**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

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**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

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**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

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**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 1/8" 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

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**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