NAVAL AIR SYSTEMS COMMAND (NAVAIR)

Additive Manufacturing of Naval Aviation Support Equipment Hydraulic Pump

Overview
NAVAIR uses a specialized engine trailer for the removal, transportation, and installation of F/A 18 aircraft engines. On-board hydraulic hand pumps controls the trailer's hydraulic system. The current hydraulic pump design is no longer available from the manufacturer. The pump is also prone to internal leakage issues, which are expensive to repair.

Objectives
- Design hydraulic pump for additive manufacturing capability
- New design must fit within design envelope of original pump
- Minimize number of potential leak points
- Minimize downtime associated with pump failure by increasing serviceability
- Design pump to be compatible with off-the-shelf hydraulic fixtures
- Minimize cost associated with pump

Approach
- Customer needs were gathered from NAVAIR engineers and ex-Navy personnel to determine the scope and objectives of the project.
- External search was conducted on patents, existing products, and 3D printing processes.
- Concepts were generated including variations of features for pump design.
- Each concept was scored based on how well it satisfied customer needs to select final concept.
- CAD model encompassing design selections was created.
- Finite-element analysis was performed to model stresses from handle forces and internal static pressure.
- Several half-scale prototypes were printed to test printability and CAD model was revised based on results.
- Team selected hydraulic cartridges and fittings.
- Full-scale prototype was produced using Objet printer and post-processed/assembled.

Outcomes
- Reduced down time achieved using additive manufacturing capabilities and removable hydraulic cartridges.
- The new pump design requires less material and post processing work than the original pump reducing cost.
- Using additive manufacturing, the pump body is one piece decreasing leak potential and increasing fluid flow efficiency.