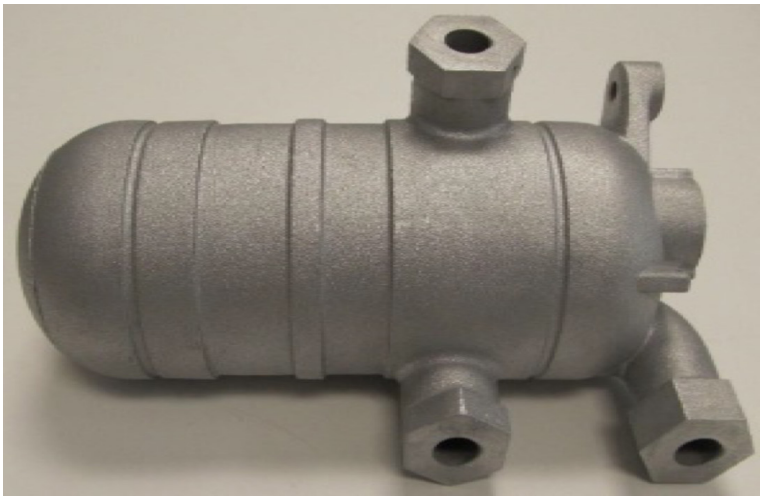
PROJECT SUMMARY 3007

Maturation of Advanced Manufacturing for Low Cost Sustainment – Oil Cooler Family of Parts



An example of a generic oil cooler that includes a flow path for the oil through internal thin-walled tubes housed in a larger volume for the fuel to flow around these tubes, providing a heat exchanger to draw heat from the oil.

PROBLEM

Additive manufacturing (AM), with its potential for reduced costs and shorter lead times for complex components, is becoming more seriously considered for future direct part replacements in the sustainment community. There is, however, a confidence gap surrounding AM processes and their ability to produce repeatable and consistent functional results for thin-walled structures. The AM process can create complex internal passages in fewer steps than conventional machining, but access to these internal geometries for inspection is limited, compounding the difficulty involved with the inspection of fuel cooled oil coolers and heat exchangers. These AM parts require greater scrutiny via proof testing and geometry inspection of the final part. If unresolved, the current lack of confidence in the process could cause unique qualification problems for future AM components.

OBJECTIVE

The objective of the project is to technically substantiate a qualification pathway by generating data through coupon, sub-element, and full component testing, modeling, and data correlation. The data gathered on the program can be used to aid in future heat exchanger (HeX) development, inspection, and qualification. In addition, the program aims to compare the fuel cooled oil cooler (FCOC) printing capability of an experienced OEM partner against that of a smaller, more typical supply chain partner to provide a snapshot in current HeX AM capability.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

VALUE CHAIN

ASTM PROCESS CATEGORY: Powder Bed Fusion

EQUIPMENT: EOS M-290/M-280, Concept Laser M2

MATERIAL: Aluminum Alloy F357

TECHNICAL APPROACH

The intent of this effort is to develop enabling technologies for AM component qualification and to highlight areas that represent a qualification barrier and need additional technical development. The research team plans to investigate laser powder bed fusion (LPBF) technologies for end-to-end AM production of an oil cooler. This oil cooler component is representative of a family of parts which are lightly loaded, complex, and functional. The initial focus is to define the required elements needed to assemble the technical data package (TDP). AM is unlike traditional manufacturing techniques where the material properties are mostly distinct from the manufacturing process; parts produced by AM have mechanical properties which are tied to characteristics such as geometry and process parameters. The team intends to perform modeling of residual stresses, optimization of the build for orientation and supports, and examination of possible in-situ monitoring techniques which can aid in qualification. A significant portion of the program involves nondestructive evaluation (NDE), destructive, and functional testing.

PROJECT START DATE

May 2017

EXPECTED END DATE

May 2019

EXPECTED DELIVERABLES

- A metal AM standard work procedure that ensures consistent, repeatable part production
- Technical data: materials characterization data, modeling and simulation results, functional test data, in-situ monitoring data, etc.
- Report outlining encountered barriers and challenges associated with the oil cooler
- Report quantifying model benefits over the traditional empirical methodology
- Recommendations and Implementation plans
- Final report including demonstration results

FUNDING

$3.5M total project budget
($3M public funding/$500K private funding)

PROJECT PARTICIPANTS

Project Principal:
University of Dayton Research Institute

Project Participants:
ANSYS (acquired original partner 3DSIM, LLC.)
GE
DRT Manufacturing Co.
Youngstown State University
Youngstown Business Incubator

Public Participant:
U.S. Department of Defense

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