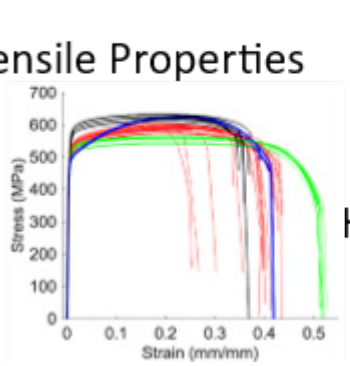
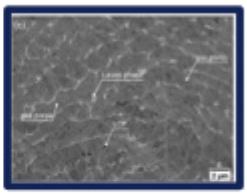
PROJECT SUMMARY 5546

Methods for Additive Manufacturing - Cross Platform Consistency (AM-CPC)

Data pedigree requirements are being established for PBF-LB platforms.





Tensile testing and heat treatment are used to determine process consistency.

PROBLEM

The capability of fabricating components on any additive manufacturing (AM) laser powder bed fusion (PBF-LB) platform is needed to enable supply chain flexibility. Qualifying AM processes for commercial and defense applications remains a challenge due to the variability in the mechanical properties of the parts produced by different platforms. Previous round-robin studies have investigated build-to-build and machine-to-machine variability to control variables. When considering PBF-LB platforms, there are differences in machine technology such as laser optics train, recoating mechanism, and gas flow along with default processing parameters in each system. Therefore, there is a critical need for a study of cross-platform consistency in PBF-LB.

OBJECTIVE

Gather data on the mechanical properties of Inconel 718 (INC 718) produced on PBF-LB platforms to:

- Establish processing pedigree data strategies across platforms
- Test for tensile properties
- Characterize mechanical properties of PBF-LB material
- Analyze the influence of process parameters, machine features, and feedstock characteristics on mechanical properties
- Develop test methods and data requirements to improve consistency
- Evaluate the effect of heat treatments on mechanical properties
- Document recommendations for test methods and data requirements for qualification and future standards needs

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
Laser Powder Bed Fusion Printing

MATERIAL
Inconel 718

TECHNICAL APPROACH

This project focuses on developing a neutral manufacturing plan leveraging the mechanical properties of INC 718 test specimens. These test specimens will be produced on PBF-LB machines to establish consistency across platforms. The OEMs of the PBF-LB machines will provide consultation on processing pedigree. Methods for analyzing and improving consistency will be determined through execution of the following tasks:

- Task 1: Test method development, confirming print layout, sample geometry, and number of tests performed
- Task 2: Definition of processing pedigree, documenting process control parameters, and structuring of data
- Task 3: Round-robin studies, evaluating processing pedigree and mechanical performance through tensile, microstructure, porosity, surface roughness, and/or fatigue testing
- Task 4: Data curation and dissemination, ensuring data follows FAIR principles, and disseminated to America Makes members
- Task 5: Data analysis, linking the processing-structure-properties relationship to explain cross-platform consistency
- Task 6: Measurement method specification, documenting key process control parameters, and recommendations for future standards development and America Makes roadmap requirements

PROJECT START DATE

July 2023

EXPECTED END DATE

January 2025

EXPECTED DELIVERABLES

- Test method for data collection and printing strategy for round robin tests
- Workflow with inputs, processing parameters and tools, and expected outputs
- Round robin testing summary report
- One-of-a-kind data set report
- Measurement method specifications and standards roadmap requirements
- Raw materials test data
- Final project report

FUNDING

$375,000 total project budget
($250,000 in public funding/$125,000 in private funding)

PROJECT PARTICIPANTS

Project Principal:
Colorado School of Mines (CSOM)

Other Project Participants:
3D Systems
Aconity 3D
AddUp
EOS North America
Concept Laser - a GE Additive Company
Open Additive
Renishaw
Velo 3D
Xact Metal

Public Participants:
U.S. Department of Defense
National Institute of Standards and Technology