Dresser-Rand 5: High Pressure Case Seal

Overview
For this project, Dresser-Rand tasked us with designing a compressor case and seal that can withstand pressures of up to 18,000 psi without failure. Recent demand has called for compressors to reach this design pressure for certain oil and natural gas applications. Computer Aided Design (CAD) and Finite Element Analysis (FEA) were to be used to model and simulate the expected loads on each design concept to determine if a passing design was created.

Objectives
The objective of this project is to optimize the case and joint design and also propose materials for a high-pressure, radial-split compressor casing that will remain sealed and maintain its structural integrity at the required pressure of 18,000 psi.

Approach
- Gathered customer needs and developed engineering specifications based on research completed on current centrifugal compressor designs and the expectations provided by Dresser-Rand
- Completed a sponsor visit to Dresser-Rand in Olean, NY to gain first-hand experience with compressor design and manufacturing
- Researched existing seal choices in handbooks provided by Parker and compared the pros/cons of choosing an elastomer, polymer, or multi-stage seal
- Generated an optimal bolt configuration by completing calculations based on yield strengths of bolt material and the expected load on each stud
- Went through a concept generation and selection phase to help brainstorm design concepts and prepare for CAD modeling
- CAD-modeled three main design revisions using Solidworks and analysed them using ANSYS Mechanical software to simulate the given design conditions and observe the resulting stresses and deflections

Outcomes
To conclude the project, the final design failed structurally but some goals defined at the beginning of the project were still met:
- Bolt design and configuration were optimized to the required design load of 18,000 psi
- A PolyPak seal with thermoplastic back-up ring was chosen from Parker to be able to withstand the pressures within the case
- The final design resulted in failure due to the maximum stress on the model being larger than the yield stress of the material used.