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BSI Standards Publication

Additive manufacturing — Design

Part 3: PBF-EB of metallic materials

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National foreword

This British Standard is the UK implementation of EN ISO/ASTM 52911-3:2023. It is identical to ISO/ASTM 52911-3:2023.

The UK participation in its preparation was entrusted to Technical Committee AMT/8, Additive manufacturing.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

Additive Manufacturing - Design - Part 3: PBF-EB of metallic materials (ISO/ASTM 52911-3:2023)

Fabrication additive - Conception - Partie 3: BF-EB de
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Additive Fertigung - Konstruktion - Teil 3:
Pulverbettbasiertes Schmelzen von Metallen mittels
Elektronenstrahl (ISO/ASTM 52911-3:2023)

This European Standard was approved by CEN on 17 February 2023.

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European foreword

This document (EN ISO/ASTM 52911-3:2023) has been prepared by Technical Committee ISO/TC 261 "Additive manufacturing" in collaboration with Technical Committee CEN/TC 438 "Additive Manufacturing" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2023, and conflicting national standards shall be withdrawn at the latest by September 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO/ASTM 52911-3:2023 has been approved by CEN as EN ISO/ASTM 52911-3:2023 without any modification.

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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.

This document was prepared by Technical Committee 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, and 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).

A list of all parts in the ISO 52911 series can be found on the ISO website.

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.

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Introduction

Powder bed fusion of metals (PBF/M) is an additive manufacturing (AM) process that offers additional manufacturing options alongside other established AM processes. PBF/M has the potential to reduce manufacturing time and costs, and increase part functionality. Practitioners are aware of the strengths and weaknesses of conventional, long-established manufacturing processes, such as cutting, joining and shaping processes (e.g. by machining, welding or injection moulding), and of giving them appropriate consideration at the design stage and when selecting the manufacturing process. In the case of PBF/M and AM in general, design and manufacturing engineers only have a limited pool of experience. Without the limitations associated with conventional processes, the use of PBF/M offers designers and manufacturers a high degree of freedom and this requires an understanding about the possibilities and limitations of the process.

The ISO 52911 series provides guidance for different powder bed fusion (PBF) technologies. In addition to this document on PBF-EB/M, the series is made up of ISO 52911-1 on laser-based powder bed fusion of metals (PBF-LB/M) and ISO 52911-2 on laser-based powder bed fusion of polymers (PBF-LB/P). Each document in the series shares [Clauses 1](#) to [5](#), where general information including terminology and the PBF process is provided. The subsequent clauses focus on the specific technology.

This document provides support to technology users, such as design and production engineers, when designing parts that need to be manufactured by means of PBF-EB/M. It will help practitioners to explore the benefits of PBF-EB/M and to recognize the process-related limitations when designing parts. It also builds on ISO/ASTM 52910 to extend the requirements, guidelines and recommendations for AM design to include the PBF-EB/M process.

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Additive manufacturing — Design —

Part 3: PBF-EB of metallic materials

1 Scope

This document specifies the features of electron beam powder bed fusion of metals (PBF-EB/M) and provides detailed design recommendations.

Some of the fundamental principles are also applicable to other additive manufacturing (AM) processes, provided that due consideration is given to process-specific features.

This document also provides a state of the art review of design guidelines associated with the use of powder bed fusion (PBF) by bringing together relevant knowledge about this process and by extending the scope of ISO/ASTM 52910.

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*

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

curl effect

<aspect of heat-induced warping> dimensional distortion as the melted material cools and solidifies after being built or by poorly evacuated heat input

3.2

downskin area

D

(sub-)area where the normal vector \vec{n} projection on the Z-axis is negative

Note 1 to entry: See [Figure 1](#).