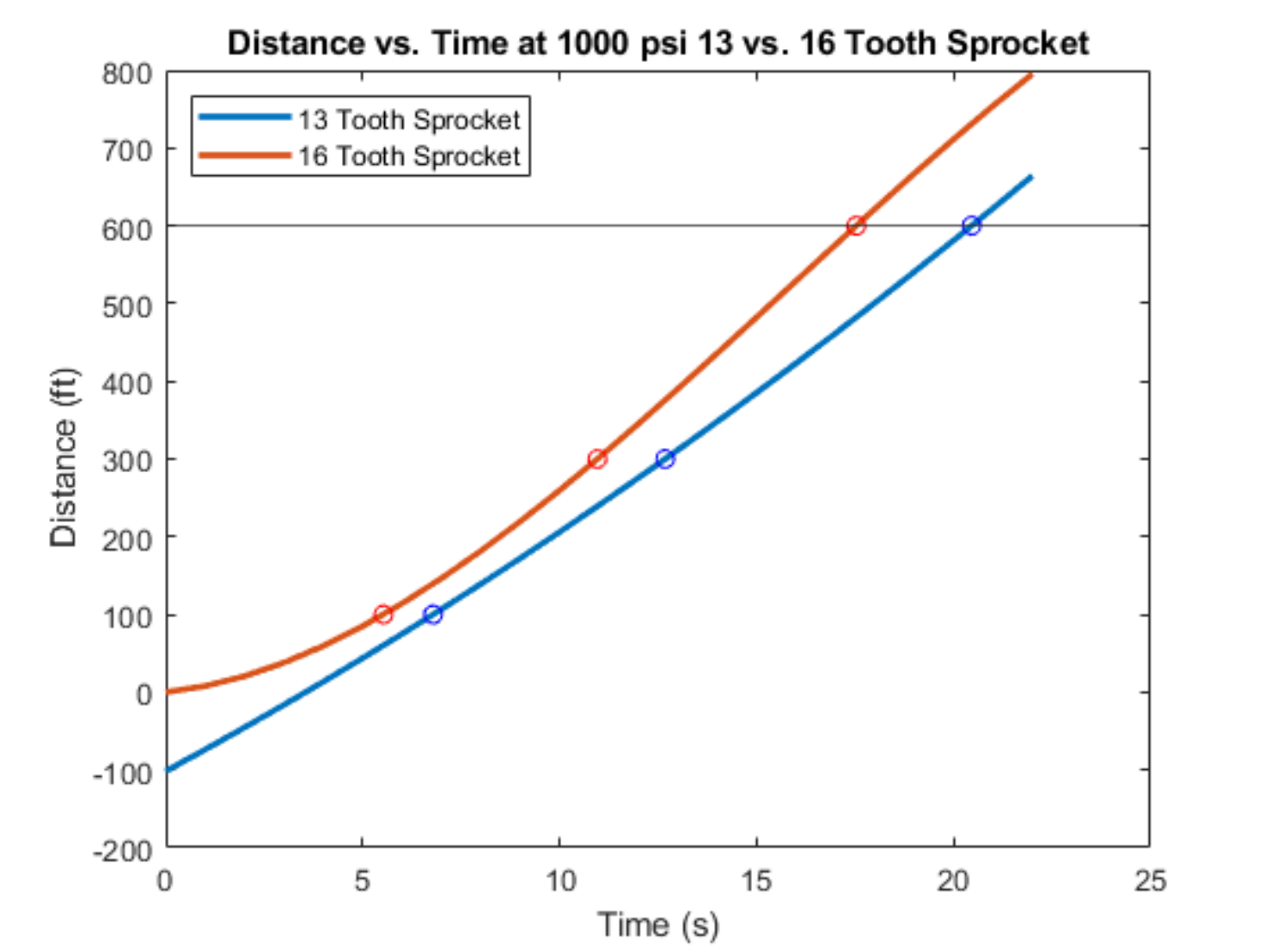

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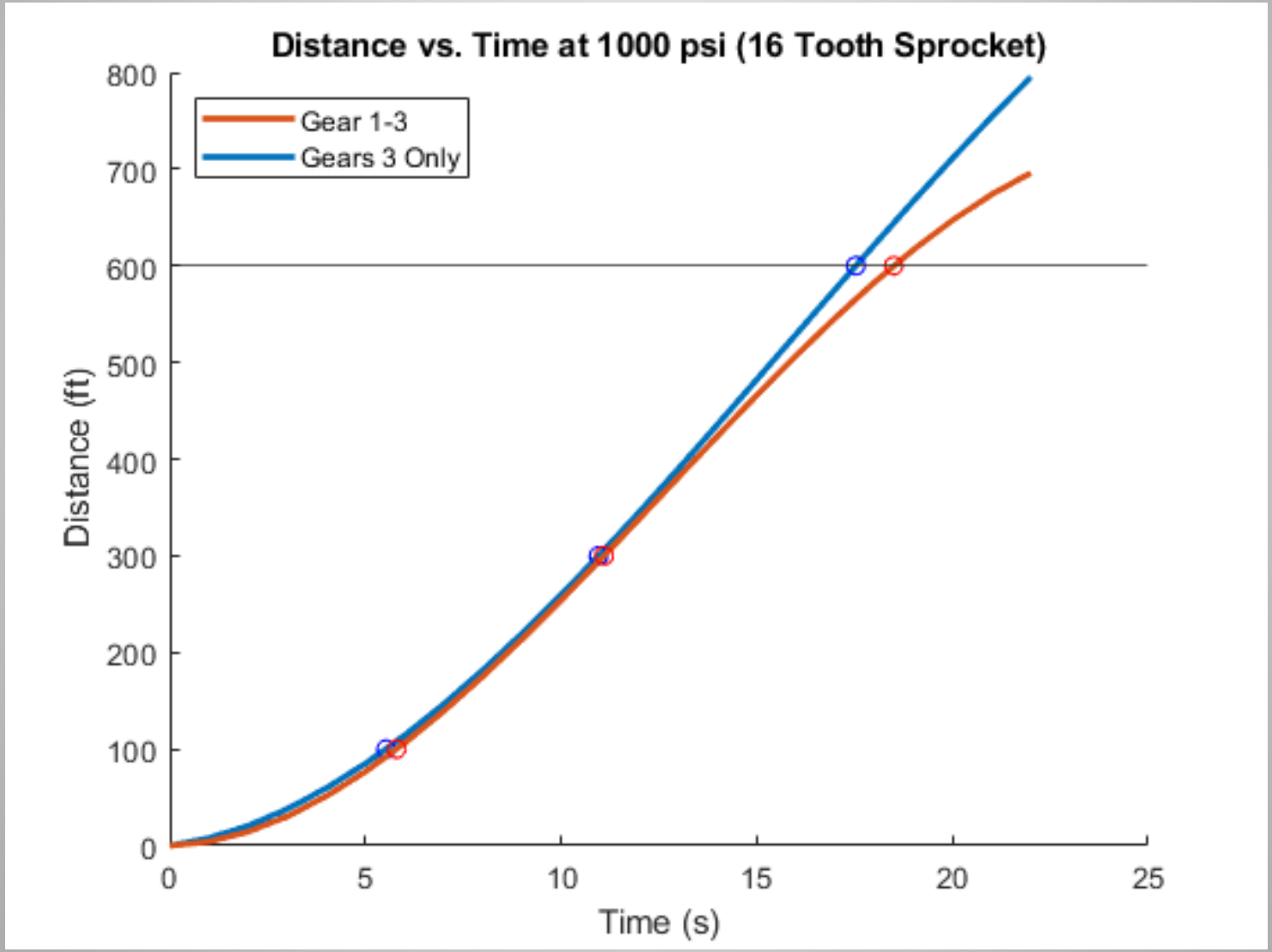

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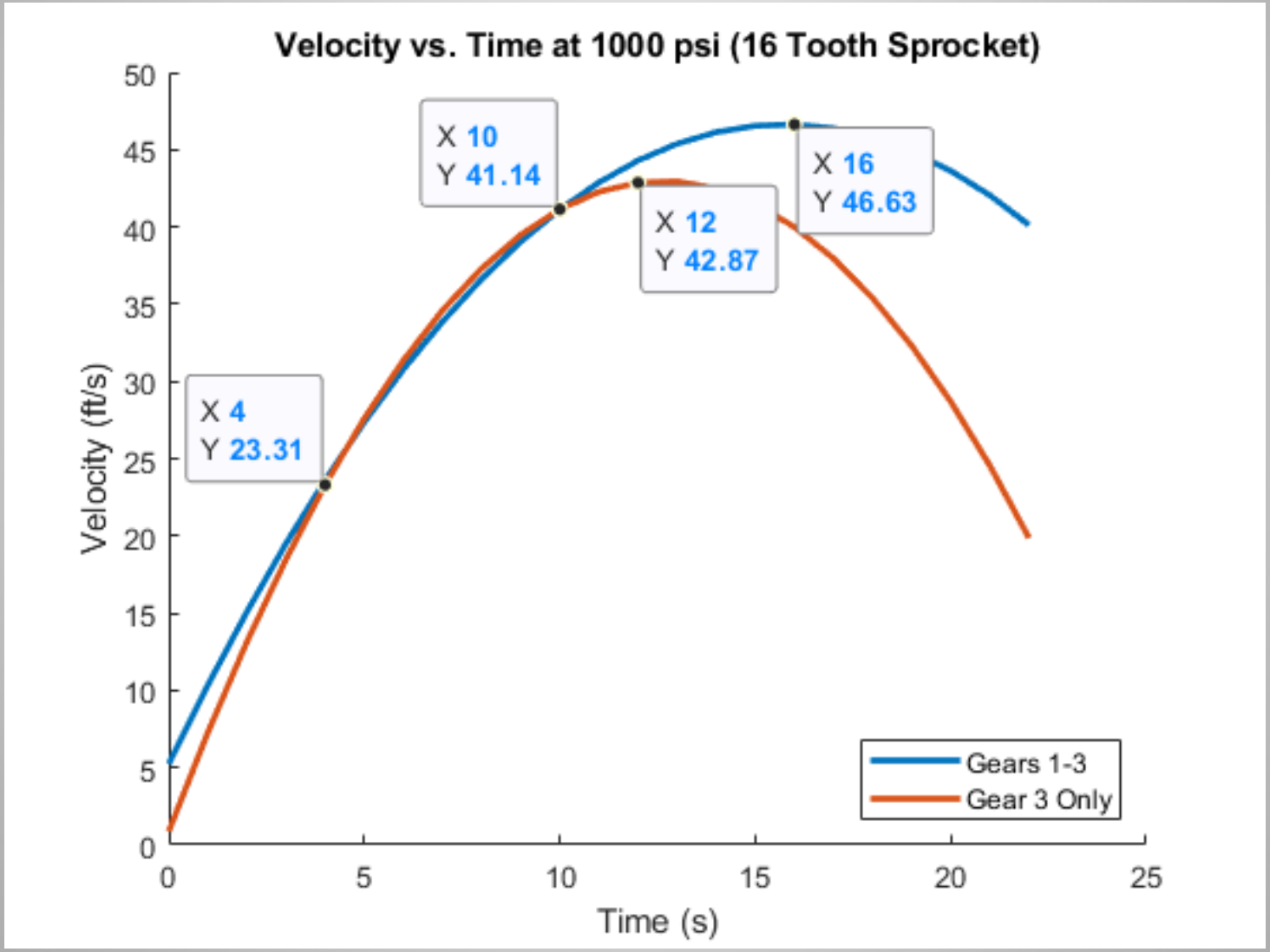

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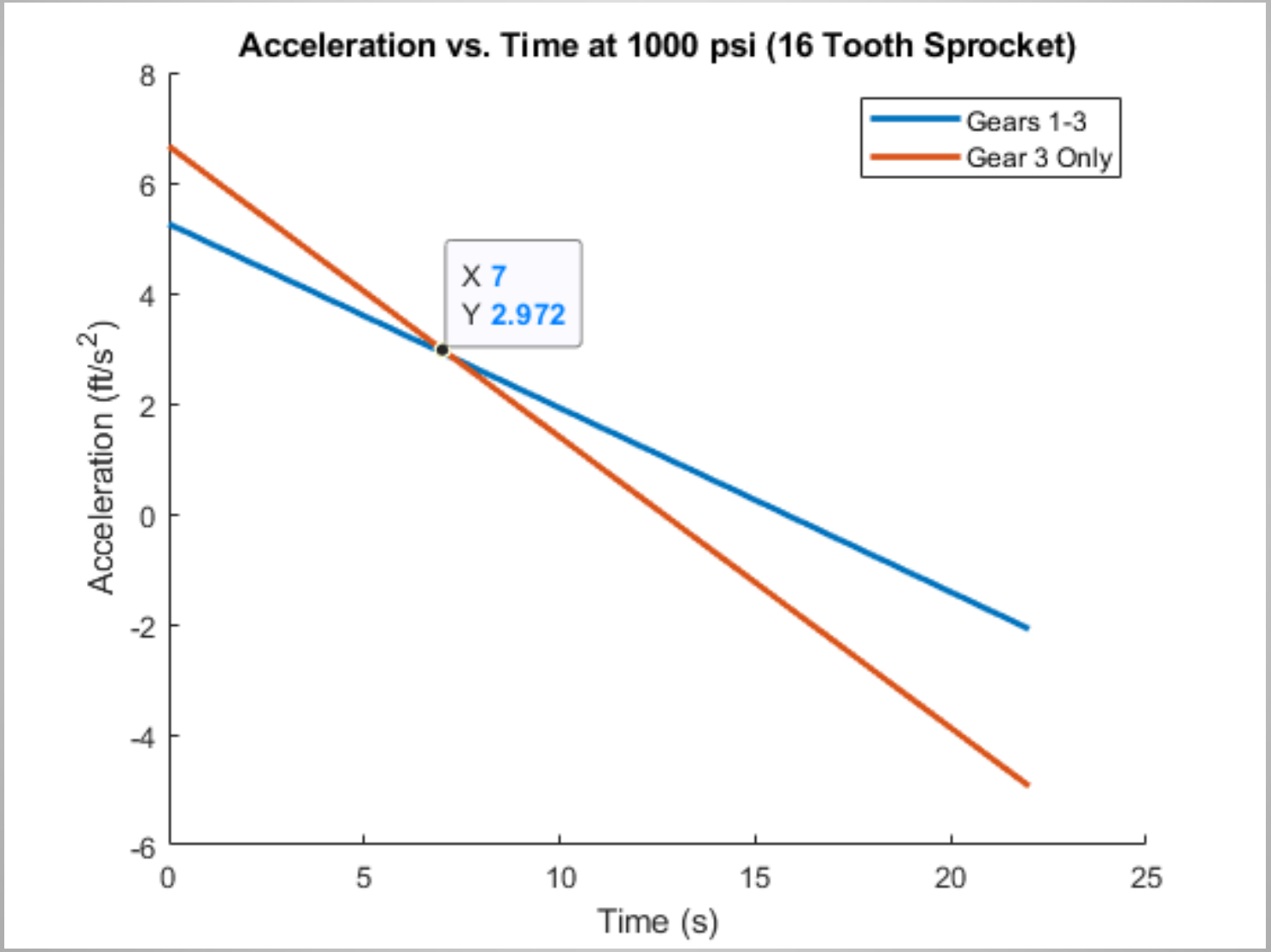
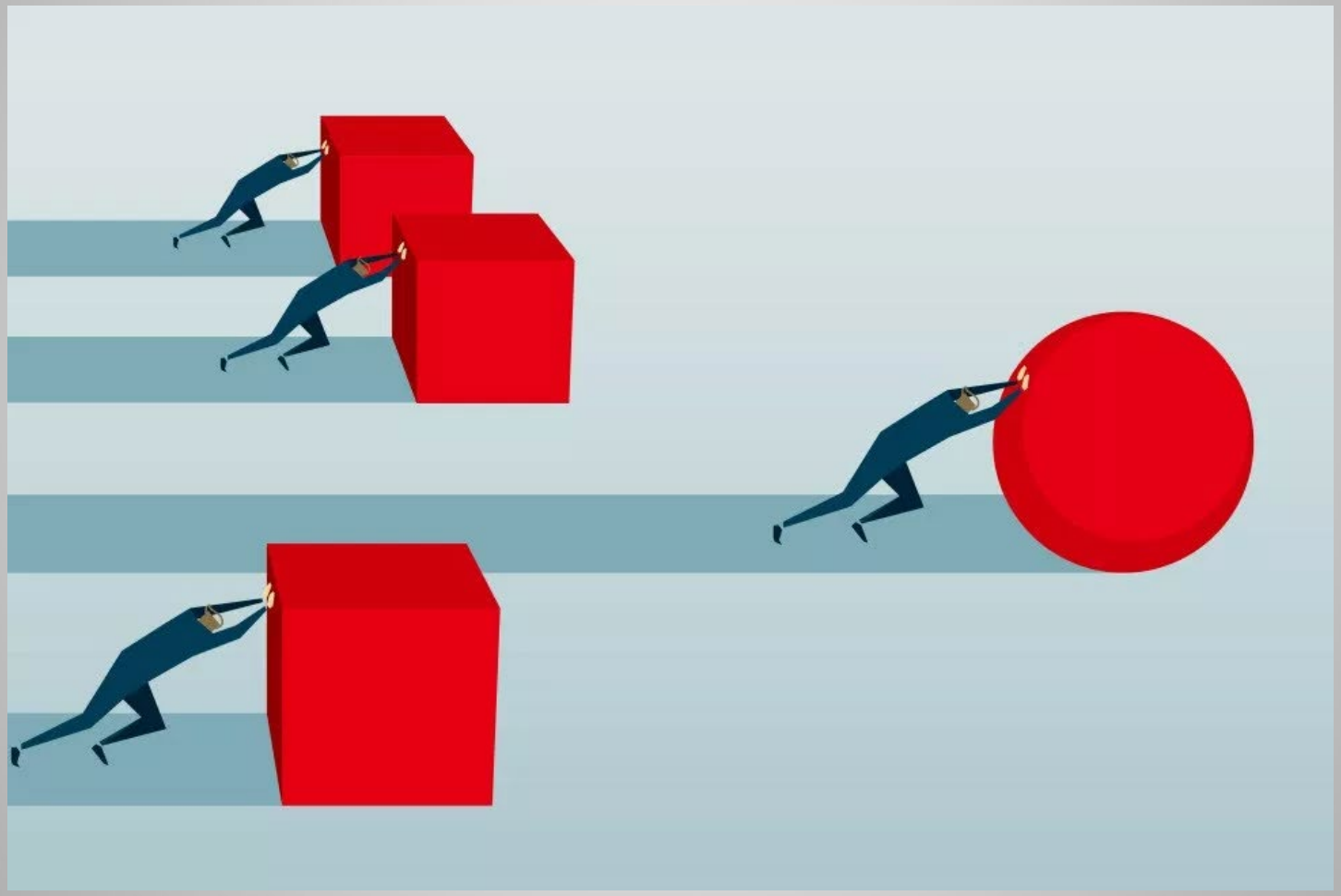


Efficiency Testing

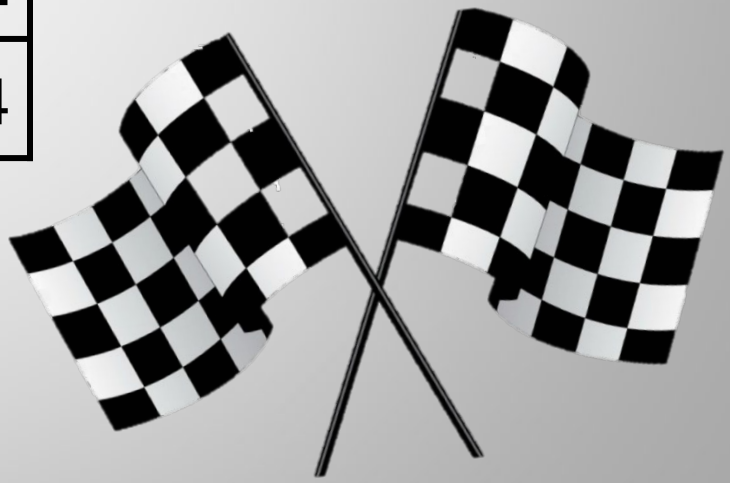


2.5 Gallon Accumulator

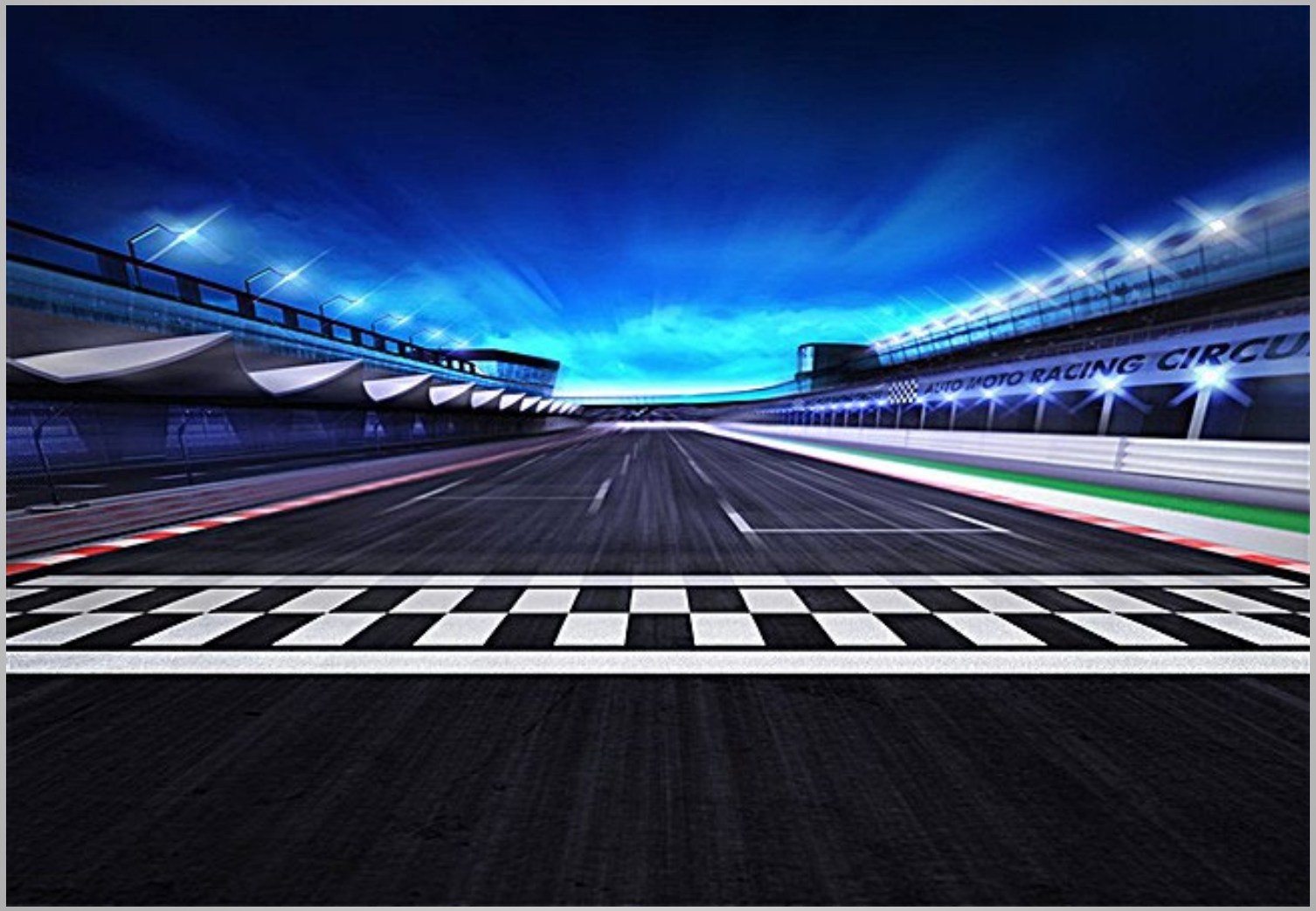
Precharge	Distance	Score
1000	4974.4	3.3
800	4995.8	4.16
600	4988.8	6.65

½ Gallon Accumulator

Precharge	Distance	Score
1000	1599.2	5.3
800	1452.2	6
600	1271.2	7.06
350	1031.2	9.82
150	915.2	20.34



Endurance

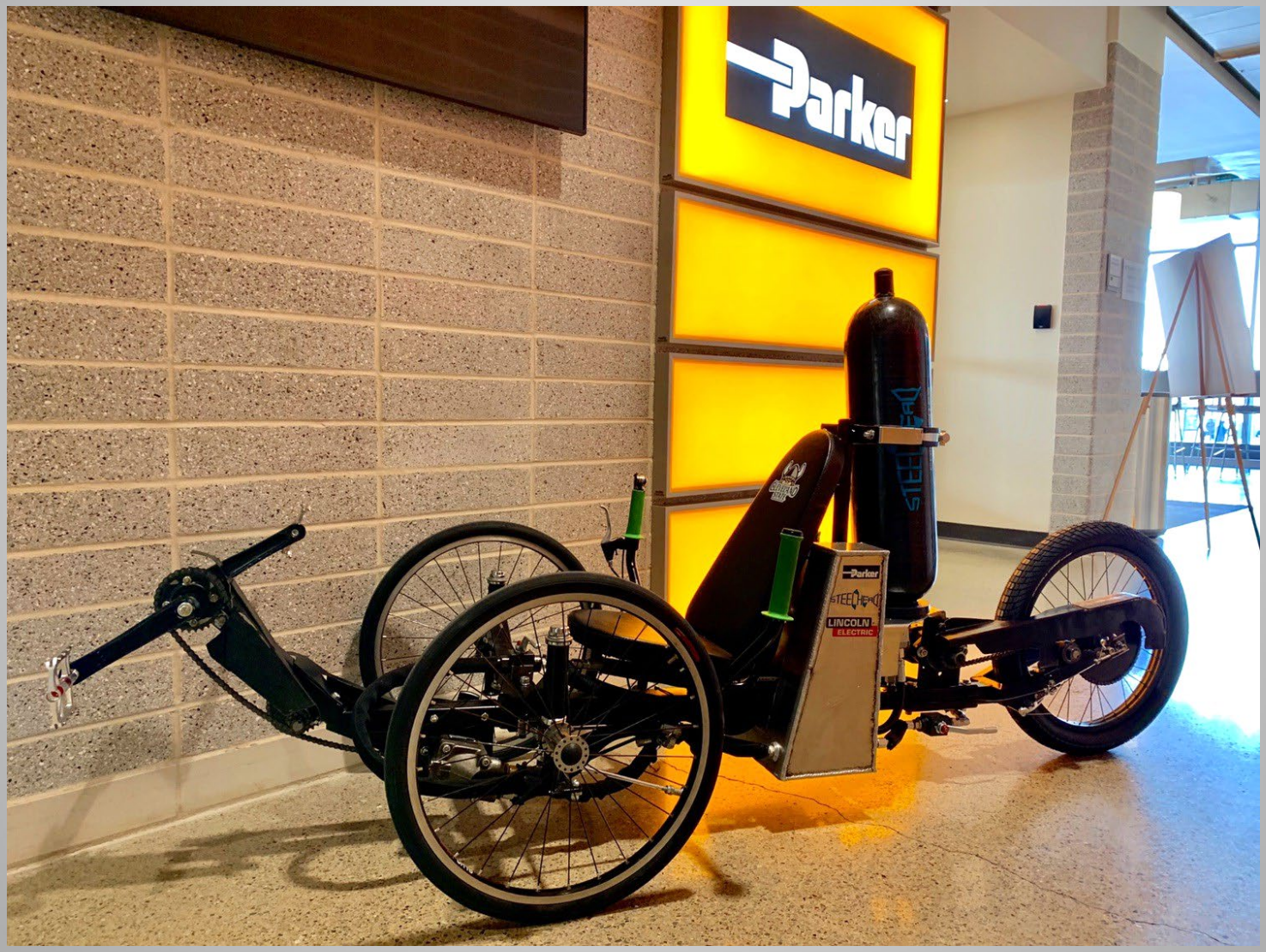


Lessons Learned

Lessons Learned Outline

- Fluid Power Circuit
  - Friction Loss in Fittings
  - Pull Valve
- Mechanical
  - Alignment
  - Gear Ratio

Final Vehicle



Questions

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