Novel Grease Gun Design

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Introduction

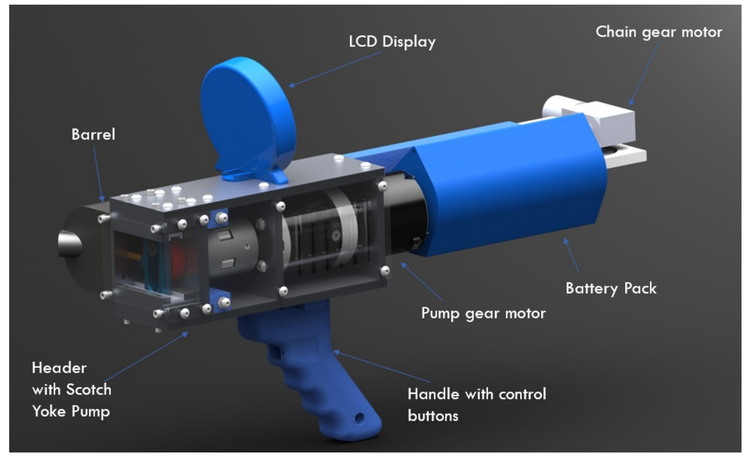
- Grease guns are a key tool for valve maintenance and have remained stagnant in design for the past 70 years.
- **Current grease guns are manually operated which requires:**
  - **Extensive labor/effort to use**
  - **Causes valves to be greased by feeling**
- Our project aims to design, manufacture and test a hand-held, innovative prototype that provides objective greasing while improving ergonomics and reducing labor intensity.

Requirements

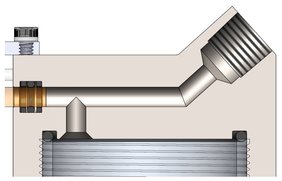
- Incorporate novel innovations
- Functional, electronically actuated prototype
- Design for maximum pressure of 10,000 psi
- FOS of 3.5 for all pressurized components, else 2.0
- Pressure blowback prevention
- Hand-held (<25 lbs)
- Capable of sensing and displaying grease pressure and safety information
- Design validation through prototyping

Design & Key Components

- Dimensions: 19.35” long, 5.66” wide, 8.83” tall
- Dry weight: 15 lbs
- Total grease volume: 0.5 L (18 fl. Oz)
- Our grease gun design utilizes a motorized chain mechanism to prime and push the grease into the high-pressure header
- The grease is then pushed out at high pressure by the motorized scotch-yoke pump
- The pressure, flow and level remaining are detected by sensors and displayed.
- Pumping stops once preset parameters for a specific valve are met

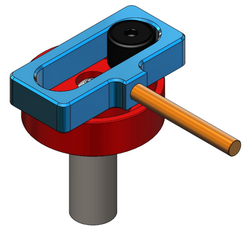


High-Pressure Header



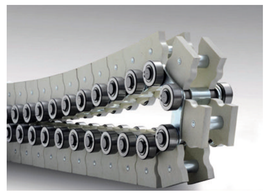
- Made of 4340 Steel
- 45-degree outlet
- Seals with Nitrile O-rings

Scotch-Yoke Pump



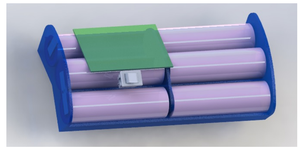
- Made of 4340 steel
- Driven by an electric motor @ 60 rpm

Compact Rigid Chain



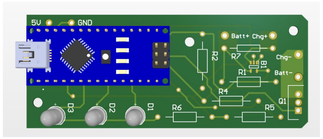
- Industry-first application
- Significantly reduce size and weight
- Designed for additive manufacturing

Battery Pack



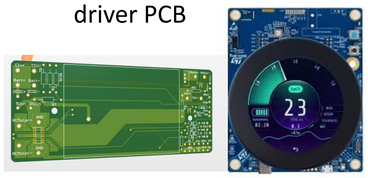
- 24V, 4Ah battery pack, fuse protected, rapid charging

Charger PCB



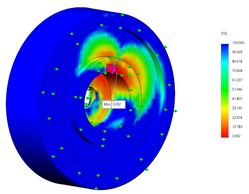
Sensors

- Grease Level Sensor
- Pressure transducer
- Motor speed sensing
- Current-based motor load sensing
- Battery monitoring
- Custom sensor & motor driver PCB

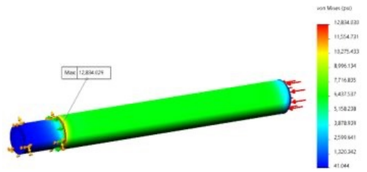


Analysis

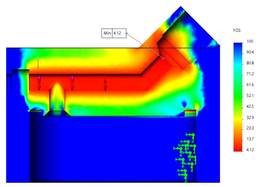
- FEA performed for mechanical components to verify design meets safety factor requirements:



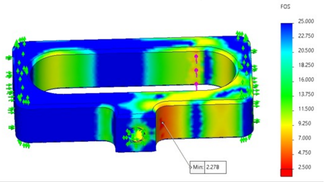
- Scotch Simulation, FOS = 3.06



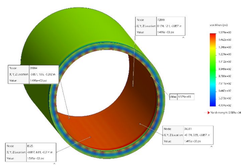
- Piston Simulation, FOS = 2.72



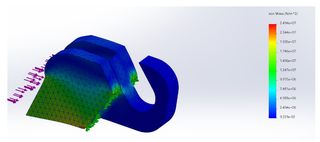
- Header Simulation, FOS = 4.12



- Yoke Simulation, FOS = 2.28



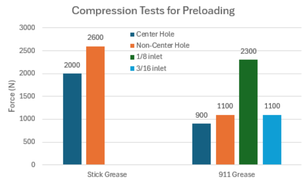
- Canister Simulation, FOS = 25.3

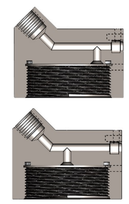


- Chain Simulation, FOS = 2

Results

- Pump mechanism design succeeded in pumping grease through electronic actuation
- Force reductions with inlet and outlet hole placements





- 20%-30% reduction in force going from off-center to center inlet placement
- From a 1/8th inlet to a 3/16” inlet gave a reduction of force greater than 50%
- 23% weight reduction from the industry-leading alternative, despite advanced features

Conclusion

- Our grease gun adheres to the requirements set by our sponsor, redefining the boundaries of grease gun design.
- Our novel, lightweight and user-friendly prototype reduces manual labor and enables objective greasing practices for the end user.

Future Improvements

- Continue to optimize the weight and manufacturing of the gun
- Integrate RFID for valves with greasing parameters and historical data for health monitoring
- Industrialize rigid chain design for fitness for mass production
- Reduce complexity of motor mount for ease of maintenance