

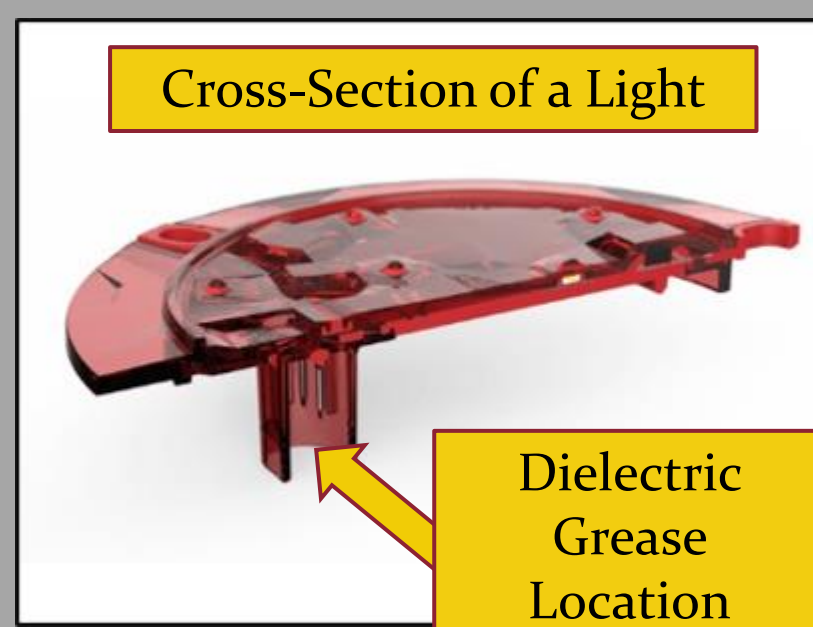
Team 08: Light Work

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Introduction

For this project, team Light Work partnered with Innotec, a manufacturing company in Zeeland, MI that specializes in interior and exterior vehicle lighting. Many of their products require dielectric grease to be added to their electrical connections for circuit protection, and at the time of starting this project, Innotec was spending around \$150,000 per year to grease lights. The current greasing station is inefficient due to the frequent maintenance required when air is trapped in the system, line delays when moving parts to be greased, and the waste it produces by over-greasing the lights.

The goal was to design and build an automated greasing system that integrates into the existing manufacturing line. This solution will save over \$150,000 per year as it will be implemented on ten different manufacturing lines in two different countries.



Objectives

Due to scope changes by customer request throughout this project, goals were adapted and adjusted. Increases in the project scope throughout the semester changed the objectives from a final industrial product to a proof of concept of several different components that will interact with each other.

- Deliver 0.1 to 1 mL of grease depending on the part
- System cost below \$6000
- Detect and manage air in the grease lines without failing
- Cycle time of 20 seconds or less
- Operate for 25000 hours with minimal maintenance

Design

In order to integrate the new system designs into the current manufacturing line, the team designed a system to distribute grease on to the electrical pins of the lights while they are electronically checked (E-check). Innotec's lights can be manufactured in batches of four to sixteen lights at a time, each requiring greasing in one E-check cycle. The team broke the design into the parts labeled Zone One, Two, and Three.

Zone 1: Compress

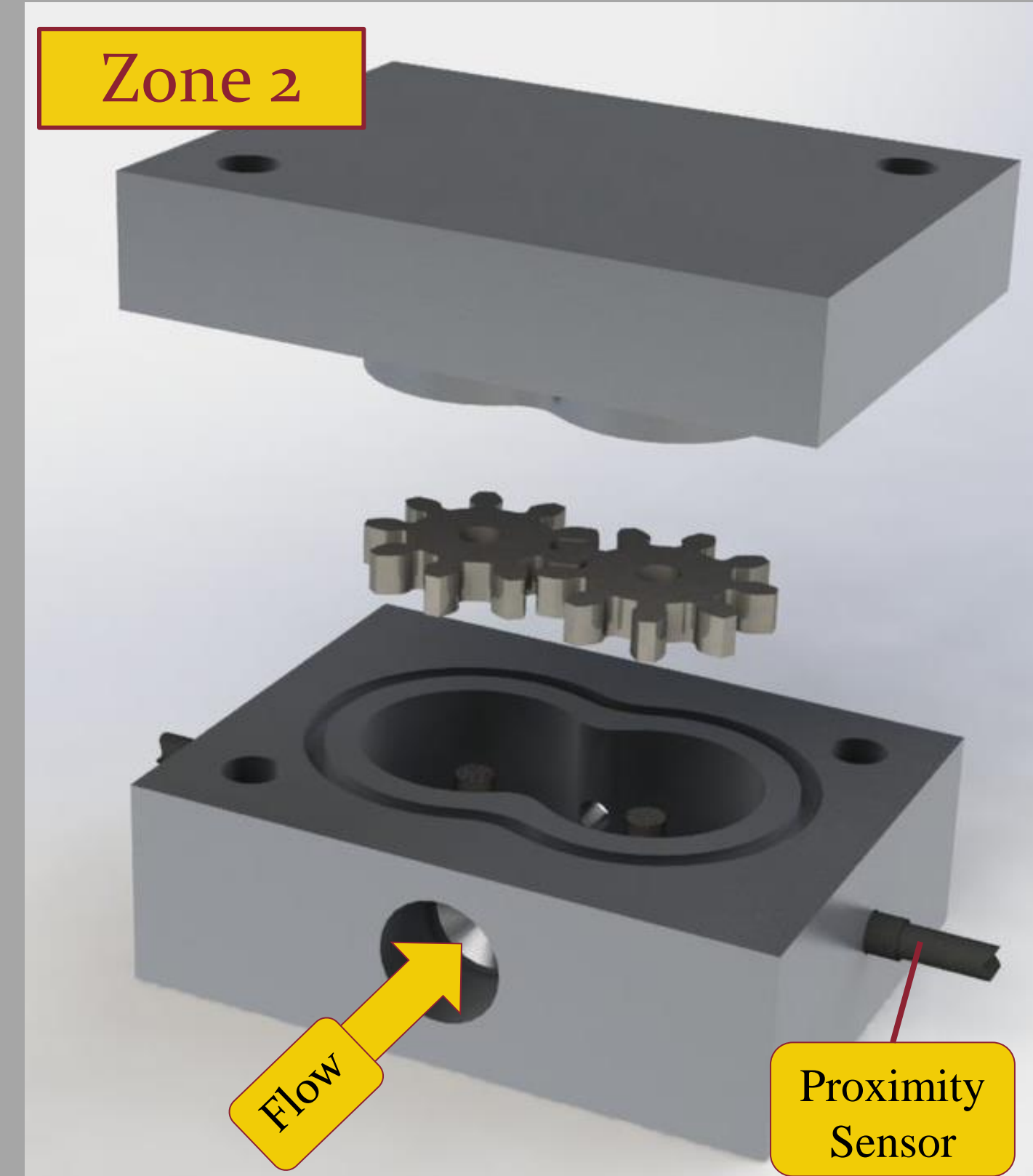
In Zone 1, the grease is pumped out of a 16-gallon keg and raised to a pressure of 1500 psi using a 50:1 air operated pump. At this pressure, any air trapped in the grease is compressed to less than 1% of the original volume. A pneumatic cylinder applies downward pressure on a pump and follower plate to continuously assist grease feed to the pump. The pressurizing cylinder also prevents a vacuum from being created within the keg.

Zone 2: Detect/Measure

The grease enters Zone 2 in a high-pressure hose and flows into a pressure regulator that decreases the pressure to 200 psi to allow any air in the line to partially expand. The regulator feeds directly into a volumetric sensor the team designed. The grease feeds into the body of the meter and turns the two passive gears as it flows out the other side. Two proximity sensors on opposite sides detect the gears by reading the teeth as they pass. Using the speed of the gears and the volume of grease that fits between the teeth of the gears, the volumetric flow is calculated. If any air is in the system, the flow meter will detect it by a rapid increase in the flow as air expands due to the pressure change and can then be purged in Zone Three.

Zone 3: Distribute

The grease flows into Zone 3 where it enters a brass cylinder (spool). A stepper motor moves the spool through the manifold to connect holes in the spool, supplying the grease to one line in the manifold at a time while sealing off the other lines. The stepper will move from one hole in the manifold to the next until all the parts in the cycle are filled with grease. O-rings and tight tolerances on the spool prevent the grease from leaking out of the manifold.



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Next Steps

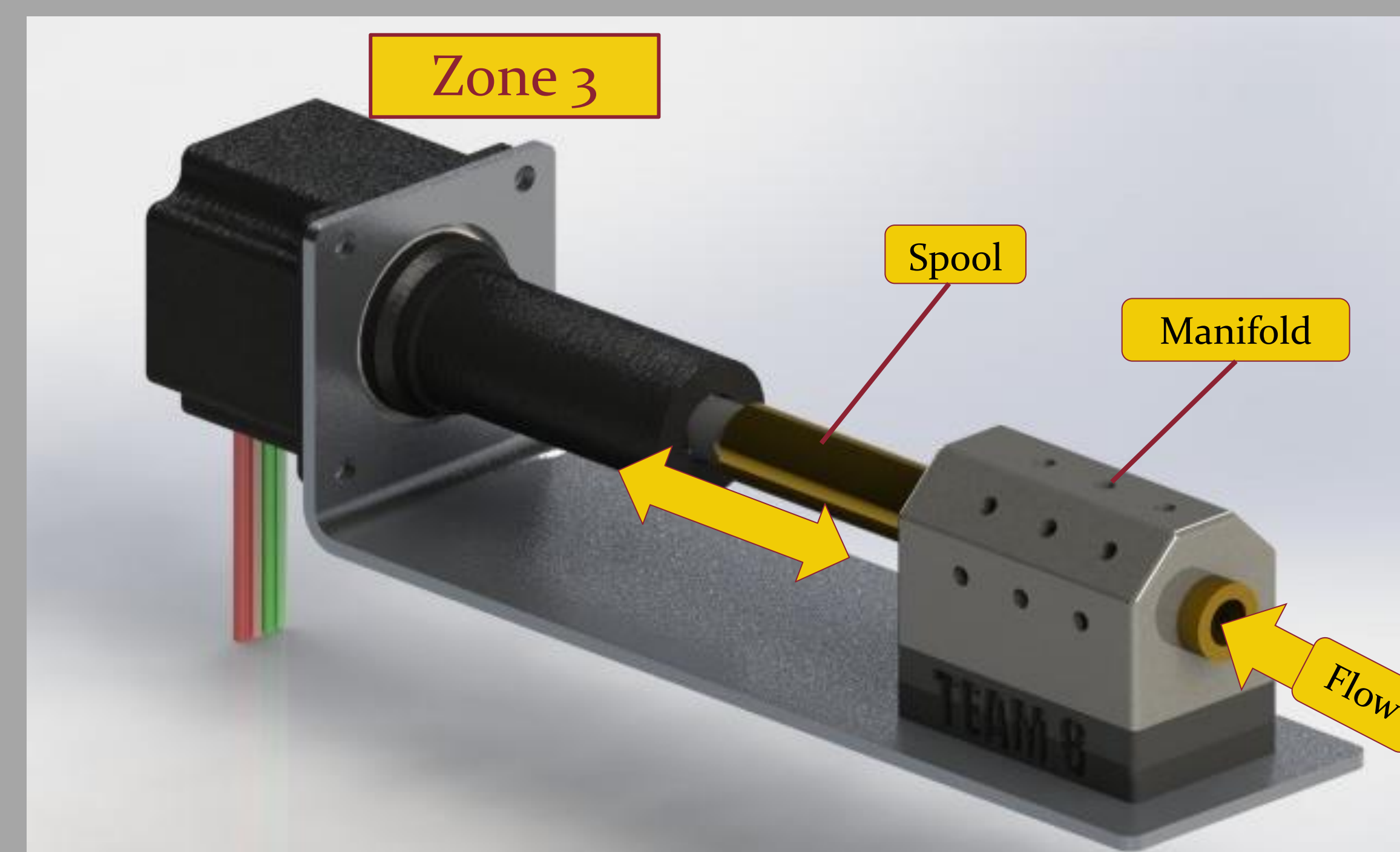
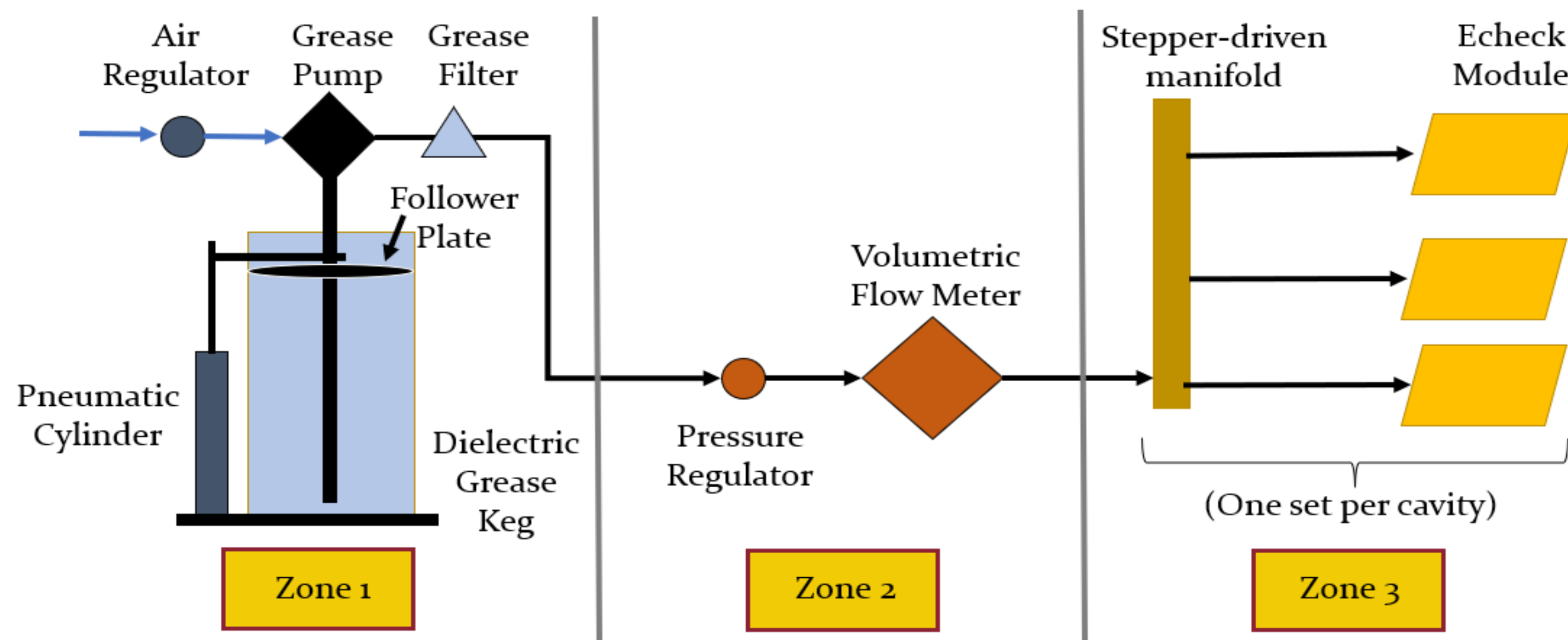
The team proved the feasibility of a grease pumping system, volumetric flow sensor, and distributing manifold. The total system cost was \$2723, well under half of the set budget. This project met customer goals and provided a great deal of learning opportunities for the team.

The next steps include the following:

- Presenting the prototype to a larger group of engineers and professionals at Innotec
- Developing an implementation plan of the current system and findings with Innotec's in-house operation
- Providing detailed documentation of findings and rationale to Innotec

Future iterations may include:

- 12:1 or 25:1 pump rather than 50:1 in Zone 1 as it compresses more than needed and requires higher pressure ratings and thus higher costs in other systems
- Alternate manifold styles to reduce linear motion



Acknowledgments

We would like to thank the following individuals for their contribution to our project:

Professor Hartemink (Calvin) – Academic Advisor
Mike Lanser - Industrial Consultant/Customer
Nate Tickfer - Industrial Consultant/Customer
Chris Sorensen (Calvin) - Machinist
Chuck Holwerda (Calvin) – Coding
Innotec - Financial Support and Guidance
True North Design - Technical Resources