International Standard

ISO/ASTM 52904

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

Second edition
2024-07

Reference number
ISO/ASTM 52904:2024(en)

© ISO/ASTM International 2024



COPYRIGHT PROTECTED DOCUMENT

© ISO/ASTM International 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester. In the United States, such requests should be sent to ASTM International.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11

Email: copyright@iso.org
Website: www.iso.org

ASTM International
100 Barr Harbor Drive, PO Box C700
West Conshohocken, PA 19428-2959, USA
Phone: +610 832 9634
Fax: +610 832 9635
Email: khooper@astm.org
Website: www.astm.org

Published in Switzerland

Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Personnel requirements **2**
5 Digital data **2**
5.1 Digital data records 2
5.2 Digital data processing 2
6 PBF equipment requirements **3**
6.1 General 3
6.2 Build consumables 3
6.2.1 Build platform 3
6.2.2 Shielding gases 3
6.2.3 Powder spreading device 3
6.2.4 Compressed air 3
6.3 Auxiliary tools and equipment 4
6.4 Machine operating software 4
6.5 Environmental controls 4
7 Feedstock requirements **4**
7.1 Purchasing feedstock 4
7.2 Control of feedstock 4
8 Qualification **5**
8.1 Design checks 5
8.1.1 Part files 5
8.1.2 Machining allowance 5
8.1.3 Orientation and location 5
8.1.4 Parts nesting 5
8.2 Pre-build checks 5
8.2.1 General 5
8.2.2 Maintenance and calibration status 5
8.2.3 PBF machine elements and systems 6
8.2.4 Build chamber environment 6
8.2.5 Build platform 6
8.2.6 Powder spreading device 6
8.2.7 Gas supply 6
8.2.8 Feedstock condition and quantity 6
8.2.9 Baseline machine and process parameters 7
8.3 Periodic preventive maintenance 7
8.3.1 General 7
8.3.2 Energy delivery verification 7
8.3.3 Z-axis movement 7
8.3.4 Compressed air 7
8.3.5 Oxygen and vacuum 7
8.3.6 Laser field alignment (LFA) 7
8.3.7 Other recommended preventive maintenance 8
8.4 Machine, process, and part qualification 8
8.4.1 Process qualification 8
8.4.2 Build platform 8
8.4.3 Test specimens 8
8.4.4 Requalification 9
8.5 Consolidated material and part 9

© ISO/ASTM International 2024 – All rights reserved

8.5.1 Material properties 9
8.5.2 Part properties 10
8.5.3 Non-conformities 10

9 Manufacturing plan and documentation 10
9.1 Manufacturing plan 10
9.2 Documentation 11

Annex A (informative) **Example of a manufacturing plan 12**

Bibliography 15

© ISO/ASTM International 2024 – All rights reserved

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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.

This document was prepared by Technical Committee ISO/TC 261, *Additive manufacturing technologies*, based on a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on additive manufacturing, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 438, *Additive manufacturing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

The main changes are as follows:

— The structure of the document is modified to reflect the following workflow: Personnel – Digital data – PBF equipment – Feedstock – Qualification – Manufacturing plan;

— Original Clauses 8 "Control of machine operating system software", Clauses 9 "Auxiliary tools and contamination" and Clauses 11 "External environmental controls" have been merged to a new Clause 6 "PBF equipment requirements";

— New structure and examples for the manufacturing plan, consistent with the new workflow;

— 9.2 "Documentation" is added to the manufacturing plan;

— Figure 1 was updated.

© ISO/ASTM International 2024 – All rights reserved

Introduction

Operation and production control of machines and processes for powder bed fusion (PBF) in critical applications are described in this document. Critical applications can be subject to regulation. This is one way of meeting quality requirements. The supplier/manufacturer can also ensure quality of components through validation and verification of the AM process, as per internal procedures and requirements, and inspection of the CTQs (critical to quality) of the AM components, as per customer agreement.

© ISO/ASTM International 2024 – All rights reserved

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

1 Scope

WARNING — This document 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 document to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

This document covers 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 of parts and mechanical test specimens using powder bed fusion (PBF) with both laser and electron beams.

Specifications related to specific fields of application are provided in respective standards.

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 52900, *Additive manufacturing — General principles — Fundamentals and vocabulary*

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

ISO 17295, *Additive manufacturing — General principles — Part positioning, coordinates and orientation*

ISO/ASTM 52926-1, *Additive manufacturing of metals — Qualification principles — Part 1: General qualification of operators*

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 ISO/ASTM 52900 and ISO/ASTM 52926-1 and the following apply.

ISO and IEC maintain terminology 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/

© ISO/ASTM International 2024 – All rights reserved