PROJECT SUMMARY 5518.001

Large Area Additive Manufacturing for Jointless Application Development

Key Machine Features

- Build envelope: 1,000mm x 900mm x 300mm
- Machine exterior: ~7' x 8' x 10'
- Gantry based architecture
- 1kW laser
- 3D scanner translates with laser
- Discrete dosing
- Optimal air flow over the print area

ATLAS Machine Experience

- 900+ days of print time
- 200+ build jobs

Rocket Nozzle Tech Demo; High Speed Parameter

ATLAS Machine

GE Additive's ATLAS laser powder bed fusion platform enables rapid design-build-test cycles to produce larger jointless designs required for applications.

PROBLEM

Metal laser powder bed fusion (LPBF) is beneficial to key aerospace and defense industries by enabling geometric designs otherwise impossible to achieve with traditional manufacturing methodologies. While capable of building complex thin walls and internal passages, LPBF is limited by relatively small build volumes, so aerospace and defense suppliers require part joining in order to fabricate a final component. These joining operations involve additional manufacturing steps—including tooling, post processing, and inspections as well as the associated development and validation of those processes—resulting in increased cost, weight, part defects, and lead times.

OBJECTIVE

The project is attempting to attain 90 percent part count reduction for a powerhead propulsion system critical to both scramjets and space launch vehicles. This addresses the needs of the Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA) to enhance supply chains through part consolidation, efficiency, and heightened performance. The powerhead considered for the project is currently composed of over 1,000 parts to run a hot gas manifold, main injector, heat exchanger, and pre-burners. This project is demonstrating how GE's proprietary ATLAS LPBF large build platform technology (1,000 x 900 x 300mm) brings the part-count down to 11.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

MATERIAL

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
ATLAS machine

MATERIAL
Inconel 718 alloy

TECHNICAL APPROACH

GE, Aerojet Rocketdyne, and NASA Marshall Space Flight Center are collaborating to develop qualification data requisite of manufacturing a powerhead for liquid fueled scramjet and rocket systems, using GE Additive's proprietary LPBF ATLAS technology. This team is positioned with engine programs and a wide array of product applications for weld joint removal including RS-25 engines. This gives opportunity to work closely with GE on the innovative large format machine (ATLAS) and the premier materials team at NASA.

GE is executing experiments to evaluate metallurgical and flow properties compared to the parts produced on other commercial LPBF machines, establishing new design approaches, new part orientations, and parameter settings.

Aerojet Rocketdyne is defining material property and feature size resolution requirements while NASA is performing the corresponding testing and evaluation. GE is building test specimens with NASA evaluating the ATLAS-produced parts.

The tasking approach for successful output is a four phase approach with Phase I encompassing the build envelop evaluation with high laser power, Phase II developing the stitching through three design of experiments and a final optimized stitching verification, Phase III addressing downward surface development and heat transfer coefficient (HTC), and Phase IV providing a full scale component build.

PROJECT START/END DATE

December 2020 - March 2022

EXPECTED DELIVERABLES

- Build geometry to characterize full build volume
- Surface finish, geometry conformance, and variation for build volume
- Tensile, high cycle fatigue, and metallography data from full build volume characterization
- Analysis of HCF stitch debit using 800W process
- Baseline (<300W) full build volume materials data vs. 800W
- Report of stitching optimization efforts
- Build geometry to characterize heat transfer performance
- Report of surface finish optimization to achieve heat transfer performance
- Dimensional analysis from full size component build
- Tensile and metallography data from full size component build coupons
- Data management plan

FUNDING

$1.1M total project budget
($1.1M public funding/$0 private funding)

PROJECT PARTICIPANTS

Project Principal:
GE Additive

Other Project Participants:
NASA MSFC (Marshal Space Flight Center)
Aerojet Rocketdyne
Auburn University

Public Participants:
U.S. Department of Defense

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