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Additive manufacturing of metals — Finished part properties — Post-processing, inspection and testing of parts produced by powder bed fusion

Fabrication additive de métaux — Propriétés des pièces finies — Post-traitement, inspection et essais des pièces produites par fusion sur lit de poudre

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Foreword

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Introduction

As with conventional manufacturing processes (e.g. casting and milling), metallic parts produced by additive manufacturing technologies have critical-to-quality characteristics. These characteristics include density, strength, hardness, surface quality, dimensional accuracy, residual stresses, absence of cracks, voids, and structural homogeneity, which are typically tested in additively manufactured components. The quality of additively manufactured components is essential for functional components produced on an industrial scale. Thus, it is necessary to qualify additive manufacturing processes according to uniform criteria and to apply standardised in-process and post-process testing.

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Additive manufacturing of metals — Finished part properties — Post-processing, inspection and testing of parts produced by powder bed fusion

1 Scope

This document specifies requirements for the qualification, quality assurance and post processing for metal parts made by powder bed fusion.

This document specifies methods and procedures for testing and qualification of various characteristics of metallic parts made by additive manufacturing powder bed fusion processes, in accordance with ISO/ASTM 52927, categories H and M.

This document is intended to be used by part providers and/or customers of parts.

This document specifies qualification procedures where appropriate to meet defined quality levels.

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 3369:2006, *Impermeable sintered metal materials and hardmetals — Determination of density*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 18265, *Metallic materials — Conversion of hardness values*

ISO 21920-1, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 1: Indication of surface texture*

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

ISO/ASTM 52907, *Additive manufacturing — Feedstock materials — Methods to characterize metal powders*

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

ISO/ASTM 52927, *Additive manufacturing — General principles — Main characteristics and corresponding test methods*[1)]

ISO/ASTM 52928, *Additive manufacturing — Feedstock materials — Powder life cycle management*[2)]

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

ANSI/ASME Y14.5, *Dimensioning and Tolerancing*

ASTM B311, *Standard Test Method for Density of Powder Metallurgy (PM) Materials Containing Less Than Two Percent Porosity*

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2) Under preparation. Stage at the time of publication: ISO/DIS 52928:2023.

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ASTM B962, *Standard Test Methods for Density of Compacted or Sintered Powder Metallurgy (PM) Products Using Archimedes' Principle*

ASTM E8/E8M, *Standard Test Methods for Tension Testing of Metallic Materials*

DIN 50125, *Testing of metallic materials — Tensile test pieces*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
grain size
average grain size in the metallurgical structure when viewed in cross-section

4 Abbreviations

The abbreviations listed in Table 2 are used throughout this document.

Table 2 — Abbreviations

AM	additive manufacturing
EDX	energy-dispersive X-ray spectroscopy
SEM	scanning electron microscope
CAD	computer aided design
NDT	non-destructive testing
QA	quality assurance
COC	certificate of conformance
ASL	approved supplier list
HIP	hot isostatic pressing
EDM	electrical discharge machining
PBF	powder bed fusion

5 Qualification

5.1 General

The manufacturer shall demonstrate the capability to produce AM parts to the requirements given in the purchase specification. The inspection and testing described in the following clauses are performed and assessed using the methods and acceptance criteria stated in the purchase specification.

NOTE Inspection and testing methods are specified at the design stage, as described in ISO/ASTM 52927, and are in accordance with the relevant standards and regulations that are required for the conformity of that part.

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