Segmented Seal Housing Insertion Tool

Overview
Segmented seal housings are the primary component to maintain pressure within steam catapults. Segmental seal housings are complex in nature and contain 9 segments and 12 springs that must be fully compressed for assembly. After 100 uses, the segmented seal housing must be replaced, which proves difficult to mechanics. Primarily, mechanics run the risk of hand injuries as well as loss of components during the installation and removal process.

Objectives
Our objective was to design a tool that would simplify and automate the process of installing and removing the segmented seal housing during maintenance procedures.

Approach
- Customer needs were determined by meeting with our sponsor to view and discuss the process. We determined that our sponsor was primarily concerned with ease of use, safety and durability of our design.
- We experimented with the tool used by mechanics in the process and determined areas of concern during design. We determined that by reducing human involvement in the process, we could make the process easier and safer for mechanics.
- Concepts were generated during a brainstorming session and the final design was chosen based on the consumer needs. We determined the mold / clamp design was the best overall concept to meet our customer needs and engineering specifications.
- Solidworks models were generated for our mold / clamp design to provide detailed drawings for the manufacturing process as well as allow for finite element analysis to determine stresses and deflections.
- Finite element analysis was used to determine stresses and deflections in the clamp. Through our analysis we were able to determine that our design would meet all the tolerances provided by our sponsor.
- The team generated an alpha prototype with the assistance of Phil Irwin. The mold was cut from aluminum using a wire EDM process and the clamp was machined from steel.
- During testing, we determined that our actual deflection values in the clamp were higher than predicted by finite element analysis. Modifications were made to the prototype to account for this discrepancy.
- Further modifications and testing will be completed by NAVAIR on the alpha prototype to determine the feasibility of the design for mass production and use aboard aircraft carriers.

Outcomes
- Simplifies assembly of springs and segments
- Secures components to prevent loses
- Automatically installs under housing cover
- Skilled involvement reduced by 75%
- Procedural steps reduced by 20%
- Assembly reliability improved to 100%