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#### USD(R&E)

# Standards & Guidance Working Session

DSP Conference 2024

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## Manufacturing Technology Timeline

"The most fundamental change in the character of war is rapidly emerging technologies" General Milley





## **Rise of AM**







- 2012, no "digital thread"
- Only one standard Standard Terminology
- Most industrial machines not available:
  - Stratasys Fortus 900 2013
  - Stratasys Fortus 450 2014
  - E OS M290 2014
  - SLM 280 2013
- GE Fuel nozzle (FAA) 2015

- 2024, Digital thread- Digital Twin
- **182 standards** 4 Adopted
- Many machines & AM Suppliers:
  - State of the art factories combining AM/AdvM robotics
  - Many flyaway FAA approved parts – some with criticality.
  - Wide-spread use cases for AM across most supply chains
  - AM machines wide variety



#### American Society for Testing and Materials (ASTM) F42 Committee on AM



Source: Boeing/ASTM - Seven additive manufacturing processes according to ASTM Committee F42 on Additive Manufacturing.



## **Additive Manufacturing Basics**

AM is a process of joining materials to make objects from 3D model data, usually layer upon layer, and its use provides benefits for the DoD.





## Digital Engineering Incorporated in AM

- Through increased computing speed, storage capacity and processing capabilities, digital engineering empowers a paradigm shift.
  - from the traditional design-buildtest methodology.
  - to a model-analyze-build methodology.
- 2. Strategy is meant to foster shared vision and ignite timely and focused action.
- 3. Digital engineering emphasizes continuity of the use of models across the lifecycle.

#### AM uses Digital Engineering Approach

Digital Engineering Strategy June 2018



- Model Based System Engineering (MBSE)
- Digital Twin Digital Thread
- Generative model, analysis, build, test
- Integrated Computational Metrology Engineering (ICME)



## **New AM Standards Working Group**

- Defense Standardization Council (DSC) sponsored the establishment of a JAMWG sub-working group to pursue DoD adoption and development of AM standards.
- Initial meeting occurred July 16-18 at the AM Workshop. Monthly meeting to be scheduled.
- Standards WG will address adoption of 182 standard, 77 which are underway.
- Liaise with all consortia developing NGS (i.e., American Welding Institute).
- Support ANSI AM Standards Collaborative (AMSC) efforts to identify standards gaps & area of opportunity.
- Build an organized approach.



#### Additive Manufacturing Standards Adoption Strategy (Proposed)

#### LOE 1

#### AM Standards Strategy

- Review Non-Government AM Standards (NGS) adoption notices in ASSIST.
- Review existing NGS available for adoption.
- Work with DoD Services to develop adoption strategies for identified population.

JAMWG Standards Working Group **LOE 2** 

## Tag all AM Standards in the ASSIST Database

- Define criteria for what is considered AM standard.
- Validate existing tagged standards in the ASSIST database.
- Coordinate standards adoption strategy with DOD Services.
- Reflect adoption in the ASSIST database by publishing notices.
- Tag adopted standards.

DoD LSA and JSWG Adopt NGS

#### LOE 3

#### Continued ASSIST AM Database Modernization

- Consider establishing a Standards Area for AM.
- Improved functionality and searchability of the ASSIST database and the AM library.
- Update AM library with the latest standards tracking evolving digital standards.

Build AM Digital Standards Library in ASSIST



#### **ANSI AMSC Standards Gap Analysis**

Breakdown of Open Gaps by Lifecycle Area

#### 141 AM standards Gap Found as of April 2024

Section	High Priority	Medium Priority	Low Priority	Total
	(0-2 years)	(2-5 years)	(5+ years)	
Design	8	11	2	21
Precursor Materials	2	9	8	19
Process Control	2	8	3	13
Post-processing	1	4	3	8
Finished Material Properties	9	0	1	10
Qualification & Certification	13	10	3	26
Nondestructive Evaluation	5	6	1	12
Maintenance & Repair	1	4	2	7
Data	13	12	0	25
Total	54	64	23	141
Organization I	Existing Standa	rds Standar	ds Underway	
ASTM	68		31	182 AM
SAE	35		46	Standards
AWS	1			so far
DMSC	1			_



- IQ, OQ and PQ represent quality assurance protocols for each phase of the manufacturing process for AM equipment.
- Installation qualification (IQ) is a verification process that equipment was properly delivered, installed and configured according to standards set by the manufacturer or by an approved installation checklist.
- **Operational qualification (OQ)** involves testing the equipment to make sure it performs as specified, within operating ranges as listed by the manufacturer. All aspects of the equipment are tested and documented for proper operation.
- **Performance Qualification (PQ)** assures proof of concept prior to a qualified rating . Performance qualification verifies and documents that AM equipment works within an acceptable range as specified, and under real conditions. All instruments are tested together IAW test plan and must generate reproducible results.



#### **Performance Based Qualification**

#### **Performance based**

Measure Outputs for Qualification: Tensile, Porosity, Microstructure, Fatigue. Test the Coupon on build plate. AMS 7023



#### Future

#### **Prescriptive-based**

Measure Inputs for Qualification to manufacturing process. Test everything





## **Current Joint Additive Manufacturing Focus Areas**



1. Qualification/Certification: Accelerate qualification and certification of AM materials, machines and parts.



2. Data and Model Sharing: Enhance a secure common digital thread across DoD and industry.



3. Education and Workforce Development: Expand proficiency in AM: learn, practice and share knowledge.



4. Integration: Develop DoD AM policy and guidance.



5. Alignment: Improve internal and external communication and collaboration.





## •Questions?



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