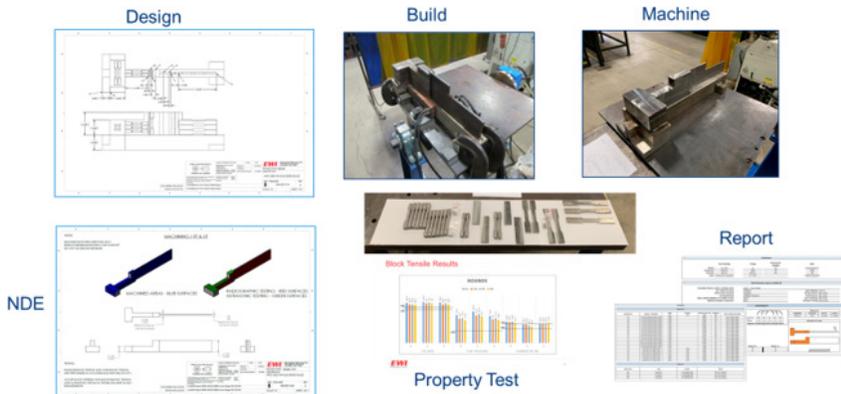


Qualification Requirements for Additive Manufacturing Processes - Phase I of III



Develop, demonstrate, and transition prescriptive prototype qualification and fabrication requirements via the approach of design, build, machine, nondestructive evaluation (NDE), property test, and reporting.

PROBLEM

Additive manufacturing (AM) processes are targeted as the next high-impact manufacturing process for NAVSEA parts and components, offering the capability to produce parts at low production volumes. To fully implement this manufacturing process, qualification and fabrication requirements must be developed. Some qualification and requirements have been established through previous project efforts, but NAVSEA has identified additional supporting processes and technology topics that need to be addressed to provide updates to NAVSEA Technical Publications.

OBJECTIVE

The overall goal of the project’s three-year effort is to develop additional procedure qualification schemes/components, support process requirements, and pertinent fabrication requirements to update NAVSEA Technical Publications for both metal directed energy deposition (DED) and metal powder bed fusion (PBF) including electron beam powder bed fusion (EB-PBF), electron beam wire fed DED (EB-DED), and laser powder fed DED (PL-DED) thus accelerating implementation of these related technologies. The project also seeks to develop both prescriptive requirements and best practices where possible to improve metal AM process qualification affordability, avoiding the need for “special” procedure qualifications that increase cost and schedule.



**AMERICA MAKES
TECHNOLOGY
DEVELOPMENT
ROADMAP**

This project aligns to:



**ASTM
PROCESS CATEGORY**
Powder Bed Fusion,
Directed Energy
Deposition

EQUIPMENT
Arcam A2X, Sciaky VX.4,
Trumpf TruDisk 6001,
Yaskawa MS80W

MATERIAL
Alloy 625, Alloy 718,
ER308L, Alloy 304L,
Alloy 308L

TECHNICAL APPROACH

EWI, the NAVSEA Technical Warrant Holder (TWH) for AM, and the Naval Surface Warfare Center Carderock Division (NSWCCD) has identified a list of supporting processes and technology topics that need to be addressed to complete development of these NAVSEA Technical Publications. During this Phase I effort, the team plans to leverage previous work that addressed procedure qualification schemes for arc DED processes using integrated and nonintegrated build platforms and for both single-sided and double-sided build applications.

The initial work established the procedure qualification schemes for standard quality build (SQB) designs, NDE procedure map, property matrix, and qualification records for each application and process combination. Because these AM processes cover a range of feature size capabilities that are defined by minimum bead width, the SQBs are designed for full scale ($\geq 5\text{mm}$) and subscale features (2-5mm). The previous efforts identified the need to develop mini SQBs for processes with features approximately $< 2\text{mm}$ bead width.

The focus for this Phase I effort is in developing NDE requirements for the SQBs, developing mini SQBs and the test specimen designs. By utilizing these designs, EB-PBF build layout, test array, and demonstration builds are being completed along with EB-DED and PL-DED procedure qualification scheme and demonstration builds. The results of the Phase I tasking support the development of the PBF and DED Technical Publications that continue to be completed throughout the overall three year/three phase project.

PROJECT START/END DATE

October 2020 - October 2021

EXPECTED DELIVERABLES

- Summary report documenting mini SQB application conditions and test matrix design
- CAD models and 2-dimensional drawings for all Task 1 designs
- EB-PBF literature review of current research and industry standards
- EB-PBF procedure qualification scheme and test results report
- Reviews of draft PBF Technical Publication, recommendations for improving content related to EB-PBF and laser PBF processes – 50% under Phase I
- EB-DED literature review of current research and industry standards
- EB-DED procedure qualification scheme and test results report
- PL-DED procedure qualification scheme and test results report
- Reviews of the draft DED Technical Publication, recommendations for improving – 50% under Phase I
- NDE methods review, recommendations for new criteria, and design for up to 12 UT calibration blocks – 75% under Phase I
- Final report-Phase I/Year 1

FUNDING

\$1.1M total project budget

(\$1.1M public funding/\$0 private funding)

PROJECT PARTICIPANTS

Project Principal:

EWI

Other Project Participants:

NAVSEA/Carderock

Public Participants:

U.S. Department of Defense

5507.001 Qualification Requirements for Additive Manufacturing Processes – Phase I of III

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