NAVSEA Additive Manufacturing

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AM Technical Warrant Holder

NAVSEA 05T

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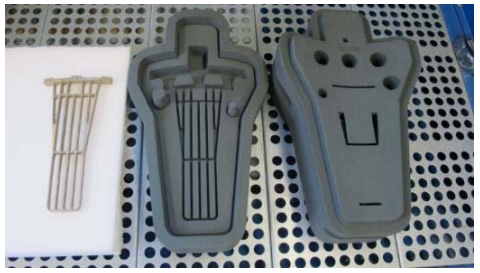
Additive Manufacturing

Why AM?

- **Increase readiness** through production of obsolete or long-lead items
- **Enhance capabilities** through mission-tailorable solutions and employment of designs not otherwise possible
- **Maintain operational availability** through “good enough” production at the point-of need



Key Initiatives

- Develop specifications and standards necessary to incorporate AM components for surface and subsurface applications
- Engage fleet and leverage logistics databases to ID priority components
- Prototype the digital infrastructure to securely store and share files
- Published policy for installing equipment onboard submarines
- Working closely with industry on identification and approval of components for AM.

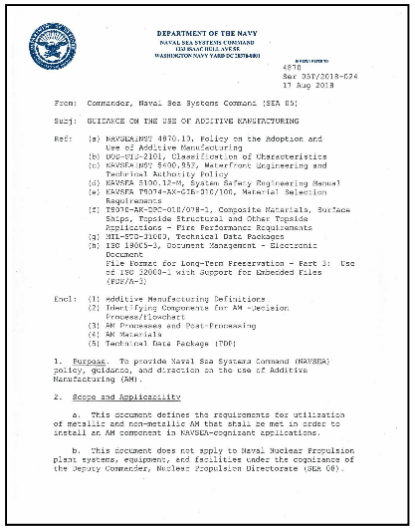
Approval Process and Spec/Standard Development

- NAVSEA AM Guidance released August 2018
  - Guidelines for use of polymeric materials aboard ship (fire, smoke, and toxicity requirements)
- Powder Bed Fusion Technical Publication published – 21 Jan 2020
- Directed Energy Deposition Technical Publication Final Draft – 27 Feb 2020
- Establishing framework for qualifying critical polymer machines and components
- Establishing Technical Data Package for 'Blue Box' components
- Performing machine assessment for new metal AM systems going to NSYs and NSWCs
- Engage Standard Development Organizations with industry for AM processes
- Establishing methodology to qualify vendors for metal AM production




Approval/Guidance

- NAVSEA AM Guidance (Ser 05T/2018-024):
  - Decision/Approval Process
  - Definitions
  - AM Process
  - AM Materials (including Fire/Smoke/Toxicity limitations for polymer)
  - Technical Data Package Requirements
- Does:
  - Requirements for shipboard components
  - Submittal/approval process for AM components installed shipboard
  - Applicable for all vessels
    - EXCEPTION: No AM Polymer material is permitted on a submarine w/o NAVSEA approval (off gassing of material need further investigation)
  - Fire/Smoke/Toxicity compliant polymer materials
  - Requirements for incorporation of polymer materials shipboard
  - Metallic material requirements/considerations
- Does NOT:
  - Apply to Naval Nuclear Propulsion plant systems, equipment and facilities under cognizance of Naval Reactors (SEA08)
  - Apply to Strategic Weapons Systems and Attach Weapons Systems under cognizance of Strategic Systems Programs
  - Provide guidance for AM equipment installation shipboard



DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
1333 ISAAC HULL AVENUE
WASHINGTON NAVY YARD DC 20376-4801

4870
Ser 05T/2018-024
17 Aug 2018

From: Commander, Naval Sea Systems Command (SEA 05)

Subj: GUIDANCE ON THE USE OF ADDITIVE MANUFACTURING

Ref: (a) SECNAVINST 4870.1D, Policy on the Adoption and Use of Additive Manufacturing
(b) DOD-STD-2101, Classification of Characteristics
(c) SECNAVINST 5400.95J, Waterfront Engineering and Technical Authority Policy
(d) NAVSEA S100.12-M, System Safety Engineering Manual
(e) NAVSEA T9074-AX-GTB-010/100, Material Selection Requirements
(f) T9074-AM-SPC-010/078-1, Composite Materials, Surface Ships, Topside Structural and Other Topside Applications - Fire Performance Requirements
(g) MIL-STD-31000, Technical Data Packages
(h) ISO 19005-3, Document Management - Electronic Document File Format for Long-Term Preservation - Part 3: Use of ISO 32000-1 with Support for Embedded Files (PDF/A-3)

Encl: (1) Additive Manufacturing Definitions
(2) Identifying Components for AM -Decision Process/Flowchart
(3) AM Processes and Post-Processing
(4) AM Materials
(5) Technical Data Package (TDP)

1. Purpose. To provide Naval Sea Systems Command (NAVSEA) policy, guidance, and direction on the use of Additive Manufacturing (AM).

2. Scope and Applicability

a. This document defines the requirements for utilization of metallic and non-metallic AM that shall be met in order to install an AM component in NAVSEA-cognizant applications.

b. This document does not apply to Naval Nuclear Propulsion plant systems, equipment, and facilities under the cognizance of the Deputy Commander, Nuclear Propulsion Directorate (SEA 08).

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Overview

Existing Industry Specifications for Metal AM Laser Powder Bed Fusion (select)

- MSFC-STD-3716. Standard for Additively Manufactured Spaceflight Hardware by Laser Powder Bed Fusion in Metals (NASA Marshall Space Flight Center) (2017)
- SAE AMS7003. Laser Powder Bed Fusion Process (2018)
- AWS D20.1/D20.1M. Specification for Fabrication of Metal Components using Additive Manufacturing (2019)

NAVSEA is establishing Technical Publications for metal AM processes (PBF, DED, etc.), to enable the approval of end-use AM components

- Requirements developed based on philosophy of welding *(Control essential elements through tolerances. Manage the procedure to achieve the desired mechanical properties.)* and casting *(emphasis on process control plans to achieve desired outcome)*.
- Address small lot sizes and maintain flexibility for adjusting the procedure to application specific requirements.

Requirements for Metal Powder Bed Fusion Additive Manufacturing (S9074-A2-GIB-010/AM-PBF)

- Released by NAVSEA on January 21, 2020
- First of kind in United States Department of Navy (DoN)
- Document is publically available

Requirements for Metal Directed Energy Deposition Additive Manufacturing

- Routing for NAVSEA Approval
- Estimated Completion - Sept 2020

Chapters

- 1-0 Scope and Applicability
- 2-0 General Requirements and Test Reports
- 3-0 Powder Bed Fusion Procedure Qualification
- 4-0 Part Verification Procedure
- 5-0 Production Conformance Evaluation Plan
- 6-0 Quality Assurance and Process Control Plan
- 7-0 Evaluation and Requalification
- 8-0 Acquisition


S9074-A2-GIB-010/AM-PBF

ORIGINAL

NAVSEA TECHNICAL PUBLICATION

REQUIREMENTS FOR METAL POWDER BED FUSION ADDITIVE MANUFACTURING

DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND

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21 JANUARY 2020

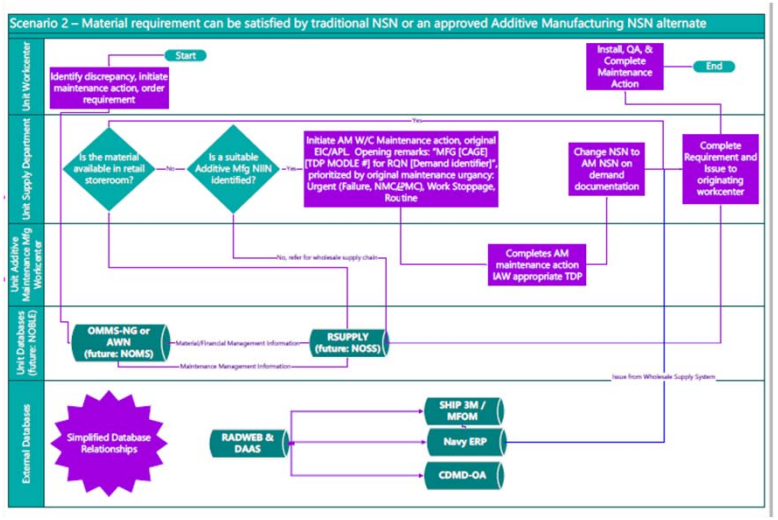
Who Has the Authority to Approve AM Parts?

1-4.1.6 AM Authorized Representative. An AM authorized representative is specifically authorized to approve equipment, material, or procedures within the scope of this document for NAVSEA. AM Authorized representatives are Naval Surface Warfare Center Carderock Division and NAVSEA only. Other AM authorized representatives must be approved by NAVSEA.

Logistics Integration

- Motivation: Growing application space for AM across the Naval Enterprise requires supply chain Integration

- Goal: Data-driven AM part identification using automated logistics, supply and maintenance data



- Approach: Leverage existing databases and policies to integrate AM into the supply chain to promote improved agility, lower response times minimize brittleness

- Current Roadmap:
  - Establish cataloging and provisioning guidelines for AM parts
  - Logistics database and search for evaluating AM mission impact and readiness
  - Establish procedures for traceability of shipboard AM components at all levels; risk assessment and management

Afloat/Expeditionary AM

- Afloat R&D
  - Outfit a limited number of platforms/hulls with AM Equipment
  - Establish networking requirements and means to transfer digital files securely
  - Identify ship modifications
  - Assess performance of equipment and materials in non-static, non-laboratory environments

- Equipment Installation Challenges:
  - Networking of equipment/alternative IT approvals to allow stand alone
  - Electrical requirements for industrial equipment
  - Space configuration and shock mounting

- Other Metrics and Outcomes:
  - Identify the ‘use case’ for the equipment
  - Define workforce development and training requirements
  - Establish requirement for equipment, and ID/prioritize platforms/hulls

- Future Equipment Installation
  - Current: AM equipment installed shipboard via a Ship Change Document (SCD)
  - Establish “green box” for AM equipment, identifying requirements for desktop printers (power, etc.), installation requirements (mounting, etc.) and IT and Infrastructure requirements (computers, networking, etc.)
  - Determine means to establish afloat AM within NAVSEA structure (Program of Record, Outfitting Allowances, etc)

Questions?