SLOVENSKI STANDARD
oSIST prEN ISO/ASTM 52904:2022

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Aditivna proizvodnja kovin - Značilnosti in tehnične lastnosti procesa - Proces fuzije plasti kovinskih prašnih delcev za doseganje kritičnih aplikacij (ISO/ASTM DIS 52904:2022)

Additive manufacturing of metals - Process characteristics and performance - Metal powder bed fusion process to meet critical applications (ISO/ASTM DIS 52904:2022)

Additive Fertigung von Metallen - Prozessanforderungen und Qualifizierung - Pulverbettbasiertes Schmelzen von Metallen für kritische Anwendungen (ISO/ASTM DIS 52904:2022)

Fabrication additive de métaux - Caractéristiques et performances du procédé - Procédé de fusion sur lit de poudre métallique en vue de répondre aux applications critiques (ISO/ASTM DIS 52904:2022)

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Additive manufacturing of metals — Process characteristics and performance — Metal powder bed fusion process to meet critical applications

Fabrication additive de métaux — Caractéristiques et performances du procédé — Procédé de fusion sur lit de poudre métallique en vue de répondre aux applications critiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM Committee F42, *Additive Manufacturing Technologies*, on the basis of a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on Additive Manufacturing.

This second edition cancels and replaces the first edition (ISO/ASTM 52904:2019), which has been technically revised.

The main changes compared to the previous edition are as follows:

— restructuring acc. the process chain,

— added various references to new AM standards that cover the previous requirements,

— update in figure 1,

— restructuring of manufacturing plan.

Additive manufacturing of metals — Process characteristics and performance — Metal powder bed fusion process to meet critical applications

1 Scope

This document provides recommendations for the operation and production control of metal powder bed fusion (PBF) machines and processes for areas of critical applications. A critical application is assumed once failing parts-functionality leads to immediate threats.

This document is applicable for production components and mechanical test specimens using powder bed fusion (PBF) with both laser and electron beams.

This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

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 8573-1, *Compressed air — Part 1: Contaminants and purity classes*

ISO/ASTM 52921, *Standard terminology for additive manufacturing — Coordinate systems and test methodologies*

ISO/ASTM/TS 52930:2021, *Additive manufacturing — Qualification principles — Installation, operation and performance (IQ/OQ/PQ) of PBF-LB equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Specification F2924, ISO/ASTM 52900, ISO/ASTM 52921, Guide E2910 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
build programmer
person responsible for programming a build including part orientation, part(s) nesting, and the application of critical build parameters

3.2
machine operator
person responsible for initiating builds and turning over machines, which includes, but is not limited to, loading feedstock powder, loading build platforms, removing completed builds and routine machine cleaning and filter changes

3.3
recoater blade
rake
recoater
roller
brush
portion of the machine that comes in contact with and spreads feedstock across the build area

4 Personnel requirements

The personnel involved in operating the PBF-equipment shall be qualified in accordance with the manufacturer or sector specific requirements (see ISO/ASTM 52926 parts 1 and 2 for PBF-LB operators or parts 1 and 3 for PBF-EB operators).

Records of qualification shall be maintained by the manufacturer in accordance with manufacturer or sector specific requirements (for example, ISO 9001, ISO 13485, ASQC C1, AS 9100).

5 Digital data

5.1 Digital data records

The component manufacturer shall maintain records of all software, CAD, and part nesting layouts used in the production of components, including:

— PBF machine operation software version, as recorded on the manufacturing plan (Clause 9);

— Customer supplied or customer approved CAD files;

— Modifications to the customer CAD files, which shall be in accordance with Clause 8, and files such as AMF and STL that are converted from customer-supplied CAD files. The party that performs the translation from native CAD format to triangulated format (e.g. AMF, STL) is also responsible for performing a quality check of the translated file to ensure there are no unacceptable errors (e.g. bad/free edges, overlapping or intersecting triangles) and confirm that all required geometrical features are still present;

— Slice or layer files used by the PBF machines;

— Record of part nesting and build layout (for example, data-preparation files; screenshots of isometric view);

— PBF machine build log file.

Any other customer-supplied electronic data, dimensional drawings, statement of work, PBF machine log file, or combination thereof, shall be maintained and saved. Multiple build cycles in a manufacturing lot shall be recorded their unique manufacturing plan number.

The record retention period shall be as required for the relevant application/sector, or where not otherwise specified, shall be a minimum of 5 years.

5.2 Digital data processing

The component manufacturer shall have a manual or automated method for engineering file configuration control to ensure that the correct file designation on the purchase order is processed via PBF and, if necessary, final machining.

If the build model is modified from the original form received from the customer (e.g. to add machining allowance), the modification shall be performed in an engineering file format that allows for geometric inspection of the preform. Support structures added to aid PBF processing shall not be considered as modifications to the original form. Modified CAD files shall be verified in the same manner as 8.1.

When engineering files, such as CAD files, are converted to triangulated surfaces for purposes of PBF processing, parameters used for the triangulation resolution of surfaces (e.g. chord height) shall be specified and recorded.

All CAD file translations necessary to support PBF processing, shall be configuration controlled.

NOTE PBF machines with the ability to program builds from native CAD files would significantly reduce the probability of configuration control errors.

6 PBF equipment requirements

6.1 General

Requirements for the following aspects are available in ISO/ASTM 52930:

— Build consumables (build platform, recoater, gases) see ISO/ASTM 52930:2021 section 6.4.2.1;

— Auxiliary tools and equipment;

— Machine operating software;

— Environmental controls.

For PBF-LB, the component manufacturer shall specify shielding gases that, as a minimum, includes consideration of the gas composition and compatibility with the feedstock grade, build platform used and the PBF machine.

6.2 Build consumables

6.2.1 Build platform

The component manufacturer shall define a build platform specification that, as a minimum, includes consideration of the following:

— compatibility of the substrate material grade with the feedstock grade and any shielding gases used;

— geometrical requirements, such as size, thickness and parallelism requirements;

— where the build platform is intended to be reused, sufficient additional thickness beyond the minimum specified by the machine manufacturer to allow for thinning during subsequent recovery of the build surface with each reuse;

— surface finish and cleanliness requirements.

6.2.2 Shielding gases

For PBF-LB, the component manufacturer shall specify shielding gases that, as a minimum, includes consideration of the following:

— gas composition and purity

— compatibility with the feedstock and build platform used

— PBF machine requirements;

6.2.3 Recoater blade

The component manufacturer shall specify and select a recoater material with consideration of the material compatibility with feedstock and consolidated material.