Exhaust Bellow Test Stand

Overview
This project is a continuation from the previous semester. The goal of this project is to create a test stand that can qualify bellows found within the exhaust system of John Deere agricultural tractors. Currently, John Deere bellows are overdesigned and an alternative design that lowers the cost of the bellow is needed. The test stand is required to generate heat in a range of 550-650 degrees Celsius and vibration in axial and radial direction with displacement of +/- 20mm.

Objectives
To create a test stand that mimics the vibration and heating conditions experienced by a bellow within the engine system of a John Deere 5/6 series agricultural tractor.

Approach
- The team gathered a list of customer needs based upon the requirements of the test stand specified by John Deere.
- Several concepts were generated for the heating and vibration system of the test stand and were selected using a scoring matrix.
- The team did a patent search to analyse existing products available on the market that produces similar vibration and heating requirements.
- A visit to the sponsor was made at the beginning of the semester to further understand the expectations of the project.
- The team created SolidWorks models to visualize the test stand sections.
- The alpha prototype focused on improving the heating system; a temperature of 480 degrees Celsius was achieved.
- The beta prototype focus was on increasing the temperature of the heating system by utilizing a closed-loop system powered by a fan. The vibration system was built in the radial and axial directions using linear rails.
- The gamma prototype focused on adding insulation tape around the closed loop system and extending the table to fit the axial and radial directions of the vibration system.
- The maximum temperature reading was 662 degrees Celsius; displacement was +/-15mm in radial and axial directions with an initial offset of 8mm.

Outcomes
The test stand will benefit John Deere in the following ways:
- John Deere will be able to test new bellow designs from different suppliers.
- The test stand reduced the time needed to reach to the required temperature from previous semester.
- The test stand provides bellow testing with high reproducibility.