PROJECT SUMMARY   **5541**

Demonstration of Novel Methods for Effective AM Process Qualification/Requalification

Item	Risk Description	Category
1	New Machine Type	Major
2	New Machine Capability (multi-laser, pulsed heat sources)	Major
3	New feedstock form (atomization method)	Major
4	New feedstock form (PSD, morphology)	Minor
5	Heat source focus settings	Minor
6	Major machine software change	Major
7	New recoater type	Minor
8	New programmed layer height	Major
9	Processing environment controls	Minor
10	New heat treatment	Major
11	New machine location	Minor
12	New part supplier	Major
13	New powder feedstock supplier	Major
14	Equipment subcomponent replacement	Minor
15	Minor machine software change	Minor
16	New AM process parameter set	Minor

Program Risk Scoring

Probability of Impact ↓		1 - Low	2 - Minor	3 - Moderate	4 - Significant	5 - High
Very likely 90%	5 - High					
Likely 70%	4 - Significant				1 2 10	
Possible 50%	3 - Moderate	7	4	3 6 8	12 13	
Unlikely 30%	2 - Minor		15	5 9 11 14 16		
Very Unlikely 10%	1 - Low					
	Consequence of Impact	1 - Low	2 - Minor	3 - Moderate	4 - Significant	5 - High

Honeywell performed a risk assessment to select the minor machine software change for the project.

PROBLEM

Additive manufacturing (AM) machines and materials qualification are major barriers to broad AM adoption. Generating the requisite data and models requires significant resources to produce statistically significant data. This qualification process requires generating test coupons under a controlled process and testing and analysis of the resulting data. These processes are then "frozen" with no changes to key process variables allowed. Standard-based guidance does not exist for requirements when a process change is needed. This greatly inhibits the agility of AM processes to respond to changes in the technology or supply base, allowing only one path to implement change to a qualified process — a total requalification, which may cost more than $3M per machine/material combination and take several years.

OBJECTIVE

The objective of this project is to develop an effective, streamlined process for requalifying laser powder bed fusion (LPBF) Ti-6Al-4V and any components manufactured from this material after the equipment has undergone a minor software change.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
SLM280

MATERIAL
Ti-6Al-4V

TECHNICAL APPROACH

Honeywell will review its current machine qualification plan for opportunities to significantly reduce the number of tests necessary to requalify a machine after a minor software change. This review will inform the development of a delta qualification test plan and associated build layout. Honeywell will then complete a baseline qualification per its standard baseline qualification process to allow for subsequent comparison to a reduced delta qualification. Once the baseline qualification process is complete, Honeywell will complete the reduced qualification test plan and builds developed for a minor software change. Mechanical property results from the test plan will be compared to the baseline qualification process and Joint Metal Additive Database Definition (JMADD) mechanical property results to determine equivalency. Finally, a candidate machine will receive an approved minor software update and the reduced qualification will be repeated. Mechanical property results will be compared to the previously acquired mechanical property results on the project and if all results align, the reduced qualification test plan will be considered acceptable for use.

PROJECT START DATE

September 2023

EXPECTED END DATE

June 2025

EXPECTED DELIVERABLES

- Conventional test matrix and test plan
- Standards and material/process specifications used on project
- Powder reuse strategy
- Statistically based mechanical property curve (B-basis)
- Final report

FUNDING

$727,825 total project budget
($341,815 public funding/$386,010 private funding)

PROJECT PARTICIPANTS

Project Principal:
Honeywell

Public Participants:
U.S. Department of Defense