International Standard

ISO/ASTM 52966

Additive manufacturing — Qualification principles — Framework for categorizing resources and process capabilities

Fabrication additive — Principes de qualification — Cadre pour la catégorisation des ressources et capacités de traitement

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Introduction

The introduction of additive manufacturing (AM) in the production of parts to support temporary self-sufficient systems (e.g. oil rigs, ships, forward operating bases) has opened new possibilities. However, the limited resources (e.g. space, equipment, utilities, personnel and training) within these systems pose challenges for the implementation of AM. Due to these limitations, it is not realistic to have the AM equipment, and staff to respond to all possible needs at the same AM service site at every self-sufficient system. Rather, it is necessary to optimise the set-up of the AM service site in order to correspond to the most frequent and critical needs of each self-sufficient system. However, this optimisation will mean that there could be situations when the local AM service site cannot respond to the actual need at the time of need. Still, it would be possible for capabilities of different self-sufficient systems to complement each other, thus forming a framework enabling higher levels of combined self-sufficiency, operational readiness and resilience. To enable such a framework to work efficiently it is necessary to specify and categorize the available resources and process capabilities of each AM service site, thus providing a clear structure for coordination of capabilities. This document establishes a system for categorization of AM resources and processes capabilities thus providing clarity and consistency for planning and logistical support of self-sufficient systems.

In addition to the requirements for AM in self-sufficient systems, this standard also facilitates support between different frameworks. For example: ships equipped with Level 2 AM capabilities can support those with Level 1 AM, or ships with no AM capabilities, or even from different shipping companies, and from different nationalities.

By implementing this standardized framework, collaboration and assistance between different systems become easier, enabling the exchange of resources, expertise, and part production.

This normative approach addresses the allocation problem, where to put AM capabilities depending on the available resources on site, not by focusing on quality or cost minimization, but rather by prioritizing availability, speed, and the reduction of time back online and mean time to repair. The framework can be resilience-optimized to meet the unique needs of isolated operating systems and to support them remotely with optimized logistics. The AM integration process is dynamic, evolving through iterative phases of analysis, structuring, and implementation. This ensures that the AM framework becomes increasingly adaptable over time, supporting the broader adoption and effective utilization of AM technologies in challenging environments.

In addition to its primary function of enabling AM in self-sufficient systems, the standardized framework brings forth a multitude of advantages, prominently among them being the enhancement of supply chain resilience. These benefits extend to both civilian and military domains, underlining the framework's significance.

In summary, the standardized framework not only facilitates AM but also fosters a cohesive AM ecosystem. It does so by promoting interoperability, collaboration, and efficiency across diverse self-sufficient systems, thereby contributing significantly to overall supply chain resilience, particularly in times of uncertainty or crisis.

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Additive manufacturing — Qualification principles — Framework for categorizing resources and process capabilities

1 Scope

This document specifies a standardized level framework for the implementation of additive manufacturing to support temporary self-sufficient systems. It defines principles and criteria, from a resource perspective (personnel, training, infrastructure, materials, etc.) and provides guidance for categorizing additive manufacturing processes into different levels to support self-sufficient systems (ships, small islands, oil rigs, etc.). Support can be established through onboard and onshore operation. This covers the complete part cycle from design (if applicable), manufacturing, to a finished part that meets requirements.

It aims to provide clarity and consistency for non-AM experts dealing with logistical support of self-sufficient systems.

This document is applicable to industries, military institutions, research institutions, and regulatory bodies involved in additive manufacturing, facilitating interoperability and harmonization of practices across different stakeholders.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/ASTM 52900, *Additive manufacturing — General principles — Fundamentals and vocabulary*

ISO/ASTM 52901, *Additive manufacturing — General principles — Requirements for purchased AM parts*

ISO/ASTM 52904, *Additive manufacturing of metals — Process characteristics and performance — Metal powder bed fusion process to meet critical applications*

ISO/ASTM 52920, *Additive manufacturing — Qualification principles — Requirements for industrial additive manufacturing processes and production sites*

ISO/ASTM 52926 (all parts), *Additive manufacturing of metals — Qualification principles*

ISO/ASTM/TS 52930, *Additive manufacturing — Qualification principles — Installation, operation and performance (IQ/OQ/PQ) of PBF-LB equipment*

ISO/ASTM 52935, *Additive manufacturing of metals — Qualification principles — Qualification of coordination personnel*

ISO/ASTM 52942, *Additive manufacturing — Qualification principles — Qualifying machine operators of laser metal powder bed fusion machines and equipment used in aerospace applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/ASTM 52900, as well as the following apply.

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