Oscillating Pneumatic Pump for Neonatal Ventilation

Overview
Premature infants often suffer from a deformed chest walls due to the lack of bone calcification. This can lead to the collapsing of lungs, depriving infants of necessary oxygen flow. Current methods of ventilation include invasive intubation which can lead to long term health issues such as chronic lung disease. Non-invasive solutions to ventilation are currently being developed.

Objectives
The goal is to create a non-invasive pneumatic ventilation pump to be used in the Neonatal Intensive Care Unit. The pump will control a pneumatic actuator attached to the chest wall providing distending pressure to the chest, restoring lung volume, and an oscillatory pressure facilitating gas exchange in the lungs.

Approach
- The sponsor, a neonatal doctor at Hershey Medical Center, provided the team with customer needs
- The team visited Hershey Medical Center to gather information from the sponsors and gain exposure to the NICU environment
- An aquarium pump was dissected and analyzed during the product development phase
- A COMSOL model was created to analyze losses throughout the system tubing and combination of constant and oscillatory air flow
- SolidWorks models of the pump and pump components were created
- An alpha and final prototype were created; the final prototype was encased in a delrin lasercut box
- Tests to evaluate the amplitude and frequency of the oscillatory pressure were conducted and tests were done to ensure that a minimum mean airway pressure was achieved
- Additional tests performed included weighing the device and using a sound meter to determine noise level of the device
- A pressure transducer was used to conduct all pressure tests
- Results show that product was able to maintain a mean airway pressure while varying the amplitude and frequency of oscillation

Outcomes
- Provides non-invasive ventilation therapy option incorporating electrical and mechanical components producing a variable oscillating pressure
- Provides necessary mean airway pressure to expand neonatal chest cavities to alleviate lung compression
- Oscillation component increases gas exchange within the alveoli of the lungs
- Total pump cost is $240 allowing it to be implemented in low resource areas