Flowserve Design and Fabrication of a Pump Test Loop

Overview
Flowserve is in need of a pump test rig to validate new designs and technologies. More specifically, they will be testing new impeller trims. Currently, their facilities in Bethlehem do not have their own test rig. Because of this, much time is spent travelling to a separate facility for testing. Not only does the pump test rig will be able to derive the flowrate and head calculations, but also the generated data should agree with the previous data from other Flowserve test facilities.

Objectives
The objective of this project was to design and fabricate a pump test loop that will allow Flowserve to conduct repeatable experiments that provide the data required to create pump performance information (e.g., performance and efficiency curves).

Approach
• The first step was to visit Flowserve and gather information about their requirements for the project.
• We then completed calculations to decide if we would be able to use PVC for the piping.
• After completing preliminary calculations we provided Flowserve with a SolidWorks model.
• Due to the pipe hanging off of the table we created various concepts for pipe supports and presented them to Flowserve.
• Held a design review with Flowserve representatives to get final approval on our pump test loop, while also discussing further ways to improve our project such as performing a modal analysis.
• A final test loop was assembled at Penn State, using a cardboard representation of the pump.
• Created assembly instructions for Flowserve to easily put the test loop together when they received it.
• Performed a modal analysis using SolidWorks to find the resonance frequency of the system.
• Performed testing at Flowserve and recorded data to create pump performance curves.
• Analyzed data and applied corrections for velocity and static head.
• Validated data by comparing results to pump performance curves provided by Flowserve at the beginning of the semester.

Outcomes
• We were able to supply Flowserve with a functional pump test loop that will allow them to test the Mark 3 Group 1 pump, and other families of pumps within a given range of specifications.
• Generated pump performance curves matched the curves provided by Flowserve.