



SLOVENSKI STANDARD
oSIST prEN ISO/ASTM 52938-1:2023
01-junij-2023

Aditivna proizvodnja kovin - Okolje, zdravje in varnost - 1. del: Varnostne zahteve za stroje za lasersko spajanje prahu v postelji (PBF-LB) (ISO/ASTM DIS 52938-1:2023)

Additive manufacturing of metals - Environment, health and safety - Part 1: Safety requirements for PBF-LB machines (ISO/ASTM DIS 52938-1:2023)

Additive Fertigung von Metallen - Umwelt, Gesundheit und Sicherheit - Teil 1: Sicherheitsanforderungen für PBF-LB-Maschinen (ISO/ASTM DIS 52938-1:2023)

Fabrication additive de métaux - Environnement, hygiène et sécurité - Partie 1: Exigences de sécurité pour les machines PBF-LB (ISO/ASTM DIS 52938-1:2023)

Ta slovenski standard je istoveten z: prEN ISO/ASTM 52938-1

ICS:

13.100	Varnost pri delu. Industrijska higiena	Occupational safety. Industrial hygiene
13.110	Varnost strojev	Safety of machinery
25.030	3D-tiskanje	Additive manufacturing

oSIST prEN ISO/ASTM 52938-1:2023 en,fr,de

DRAFT INTERNATIONAL STANDARD ISO/ASTM DIS 52938-1

ISO/TC 261

Secretariat: DIN

Voting begins on:
2023-04-27

Voting terminates on:
2023-07-20

Additive manufacturing of metals — Environment, health and safety —

Part 1: Safety requirements for PBF-LB machines

Fabrication additive de métaux — Environnement, hygiène et sécurité —

Partie 1: Exigences de sécurité pour les machines PBF-LB

ICS: 13.110; 13.100; 25.030

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO/ASTM 52938-1:2023](https://standards.iteh.ai/catalog/standards/sist/e6e81266-f811-4179-be03-5efa5ef21d2a/osist-pren-iso-astm-52938-1-2023)

<https://standards.iteh.ai/catalog/standards/sist/e6e81266-f811-4179-be03-5efa5ef21d2a/osist-pren-iso-astm-52938-1-2023>

This document is circulated as received from the committee secretariat.

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENT AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

ISO/CEN PARALLEL PROCESSING



Reference number
ISO/ASTM DIS 52938-1:2023(E)

© ISO/ASTM International 2023

iTeh STANDARD PREVIEW (standards.iteh.ai)

oSIST prEN ISO/ASTM 52938-1:2023

<https://standards.iteh.ai/catalog/standards/sist/e6e81266-f811-4179-be03-5efa5ef21d2a/osist-pren-iso-astm-52938-1-2023>



COPYRIGHT PROTECTED DOCUMENT

© ISO/ASTM International 2023

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

Published in Switzerland

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

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	3
4 Safety requirements and measures	3
4.1 General.....	3
4.2 Protective measures.....	3
4.2.1 General.....	3
4.2.2 Safeguards.....	3
4.2.3 Control devices.....	4
4.2.4 Control systems.....	4
4.3 Protection against mechanical hazards.....	8
4.3.1 Stability.....	8
4.3.2 Moving parts.....	8
4.3.3 Protection against slipping, tripping or falling.....	9
4.4 Protection against electrical hazards.....	9
4.4.1 General.....	9
4.4.2 Protection from electrostatic phenomena.....	9
4.5 Protection against thermal hazards.....	9
4.6 Protection against vibration hazards.....	9
4.7 Protection against Noise.....	9
4.8 Protection against laser radiation hazards.....	10
4.9 Protection against pneumatic hazards.....	10
4.10 Protection against hydraulic hazards.....	10
4.11 Protection against hazards generated by materials and substances.....	10
4.11.1 Metal particulate handling and recovery.....	10
4.11.2 Build object recovery and post-processing particulate.....	11
4.11.3 Explosion and fire hazards.....	11
4.11.4 Hazards generated by inert gases.....	12
4.12 Protection against ergonomic hazards.....	13
4.13 Hazards generated by overpressure.....	13
4.14 Hazards generated by failure of power supply.....	13
5 Verification of safety requirements and/or measures	13
5.1 General.....	13
5.2 Verification based on noise emission values.....	15
6 Information for use	15
6.1 General.....	15
6.2 Cleaning and maintenance.....	16
6.3 Handling.....	17
7 Marking	17
Annex A (informative) List of significant hazards	18
Annex B (normative) Overview of required performance level (PLr)	23
Annex C (normative) Noise test code	24
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered	29
Bibliography	32

ISO/ASTM DIS 52938-1:2023(E)

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.

Introduction

The ISO/ASTM 52938 series provides technical safety requirements for the design and manufacturing of Additive Manufacturing (AM) machinery for use in the industry. It concerns designers, manufacturers, suppliers and importers of the machines specified in the Scope. It also includes a list of informative items that the manufacturer will need to give to the user.

Environment, health and safety requirements for use of AM machines using metallic feedstocks are addressed in ISO/ASTM 52931:2023.

This document is a type-C standard as stated in ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO/ASTM 52938-1:2023](https://standards.iteh.ai/catalog/standards/sist/e6e81266-f811-4179-be03-5efa5ef21d2a/osist-pren-iso-astm-52938-1-2023)

<https://standards.iteh.ai/catalog/standards/sist/e6e81266-f811-4179-be03-5efa5ef21d2a/osist-pren-iso-astm-52938-1-2023>

Additive manufacturing of metals — Environment, health and safety —

Part 1: Safety requirements for PBF-LB machines

1 Scope

This document deals with the technical requirements and the means for their verification for Additive Manufacturing (AM) machines using a bed of metallic powder, pyrophoric feedstock excluded, and a laser herein designated as machine.

This document deals with all significant hazards, hazardous situations or hazardous events during all phases of the life of the machine (ISO 12100:2010, 5.4), as listed in [Annex A](#), caused by AM machines using a bed of metallic powder and a laser when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

This document does not deal with hazards which can occur:

- during construction;
- operating in potentially explosive atmospheres.

This document is not applicable to machines manufactured before the date of its publication.

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 52900:2021, *Additive manufacturing — General principles — Terminology*

ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 11553-1:2020, *Safety of machinery — Laser processing machines — Part 1: Laser safety requirements*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO/ASTM DIS 52938-1:2023(E)

ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3:2005, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13855:2022, *Safety of machinery — Positioning of protective equipment with respect to the approach speeds of parts of the human body*

ISO 14118:2017, *Safety of machinery — Prevention of unexpected start-up*

ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access*

ISO 20607:2019, *Safety of machinery — Instruction handbook — General drafting principles*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 60825-4:2022, *Safety of laser products — Part 4: Laser guards*

IEC 61310-1:2007, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3:2018, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for active opto-electronic protective devices responsive to diffuse Reflection (AOPDDR)*

IEC 61800-5-2:2017, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment — Part 1: General*

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 894-2:2008+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 1005-2:2003+A1:2008, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: planning*

EN 14034-3:2006+A1:2011, *Determination of explosion characteristics of dust clouds — Part 3: Determination of the lower explosion limit LEL of dust clouds*

EN 14034-4:2004+A1:2011, *Determination of explosion characteristics of dust clouds — Part 4: Determination of the limiting oxygen concentration LOC of dust clouds*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2015, IEC 60825-1:2014 and ISO/ASTM 52900:2021 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/>

4 Safety requirements and measures

4.1 General

For a list of significant hazards related to a machine see [Annex A](#).

The machine shall comply with the protective and/or risk reduction requirements of this document. In addition, equipment and systems shall be designed in accordance with the principles of ISO 12100:2010 for relevant, but non-significant, hazards which are not covered by this document.

Safety requirement and/or measures shall be verified according to [Clause 5](#).

4.2 Protective measures

4.2.1 General

Machinery shall be designed and safeguarded in accordance with the specific requirements and/or protective measures listed below.

Safeguards shall be positioned in accordance with ISO 13855:2022.

4.2.2 Safeguards

4.2.2.1 Fixed guards

Fixed guards shall be designed in accordance with ISO 12100:2010, 6.3.3.2.2 and ISO 14120:2015, 5.3. Guards shall be chosen according to ISO 14120:2015, Clause 6, all further requirements for protective measures are given in this clause.

ISO/ASTM DIS 52938-1:2023(E)

4.2.2.2 Interlocking movable guards

4.2.2.2.1 General

If fitted, movable guards shall be designed in accordance with ISO 14120:2015, 5.3.12, and shall be interlocked.

4.2.2.2.2 Movable guards with interlocking without guard locking

Guard interlocking without guard locking shall fulfil the principles of ISO 14119:2013, 4.2.

4.2.2.2.3 Movable guards with interlocking with guard locking

Guard interlocking with guard locking shall fulfil the principles of ISO 14119:2013, 4.3.

Guard interlocking with manually operated guard locking according to ISO 14119:2013, F.5, may be applied if the time necessary for the guard to be unlocked is greater than the time necessary for the hazardous movement to cease.

4.2.2.3 Electro-sensitive protective equipment (ESPE)

Electro-sensitive protective equipment (ESPE) shall be designed and arranged according to:

- a) IEC 61496-1:2020 and IEC 61496-2:2020 and as minimum type 2 as defined in IEC 61496-2:2020 for active opto-electronic protective devices (AOPD), also known as light curtains or light barriers;
- b) IEC 61496-3:2008 and as minimum type 3 as defined in IEC 61496-2:2020 for laser scanners (AOPDDR).

4.2.3 Control devices

The electrical hand-operated control devices of the machine, i.e. for start, normal stop, and, if fitted, for programmable end stop, panel pusher, shall be positioned on the front side of the main control panel fixed to the front of the machine.

4.2.4 Control systems

4.2.4.1 General

For the design and implementation of any safety function, whether realized in electric, pneumatic, hydraulic or mechanic technology, the appropriate requirements of ISO 13849-1:2015 apply.

Machine safety functions are implemented and assured through safety-related parts of the control system (SRP/CS) that achieve a required performance level (PL_r). This requirement is given in [Annex B](#).

Wherever a performance level is mentioned in this document, the requirements for the performance level (PL) refer to ISO 13849-1:2015.

For SRP/CS as part of a safety component or protective device for which there is an existing related type-B safety standard, all requirements of that standard apply.

The safety-related embedded software (SRESW) of the SRP/CS shall be in accordance with ISO 13849-1:2015, 4.6.1 and 4.6.2.

The safety-related application software (SRASW) of the SRP/CS shall be in accordance with ISO 13849-1:2015, 4.6.1 and 4.6.3.

SRP/CS shall be validated according to ISO 13849-1:2015, Clause 8 (see also ISO 13849-2:2012).

The environmental conditions to which SRP/CS are exposed, e.g. dust, fumes and/or gases, shall be taken into account. The SRP/CS shall fulfil the environmental requirements of IEC 62477-1:2022.

4.2.4.2 Start and restart

Before start or restart of the machine, all relevant safeguards shall be in place and operational. Start or restart shall only be possible by actuation of the start control device provided for that purpose. Unintended actuation shall be impeded, e.g. by a control device with shroud.

The SRP/CS for prevention of unexpected start/restart and for interlocking arrangements shall meet the requirements of ISO 14118:2017. For electrically operated machines, see IEC 60204-1:2016, 7.5 and 9.2.5.2.

4.2.4.3 Stop function

The stop function shall be realized according to IEC 60204-1:2016, 9.2.2.

4.2.4.4 Normal stop

The machine shall be fitted with a stop control which, when activated, brings all machine actuators and any demountable power feed unit safely to a stop.

If no emergency stop control is necessary, all normal stop control devices shall protrude and have no shroud.

For normal stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2017, 4.2.3.2 [safe torque off (STO)] and IEC 61800-5-2:2017, 4.2.3.3 [safe stop 1 (SS1)] apply.

For machine actuators stopped in stop category 0, power shall be cut to these actuators (if fitted) unless STO according to IEC 61800-5-2:2017 is used.

4.2.4.5 Operational stop

For operational stops, the stopping sequence shall be as follows.

- a) Stop the machine actuators in stop category 2 according to IEC 60204-1:2016, 9.2.2, and keep clamping effective (if fitted).
- b) Keep the stop condition monitored and maintained after stopping.

For operational stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2017, 4.2.3.4 [“safe stop 2” (SS2)] and IEC 61800-5-2:2017, 4.2.4.2 [“safe operating stop” (SOS)] apply.

4.2.4.6 Emergency stop

Machines with more than one machine actuator or where provision is made for use with more than one machine actuator (e.g. with a socket for a demountable power feed) shall be fitted with an emergency stop control. Electrical emergency stop control systems shall comply with the requirements of IEC 60204-1:2016, 9.2.3.4.2 and 10.7.

All emergency stops [machine and connected unit(s)] shall be connected and actuation of any emergency stop shall have the same result.

If an emergency stop control is required it shall be fitted according to the requirements of ISO 13850:2015. The control device shall be located on the front side of the main control panel fixed to the front of the machine.