PROJECT SUMMARY 5517.001

Hybrid Additive Manufactured Oil Coolers (HAMOC)

Fuel cooled oil cooler (FCOC) shell produced using both additive and traditional manufacturing processes.

PROBLEM

Fuel cooled oil coolers (FCOC) are utilized on nearly every powerplant in the DoD fleet for cooling of turbine oil and pre-heating fuel. These heat exchangers have become a sustainment problem due to the current lack of supply and suppliers, high part costs, long lead times, and increasing replacement volume. Traditionally, manufacture of FCOCs involves casting, machining, brazing, and/or welding—time- and cost-intensive processes which often result in low product yield. With recent developments in metallic additive manufacturing (AM), new manufacturing options are now available for improving the production process for low-volume, hard-to-source FCOCs. While coolers fully manufactured with AM are attractive for next generation performance gain, the risks of a one-part strategy (i.e., not having clear line of site inspection, difficult powder removal, etc.) currently outweigh the benefits for sustainment applications.

OBJECTIVE

Laser powder bed fusion (LPBF) is an exceptional tool for generating casting replacements of complex geometries, while traditionally manufactured tube packs are easy to source and match to legacy performance requirements. The objective of this program is to explore an approach for building sustainment FCOCs utilizing several different manufacturing processes, each providing intended function with the lowest technical risk, and joining them together into a single end use component.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
EOS Laser Powder Bed Fusion Metal Additive Manufacturing Machine

MATERIAL
Al F357

TECHNICAL APPROACH

The University of Dayton Research Institute is leading the project team, which includes Sintavia, Macy Consulting, Velo 3D, Edare, and Triumph, to develop the hybrid manufacturing of FCOCs. Definition of the required qualification testing from Air Force stakeholders to deem a hybrid FCOC flight ready is being established. To minimize risk in the use of Al F357 for the FCOC family of parts, the team plans to characterize the corrosion behavior of LPBF Al F357 and determine suitable corrosion mitigation methods for operation in FCOC applications. Welding best practices are being established and benchmarking the weld compatibility of LPBF Al F357 with Al 6061, cast F357, and LPBF Al F357 is being performed. The team is also characterizing the best method of tube joining (brazing, laser welding, mechanical joining, etc.) for FCOC applications. Finally, the thermal, pressure, and particulate release data from flow testing of various FCOCs at their respective operation conditions is being collected and analyzed.

PROJECT START DATE

January 4, 2021

EXPECTED END DATE

December 31, 2022

EXPECTED DELIVERABLES

- Operational and acceptance criteria definition
- Corrosion testing plan
- Tube joining plan
- Weld compatibility test plan
- Allowable gap identification
- FCOC builds
- Final report

FUNDING

$1,500,000 total project budget
($1,500,000 public funding)

PROJECT PARTICIPANTS

Project Principal:
University of Dayton Research Institute

Project Participants:

Sintavia
Macy Consulting
Velo 3D
Edare
Triumph

Public Participants:
U.S. Department of Defense