Overview
Flowserve Corporation is a pump and valve manufacturer that is involved in varying industries, including power, oil, gas, and chemical. In some applications, their parts are prone to abrasion and corrosion, getting worn down over time and costing money to replace or maintain. Flowserve wishes to attach an ultra-high molecular weight polyethylene (UHMWPE) liner inside their pumps to decrease maintenance costs.

Objectives
The objective of the Penn State MatSE 493 team is to determine the most viable method of attaching the liner to the inside of a pump through mechanical testing with UHMWPE and the cast iron used in the pumps. The chosen adhesion method will be tested for shear strength and corrosion resistance.

Approach
- Initially, eight high-strength adhesives were obtained to determine their viability with UHMWPE
- UHMWPE was tested alone to determine its mechanical properties before applying adhesives
- All eight initial adhesives were evaluated in a preliminary hand-pull test; the top three performers were chosen to continue with further testing
- ASTM standards were reviewed and a double lap shear test was the most appropriate method
- The double lap shear tests were performed using an Instron (Tensile test machine)
- Multiple tests of these final three adhesives (Gorilla Glue, cyanoacrylate glue, and cyanoacrylate glue with a plastics surface activator) were performed to obtain statistically significant data points
- The results of these tests were obtained as a load vs. elongation curve, which were converted to a stress vs. strain curve
- Analysis of these curves allowed the determination of an average maximum load, as well as the shear modulus for each of the final three adhesives
- The best-performing adhesive (CA w/ SA) was tested with a 24-hour immersion test in an acidic environment to determine its corrosion resistance and bond strength retention

Outcomes
- Results proved that cyanoacrylate glue with a plastics surface activator is the most viable adhesive to attach a UHMWPE liner to a cast iron pump based on its shear strength
- Given these statistical results, Flowserve can determine which adhesive is most viable for their pumps
- Flowserve can undergo further testing given this information, if necessary
- Flowserve can decrease maintenance costs and increase reliability and lifetime of their pumps, should they utilize one of these adhesives in the Durco Mk. 3