

N F P A

Fluid Power

VEHICLE

Challenge



NFPA
Education and
Technology
Foundation

Final Presentation
Cleveland State University
Advisor: Bogdan Kozul
April 28th, 2023



Team Members



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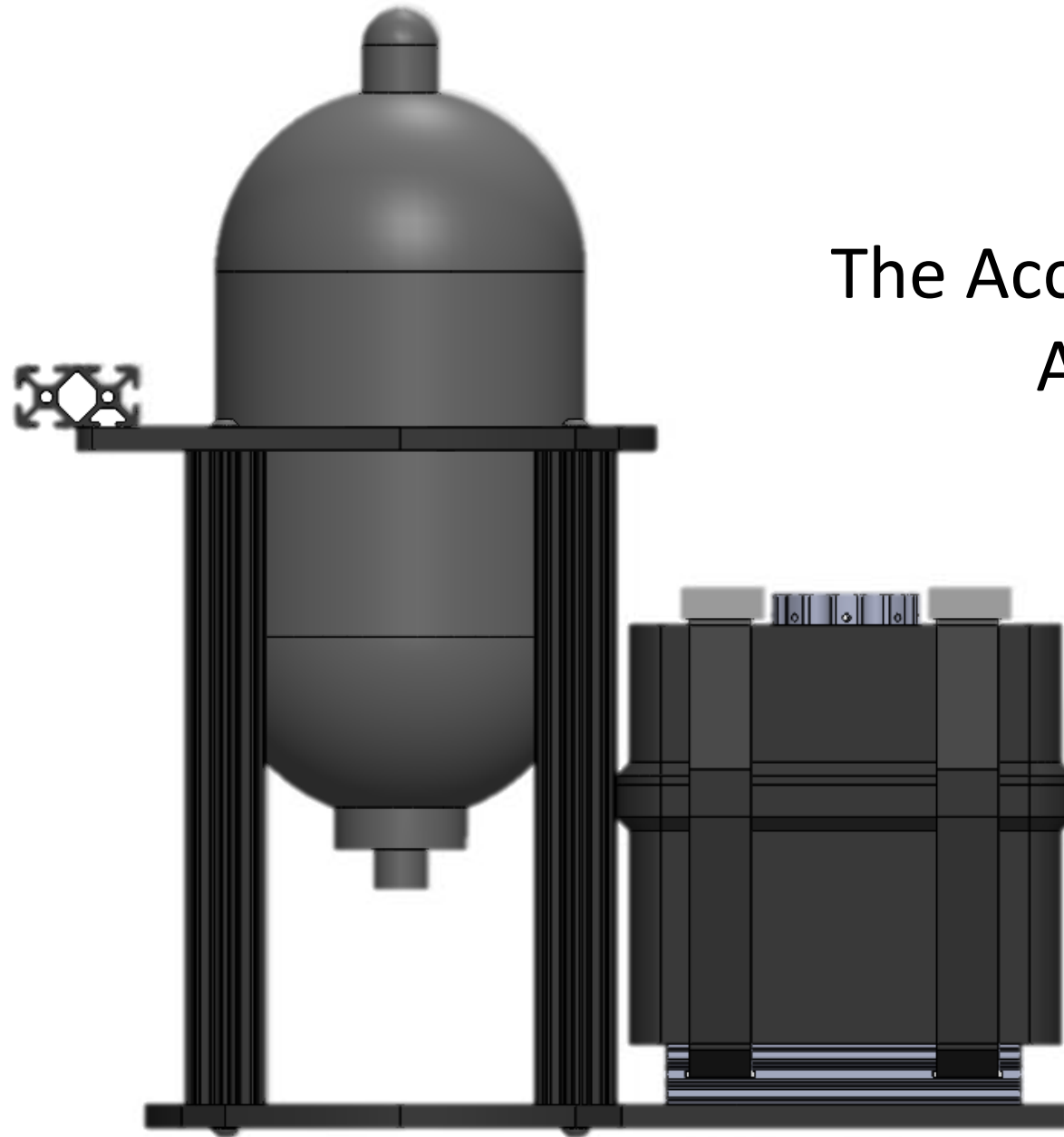
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The Accumulator/Tank Assembly

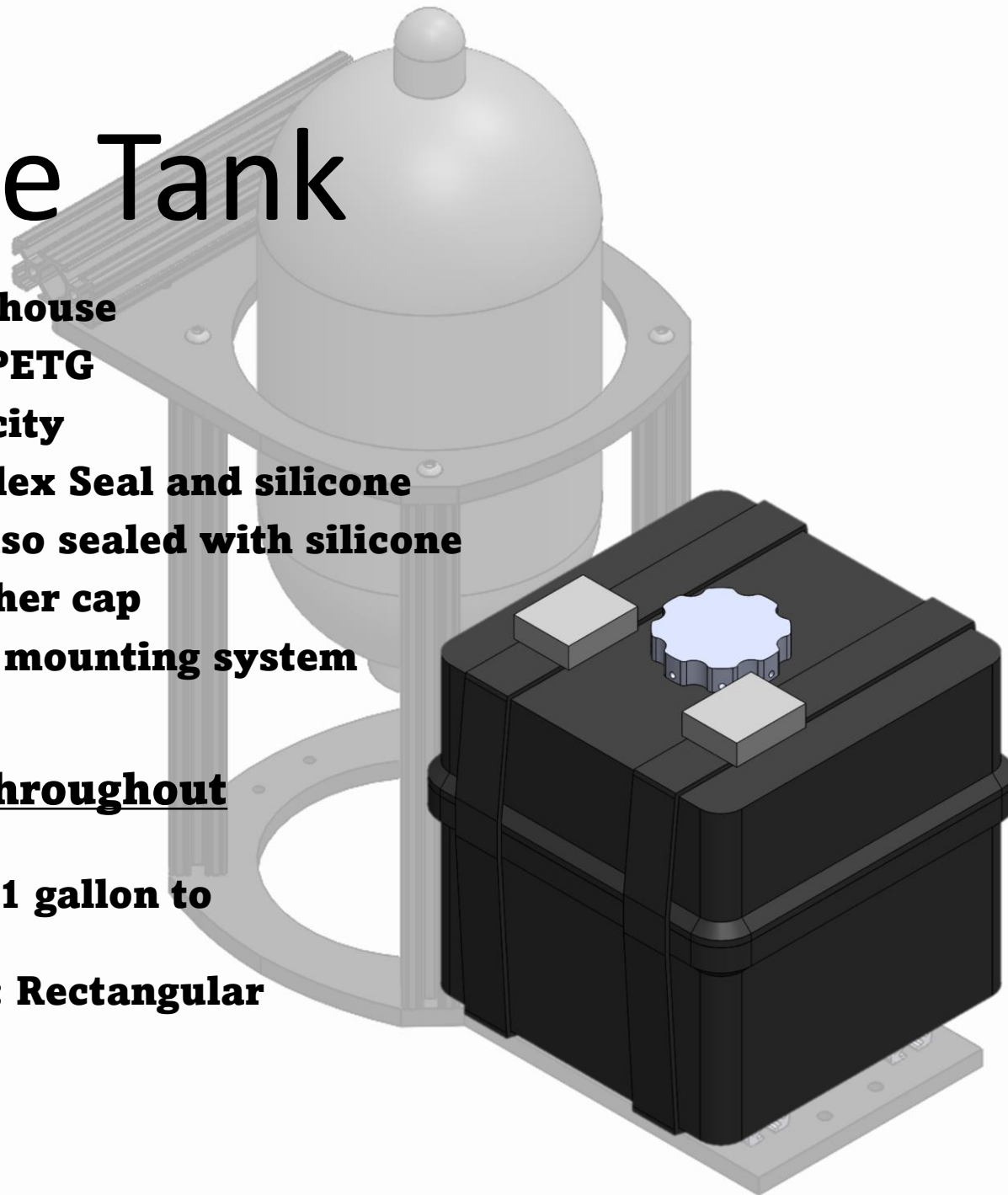


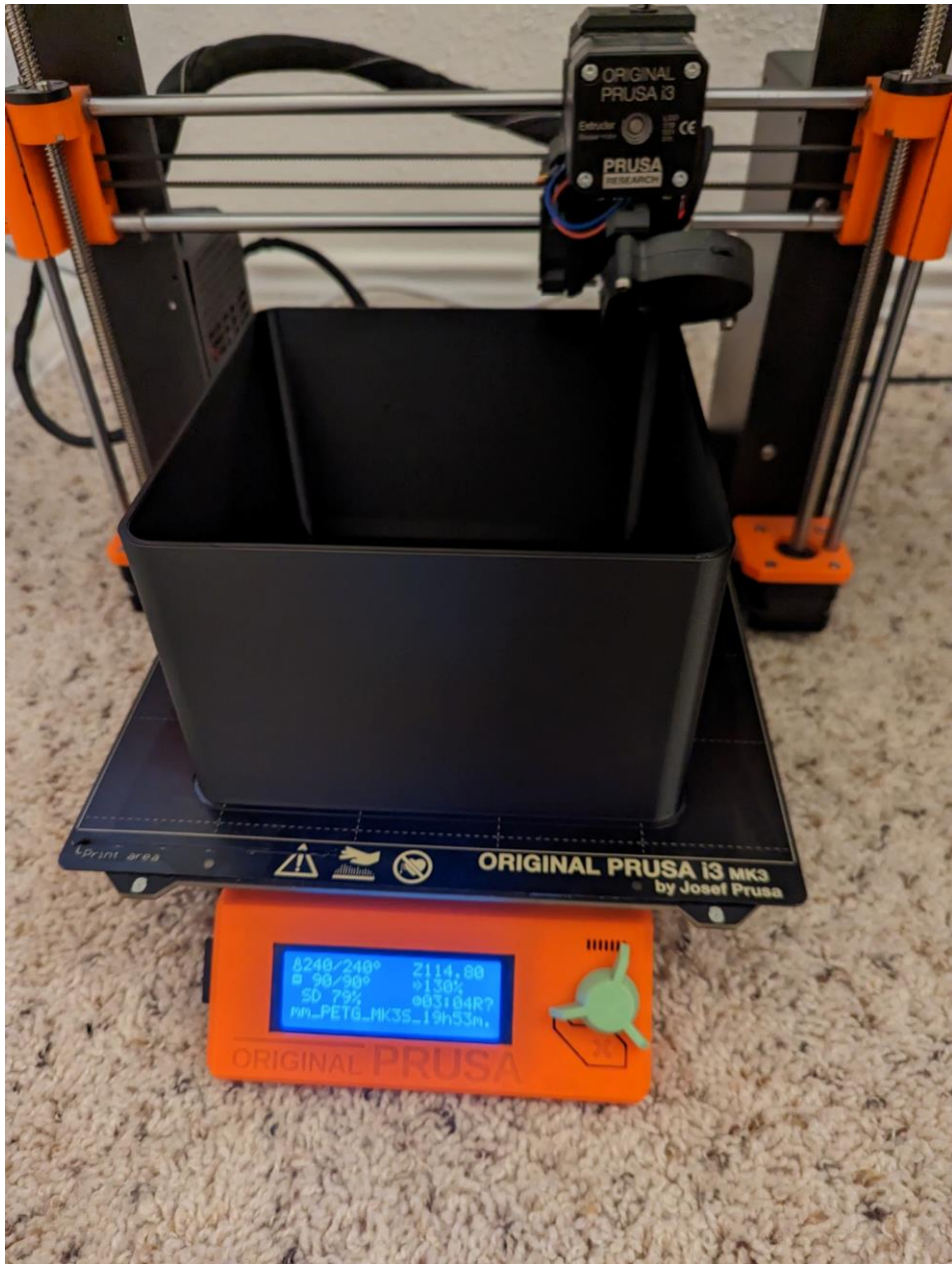
The Tank

- **3D printed in house**
- **Printed with PETG**
- **2-gallon capacity**
- **Sealed with Flex Seal and silicone**
- **Fittings are also sealed with silicone**
- **Custom breather cap**
- **Ratchet strap mounting system**

Changes Made throughout the Project

- **Size increased: 1 gallon to 1.5 gallon**
- **Shape Changed: Rectangular to Square**

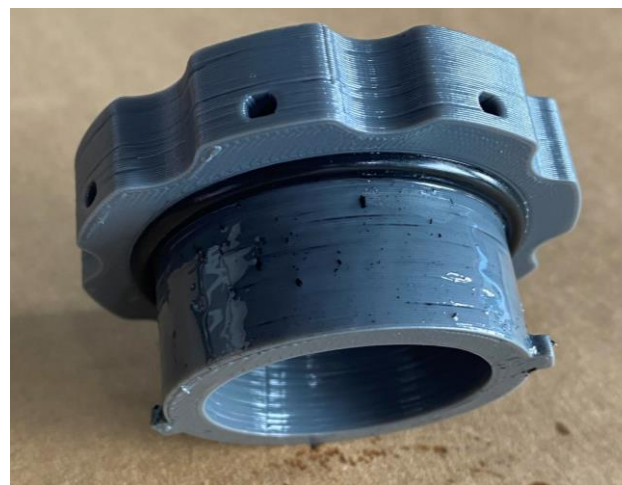




Tank being printed

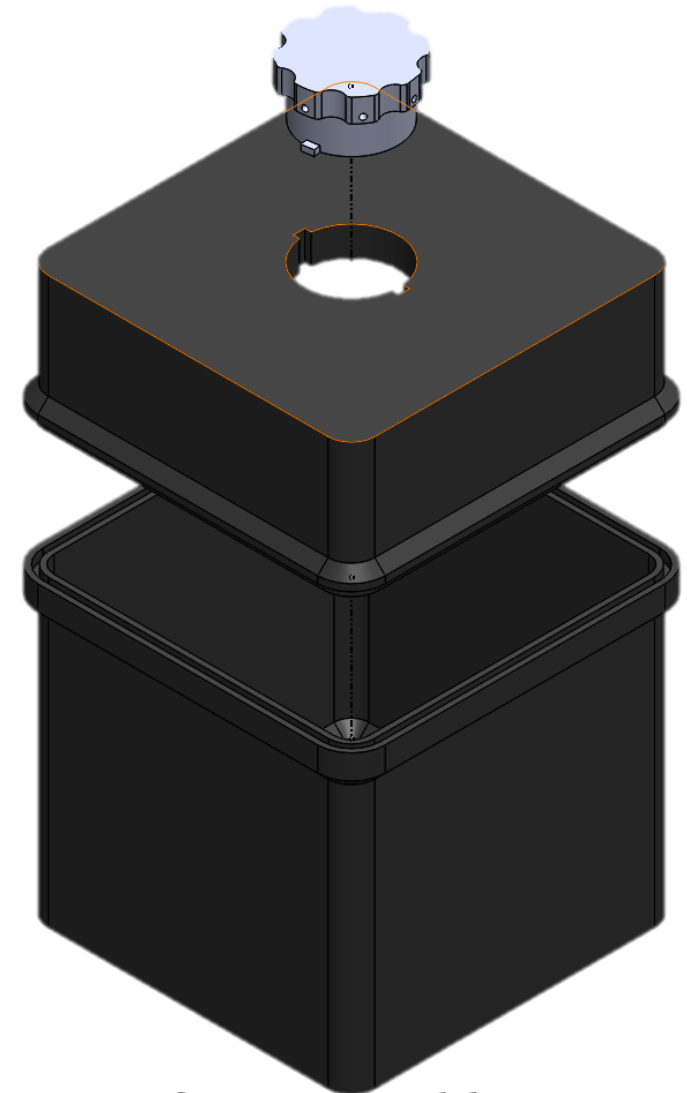


Fittings sealed with silicone



Custom breather cap

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CAD assembly

The Accumulator Mount

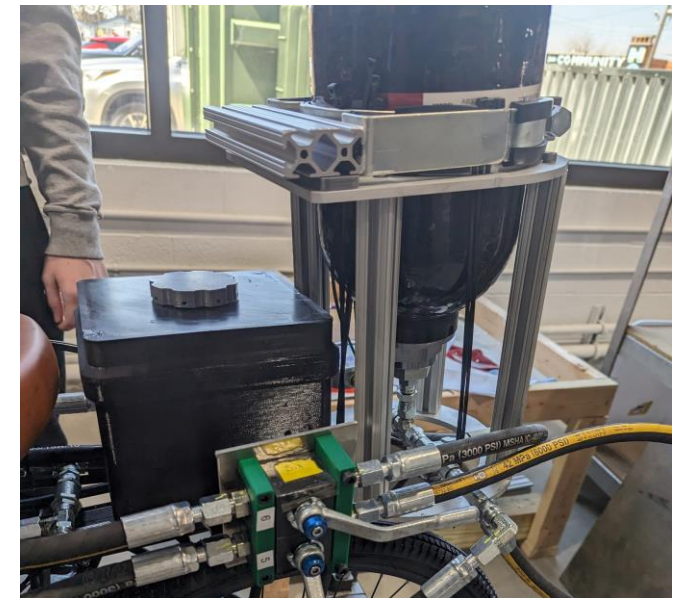
- **Plates were cut on a waterjet**
- **Accumulator height is adjustable**
- **Attached to off-the-shelf bike rack**
- **Includes tank mount**



Previous Versions



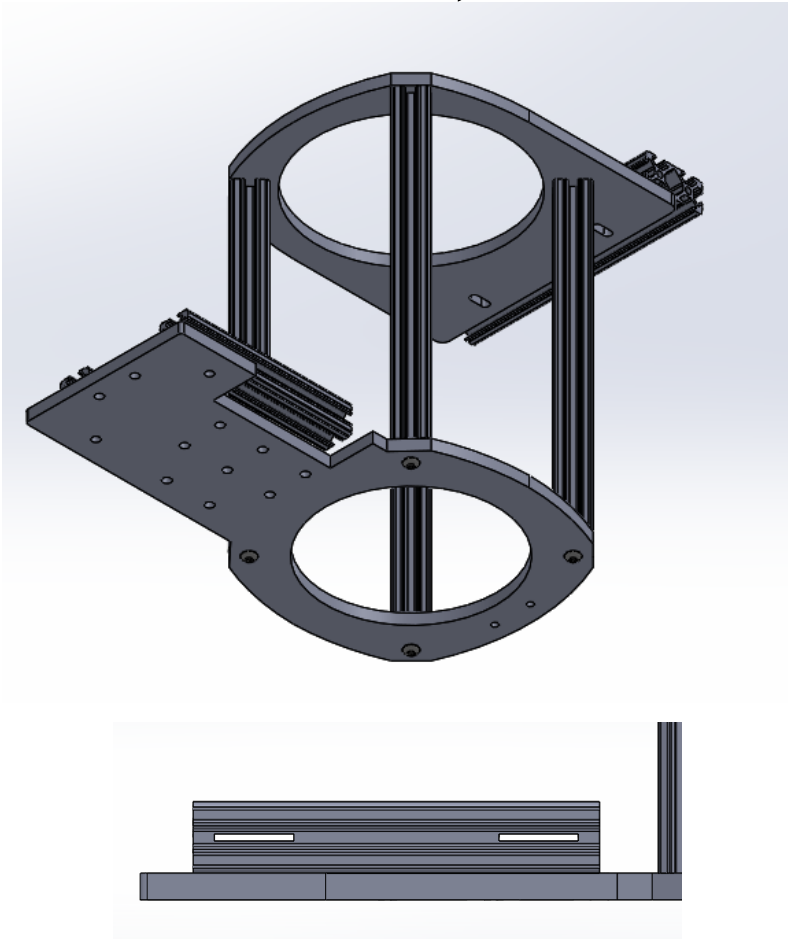
Version One: Too short, no room to mount tank

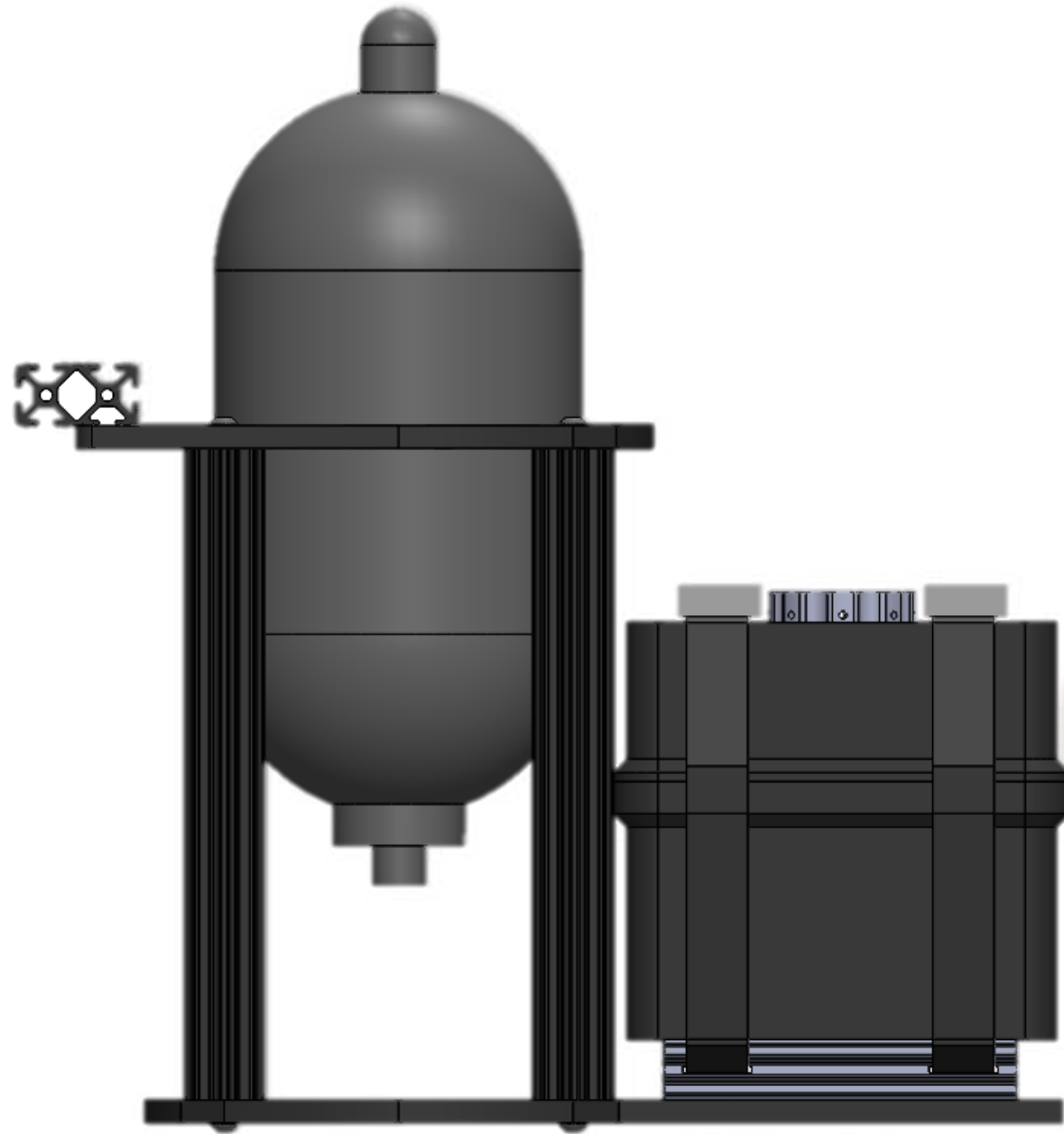


Version Two: correct height, but still needed more room for the final tank

Final Version

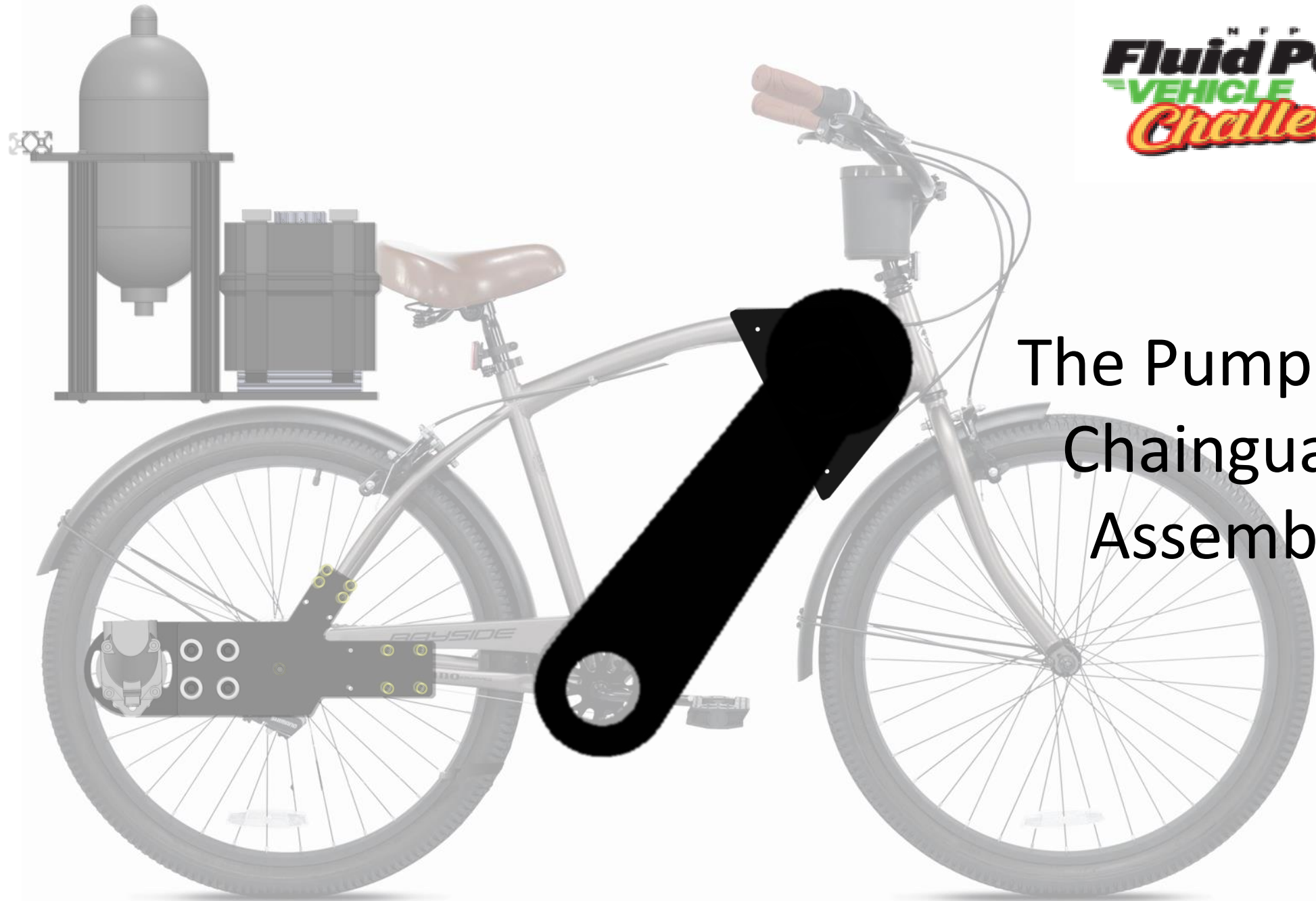
- **Extended bottom plate, added slotted extrusions to allow tank to be mounted, added cutout to incorporate valve mounting**





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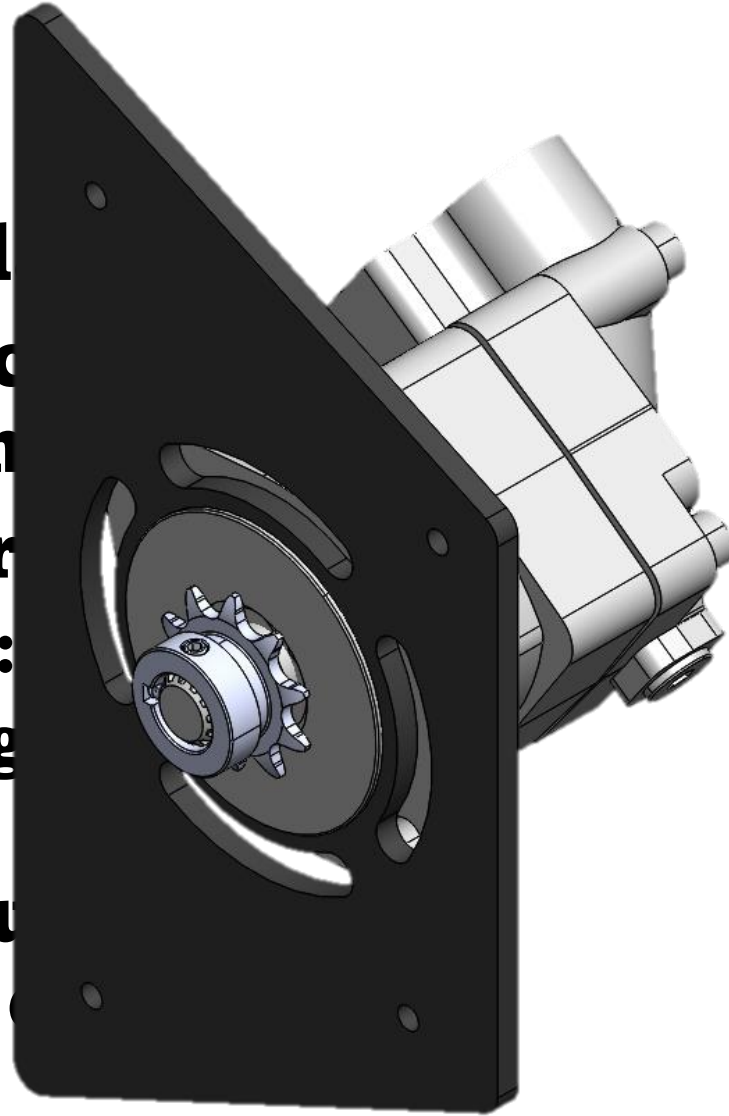
The Pump and
Chainguard
Assembly

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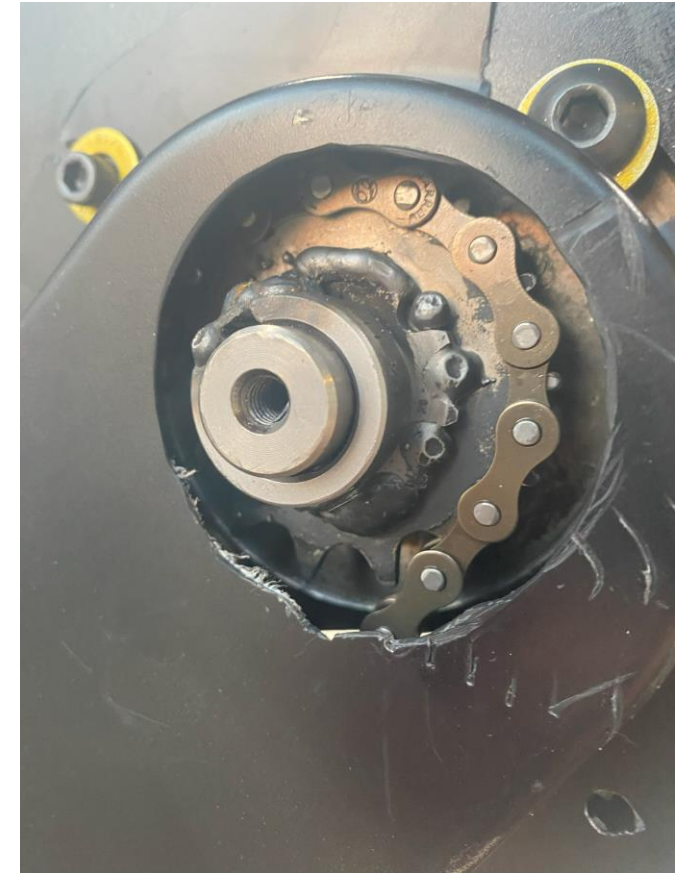


Pump Assembly

- **Custom fabricated plate**
- **Machine sprocket face work with bike chain**
- **Interchangeable gears**
 - **Direct drive gear (4.2:1)**
 - **Accumulator charging gear (3:1)**
- **Only change made during project was location of pump mount**

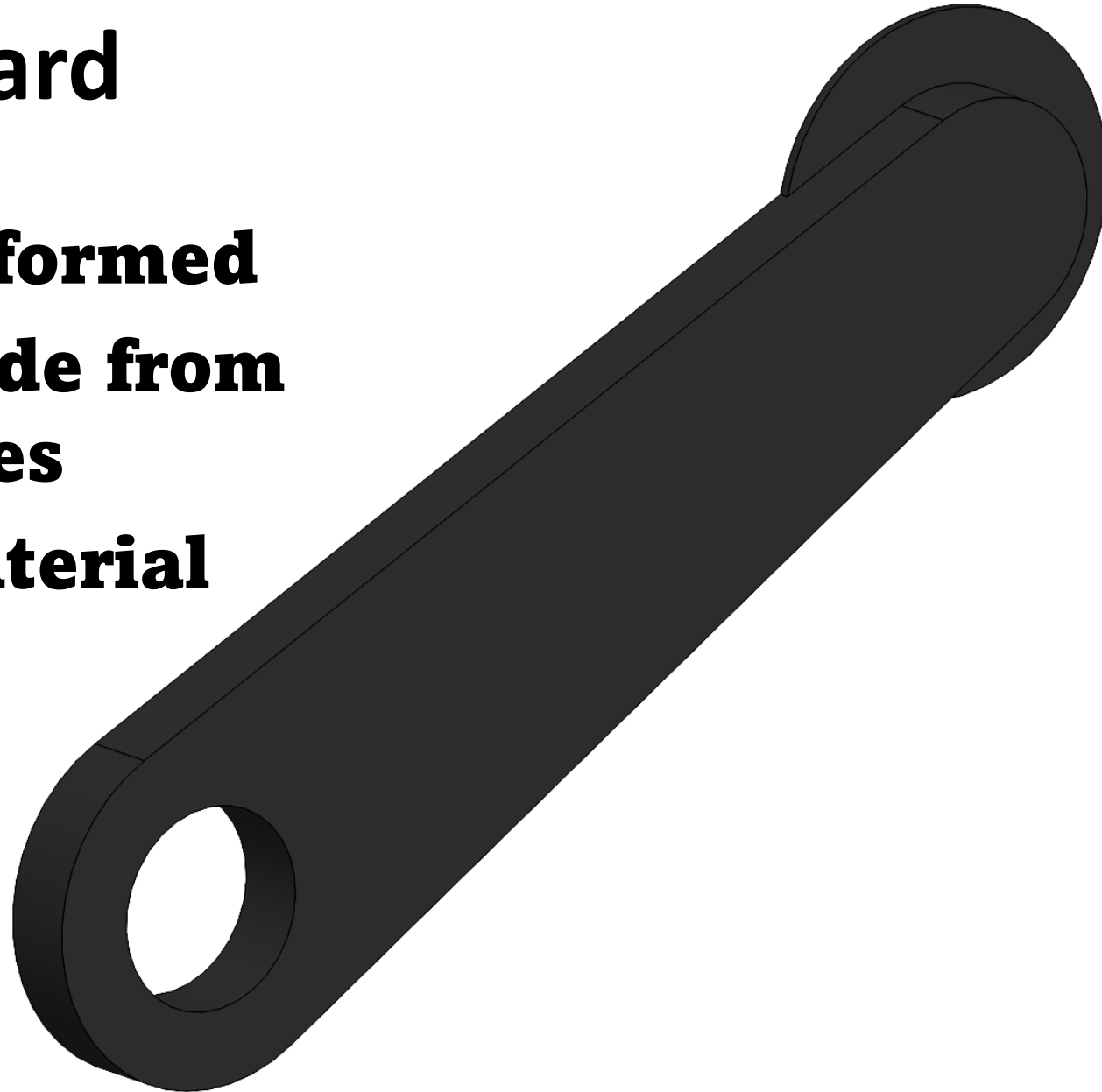


Pump Assembly Pictures



Chain Guard

- **Vacuum formed**
- **Mold made from PVC plates**
- **PETG material**



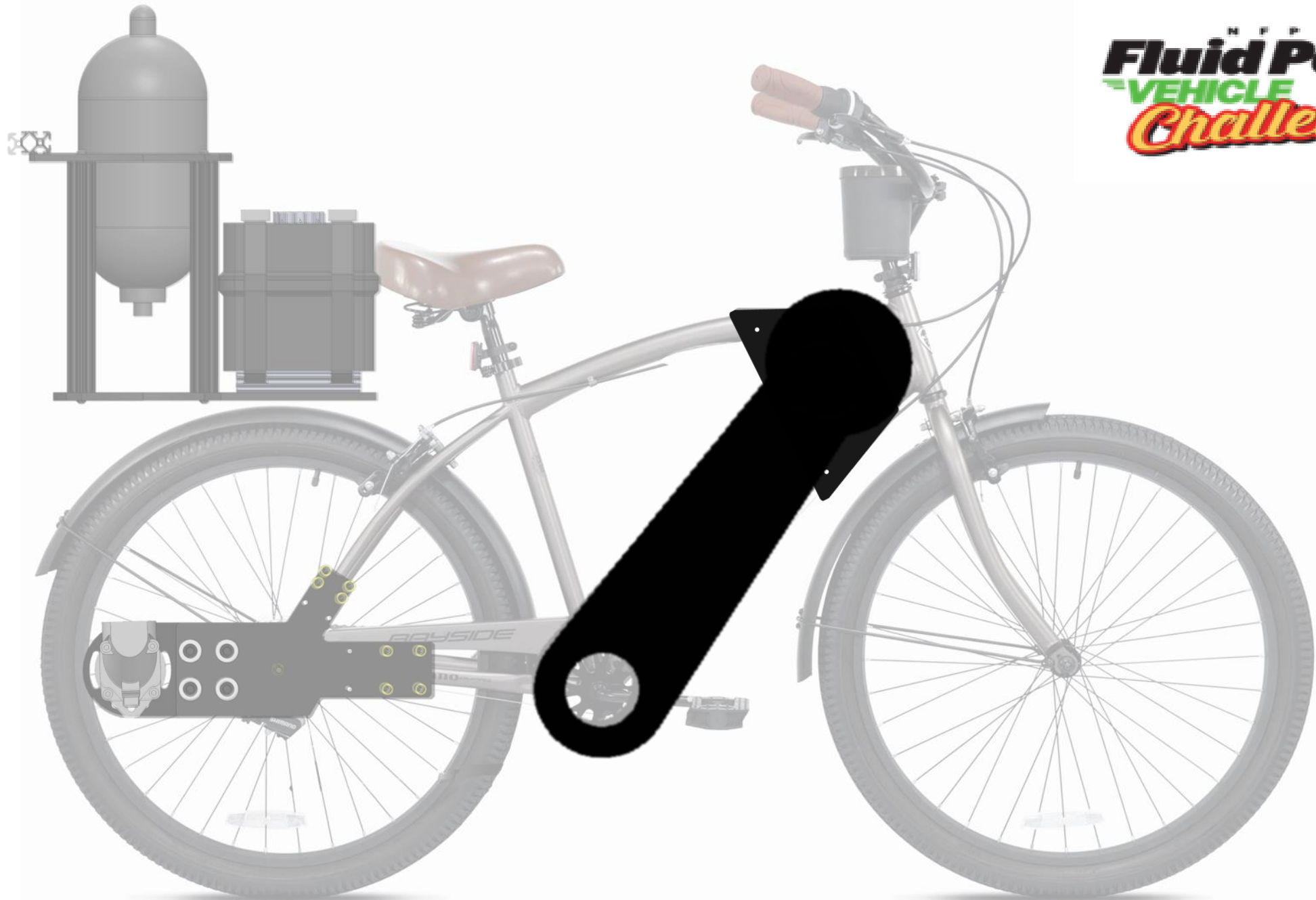
Chain Guard Fab



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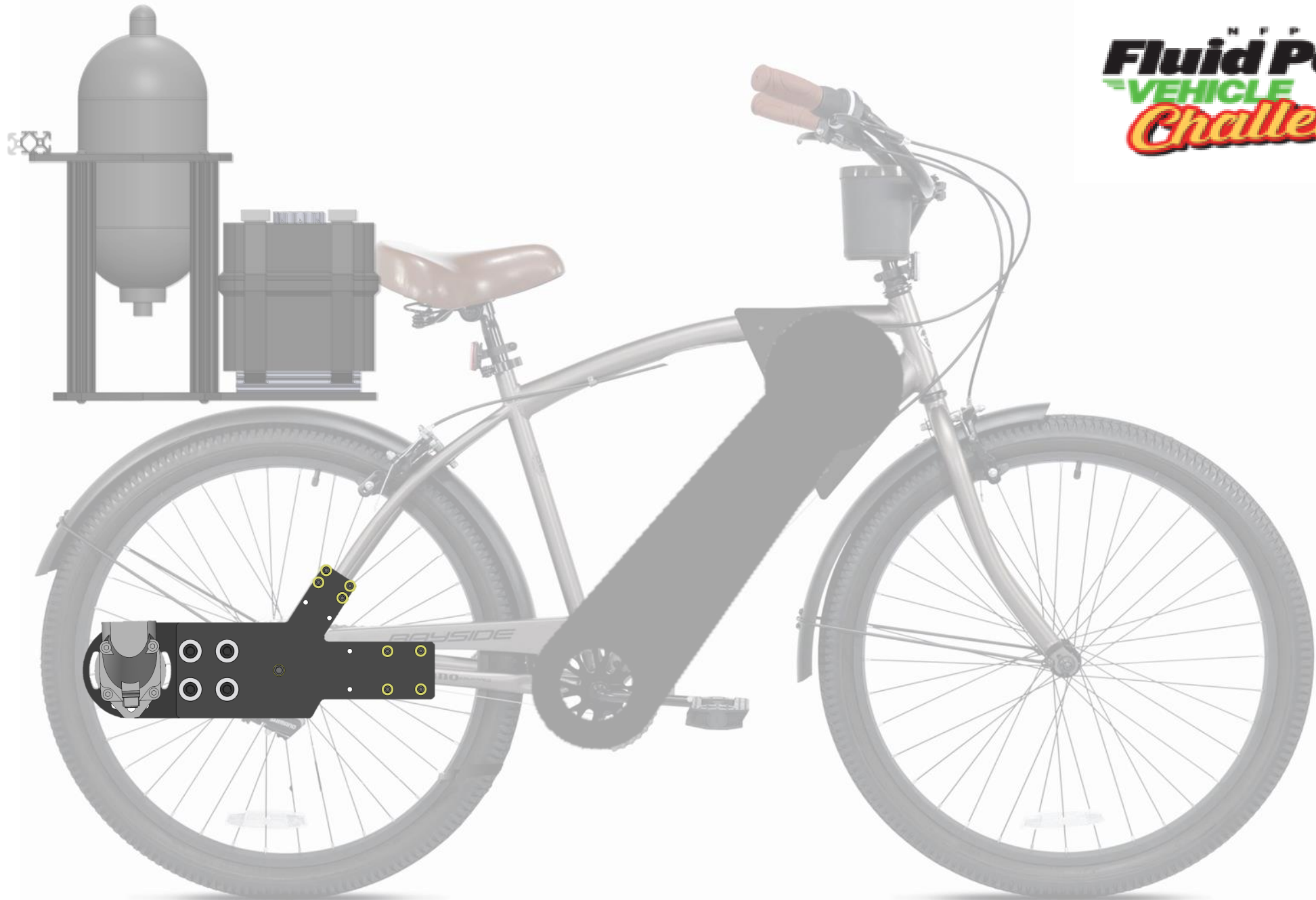
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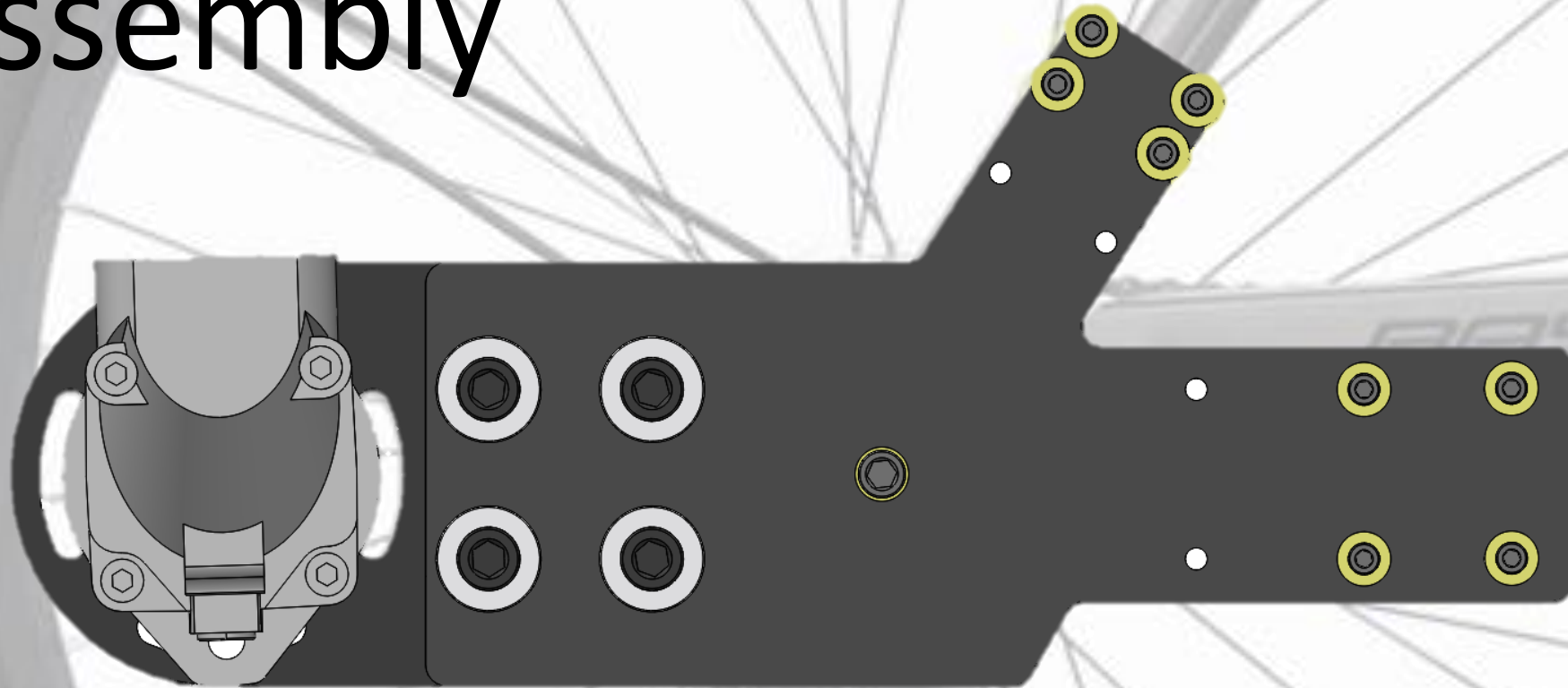


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The Motor Assembly

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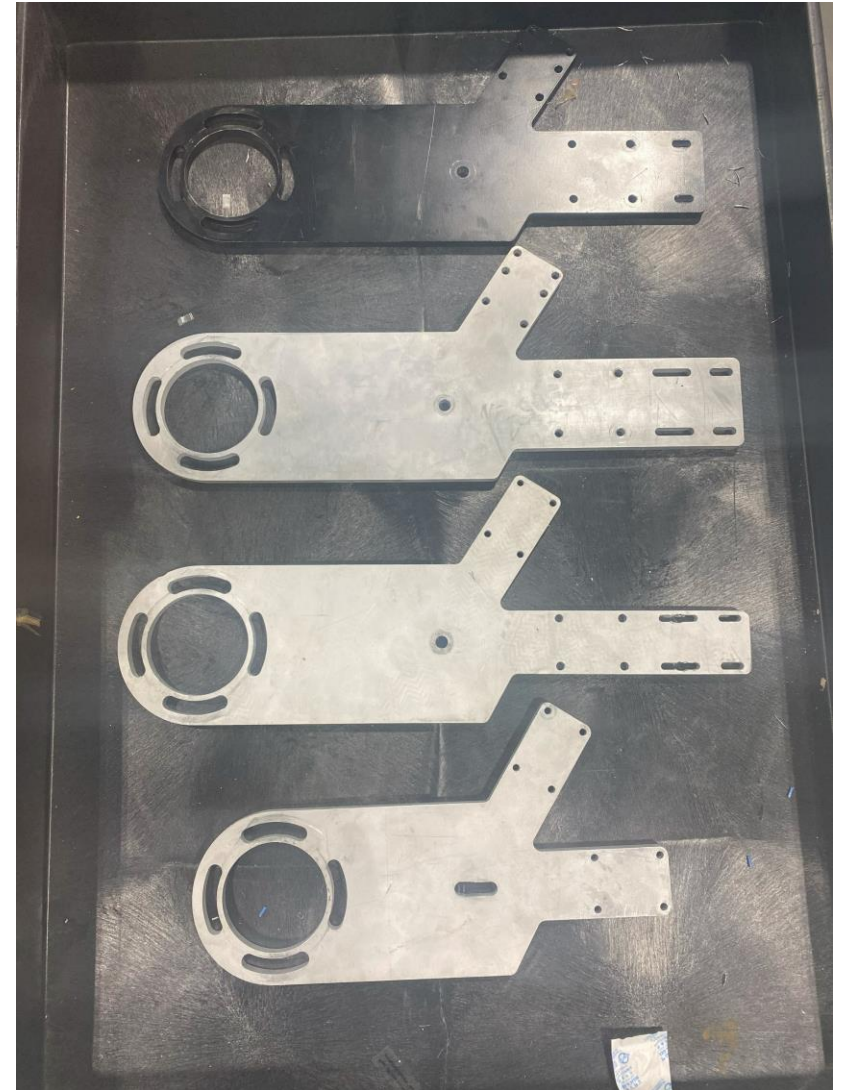
Motor Assembly

- **Plates cut on waterjet**
- **Adjustable spacer “legs” to maintain alignment**
- **Heavily modified 72T sprocket**
 - **Hub removed from sprocket**
 - **Custom plate attached**
 - **Welded to modified bike cassette**
- **6.5:1 Gear ratio**

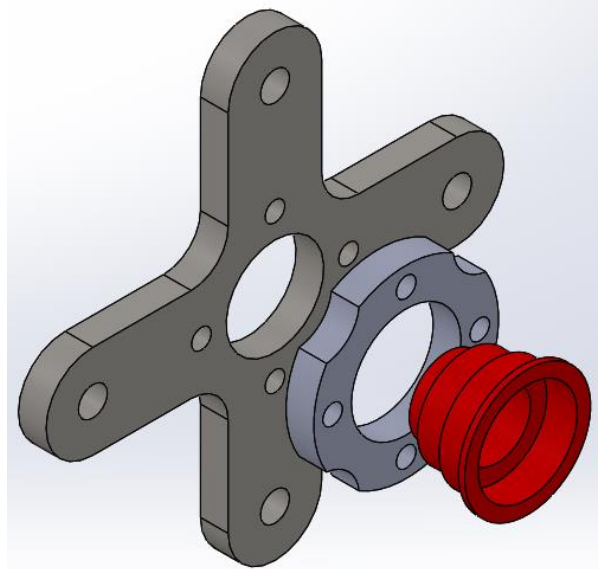
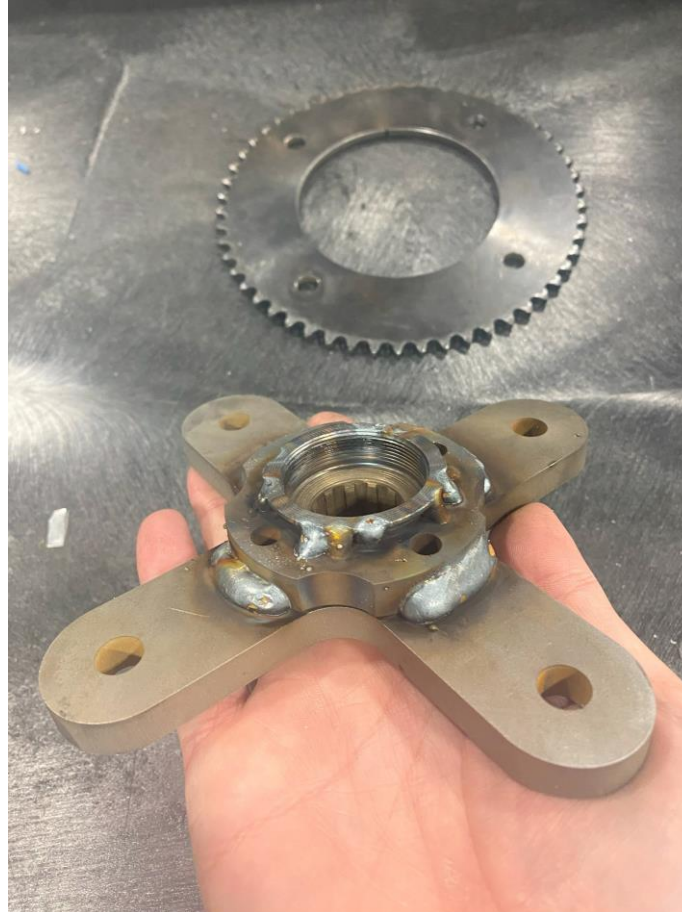


Previous Versions

- **Bottom is V1 and top is V4**
- **Changes were made for**
 - **Alignment adjustment**
 - **Sprocket distance**
 - **Reliability**



Current Version



Valve Mounting



Valve Mounting



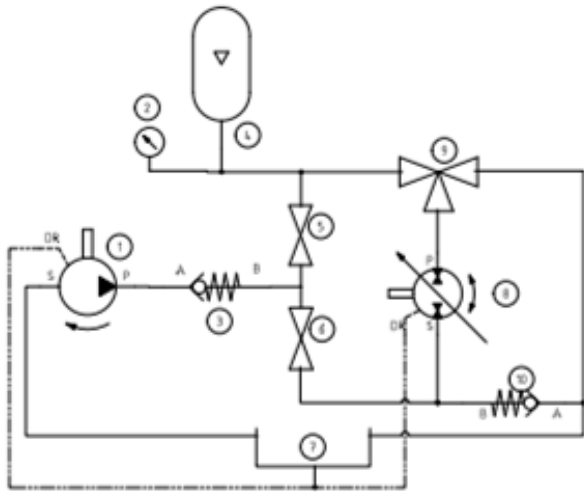
Valve Mounting



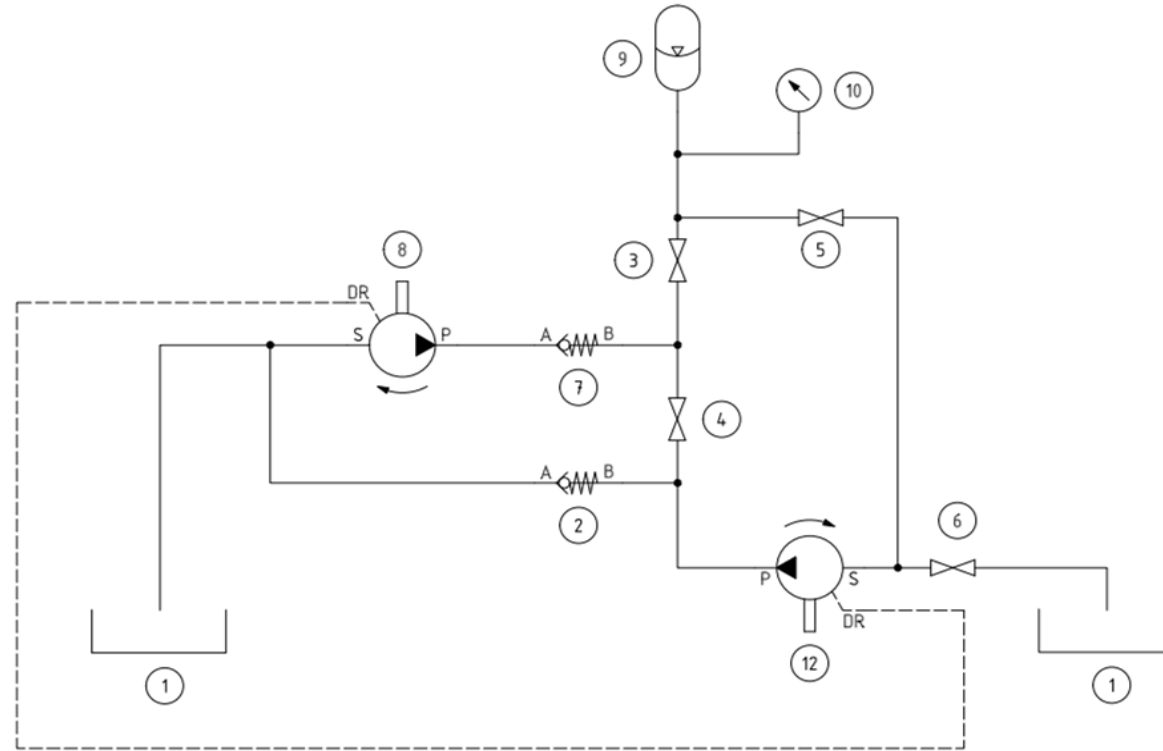
Valve Mounting



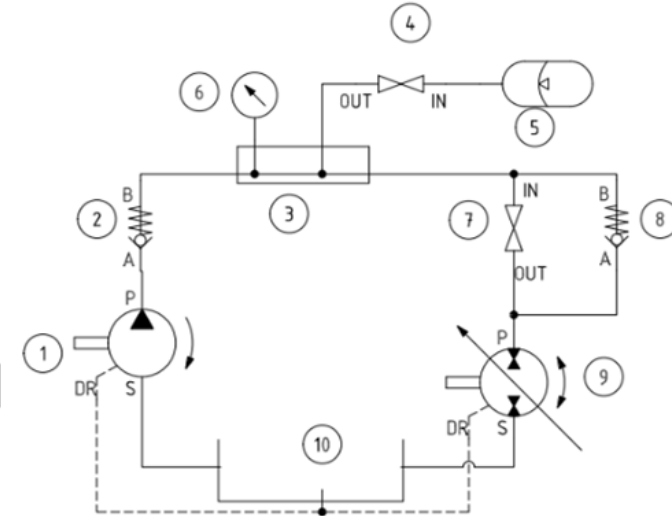
Circuits



**Last year's
circuit**



**2023 Final
Iteration**



**2023 First
Iteration**

Design Remarks

- **Every assembly was custom made from scratch for this bike, except the bike frame and rear rack**
- **All parts that were machined and/or modified were done by team members, no work was outsourced**
- **Parts were designed and manufactured with safety in mind**
- **All custom fabricated parts were deburred, sand-blasted, and painted before assembly**

Our Team in Action



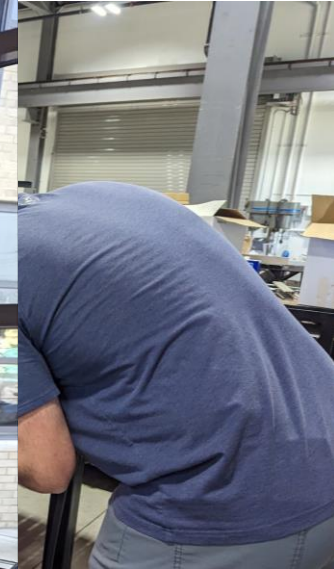
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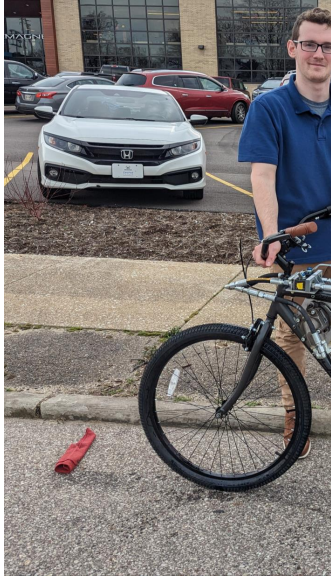
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Our Team in Action



Our Team in Action



Lessons Learned



- **Gear sizing and alignment are crucial when creating a competitive bike**
- **Custom frame, though heavy in design and fabrication efforts, would have been a much more build-friendly alternative.**
- **Determining individual team member's strengths allows for maximum productivity**

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Questions?