Design of a One-Handed Bike Pump

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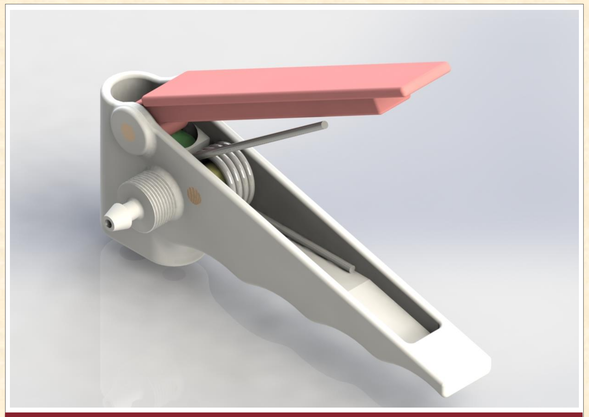
University of New Hampshire

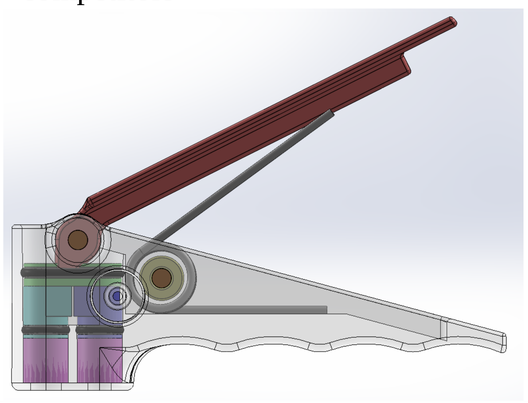


Introduction

The goal of this project was to design, assess, and build a bicycle pump valve that can be operated with one hand for those with hand impairments and amputees. The product was designed to utilize off-the-shelf parts used in standard cam-action valves made by Park Tool. Custom parts were designed with plastic injection molding in mind to keep costs low.

Objectives

- Usable with one hand
- Utilize off-the-shelf parts from Park Tool valve assembly
- Custom parts to be injection molded
- Match pressure capability of competitors



Methods

Research

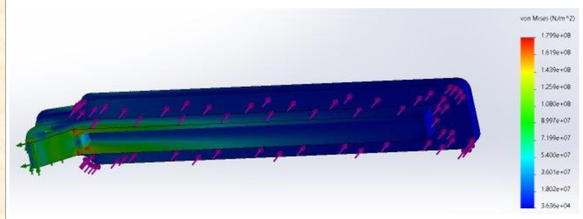
- Performed competitive analysis to find strengths and weaknesses of products already on the market
  - Cannondale Max Air / Cam Style Pump
- Analyzed 2019-2020 Bike Pump Team's design to weigh options of improving their design or starting fresh

Design

- Sketched 3D CAD models that incorporated the Park Tool ball valve system. When thinking of locking designs, mechanical advantage should be considered.

Analyze

- Utilized the SolidWorks Simulation package to analyze and estimate the strength of components prior to prototyping



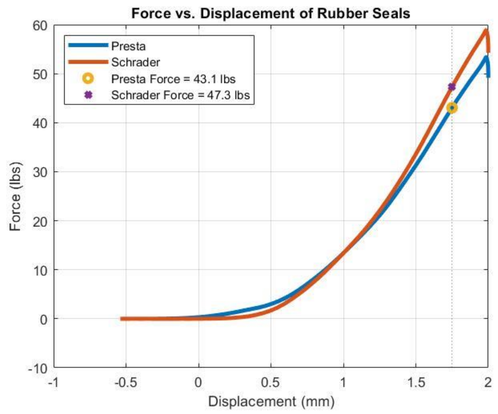
Develop

- 3-D printed prototypes to find weak points in the design

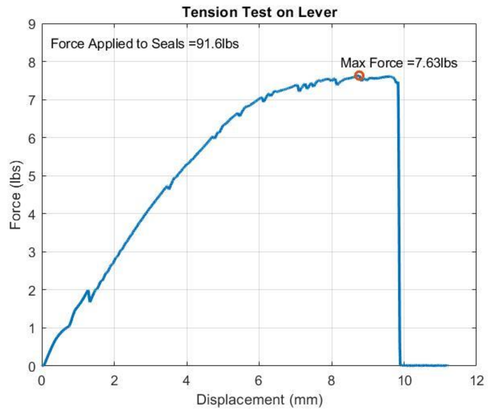
Test

- Visited Olsen Center to use Zwick 5.0 Machine Testing for compression testing of the rubber seals and a bending strength test of the lever
- Pressure testing done with an air tank

Results



Using the Zwick 5.0 static testing machine, we found that the rubber seals needed about 45lbs of force to compress 1.75mm.



Once the necessary force was known, the strength of the lever and main body was tested to make sure they were strong enough to supply that force. The 3D printed parts were able to supply over double the force needed before delaminating along a layer line. Improvements were then added to the CAD model.

Conclusions

- System is easy to apply to a tire valve with one hand
- The pressure capability needs to be improved. Increased tire pressures need more rubber seal compression, which leads to the lever pin hole breaking/delaminating

Next Steps

- Test UNH 3-D printed prototype made with ABS and compare to strength found in analysis and testing of PLA prints
- Further improve the design to handle the forces experienced in testing
  - Increase strength of the main body around the lever pin and continue pressure testing
- Consult industry experts to ensure moldability of custom parts
- Create test rig using the Park Tool's main body to prove viability of the sprung lever design

References

https://www.rei.com/rei-garage/product/163745/cannondale-airspeed-max-mini-pump