

SLOVENSKI STANDARD
oSIST prEN ISO/ASTM 52931:2021
01-november-2021

Aditivna proizvodnja kovin - Okolje, zdravje in varnost - Splošna načela za uporabo kovinskih materialov (ISO/ASTM DIS 52931:2021)

Additive manufacturing of metals - Environment, health and safety - General principles for use of metallic materials (ISO/ASTM DIS 52931:2021)

Additive Fertigung von Metallen - Umweltschutz, Gesundheit und Sicherheit - Allgemeine Grundsätze für die Verwendung metallischer Materialien (ISO/ASTM DIS 52931:2021)

Fabrication additive - Santé et sécurité environnementale - Lignes directrices normalisées pour l'utilisation de matériaux métalliques (ISO/ASTM DIS 52931:2021)

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|-----------|--|---|
| 13.020.01 | Okolje in varstvo okolja na splošno | Environment and environmental protection in general |
| 13.030.30 | Posebni odpadki | Special wastes |
| 13.100 | Varnost pri delu. Industrijska higiena | Occupational safety. Industrial hygiene |
| 25.030 | 3D-tiskanje | Additive manufacturing |

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Additive manufacturing of metals — Environment, health and safety — General principles for use of metallic materials

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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 is the first edition of this document.

ISO/ASTM DIS 52931:2021(E)**Introduction**

The use of Additive Manufacturing (AM) processes with metallic feedstock entails a number of hazards. It is therefore important, as a first step, to implement a high level of protection during manufacturing and installation of the additive manufacturing machine or plant. For this purpose, ISO/ASTM 52938-1 dealing with safety of LB-PBF machines is under preparation.

In addition, the users of additive manufacturing plants have to reduce the risks for the operators remaining after installation so that they fulfil the nationally or regionally pertinent regulations for health and safety at work. The latter are very different worldwide and the requirements of a standard cannot fully reflect them. For users of additive manufacturing plants, the guidelines and requirements of ISO/ASTM 52931 are, therefore, particularly relevant with regard to aspects not sufficiently covered by pertinent national or regional regulations for safety and health at work.

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Additive manufacturing of metals — Environment, health and safety — General principles for use of metallic materials

1 Scope

This document provides a guide and requirements for risk assessment and implementation of prevention and protection measures relating to additive manufacturing with powders.

The risks covered by this document concern all sub-processes composing the manufacturing process, including the management of waste.

This document does not specify requirements for the design of machinery/equipment used for additive manufacturing.

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 11611, *Protective clothing for use in welding and allied processes*

ISO 14116, *Protective clothing — Protection against flame — Limited flame spread materials, material assemblies and clothing*

ISO/ASTM 52900, *Additive manufacturing — General principles — Terminology*

ISO/ASTM 52907:2019, *Additive manufacturing — Feedstock materials — Methods to characterize metal powders*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

IEC 60079-10-2, *Explosive atmospheres — Part 10-2: classification of areas — Combustible dust atmospheres*

EN 2, *Classification of fires*

EN 166, *Personal eye-protection*

ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*

NFPA 10, *Standard for Portable Fire Extinguishers*

3 Terms and definitions

3.1 Definitions

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

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3.2 Abbreviations

The abbreviations and acronyms used in this document are listed in [Table 1](#).

Table 1 — Abbreviations and acronyms

| Abbreviation | Signification |
|--------------|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| AHU | Air Handling Unit |
| AM | Additive Manufacturing |
| ATEX | ATmospheres EXplosives |
| CLP | Classification, Labelling, Packaging |
| CMR | Carcinogenic, Mutagenic or Reprotoxic |
| EChA | European Chemicals Agency |
| GHS | Globally Harmonized System |
| HSE | Health-Safety-Environment |
| MSD | MusculoSkeletal Disorder |
| NIOSH | National Institute for Occupational Safety and Health |
| OEL | Occupational Exposure Limit |
| OSHA | Occupational Safety and Health Administration |
| PPE | Personal Protective Equipment |
| REACH | Registration, Evaluation and Authorisation of CHemicals |
| UNECE | United Nations Economic Commission for Europe |

4 Methodology

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4.1 General

The method described in this document allows to the user to assess the HSE risk considering the following:

- metallic powders used,
- AM process,
- AM system installation conditions,
- applicable good practices and
- feedback from experience.

The methodology is based on a characterization of physical hazards (e.g. fire and explosion), hazards to the health of the operator or the potentially exposed third parties and to the environment. The overall approach to risk assessment and implementation of prevention measures is illustrated in [Figure 1](#) and detailed in [Table 2](#).

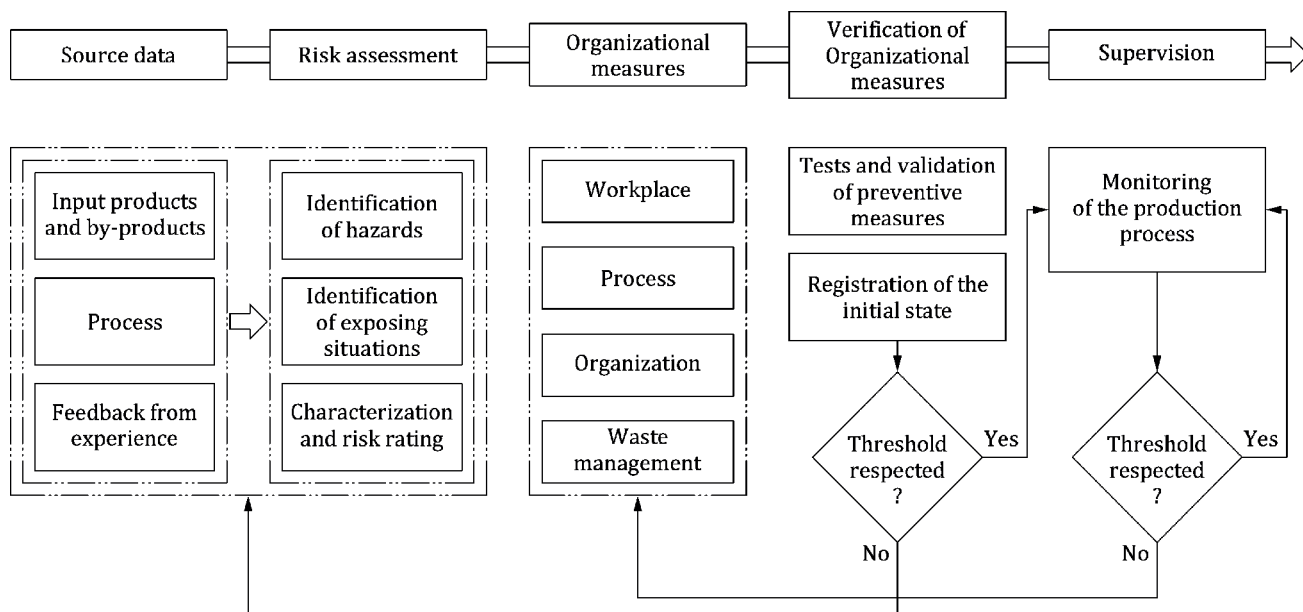


Figure 1 — Overall approach to risk assessment and implementation of prevention measures

Table 2 — Description of the HSE risk prevention process

| Main steps | Aspects taken into account | Factors / measures |
|--|---|---|
| Source data | Input products and by-products | Safety data sheets, products implemented with classification, toxicity and granulometry, Instruction handbooks, Current regulations |
| | Process | Means (premises and work equipment) implemented for the storage, transport and processing of inputs |
| | Feedback from experience | Measurement, analysis, medical follow-up, incident reports, supervision of technology and regulation |
| Risk assessment | Identification of hazards | Identification of the inherent hazards of the inputs and by-products generated at the different stages of the process and the exposing situations |
| | Identification of exposing situations | Identification of tasks and activities with potential for exposures at the different stages of the process including accidental exposure |
| | Characterization and risk rating | Characterization and rating of the risks to health, safety and environment |
| Verification of Organizational measures | Workplace | Layout, performance of containment, airflow / ventilation, air monitoring function |
| | Process | Raw material, work equipment, capture performance, sealing, filtration cleanliness, level of reliability of detection functions, controls, category of risks related to explosion,... |
| | Organization | Procedures, process flow, level of training, PPE, medical follow-up, monitoring of premises and equipment |
| | Waste management | Waste collection, storage and disposal. Spill prevention and containment |
| Verification of prevention and protection measures | Tests and validation of preventive measures | Sampling, atmospheric dosimetry, surface measurements, adequacy audit |
| | Registration of initial state | Ambient measurement |

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Table 2 (continued)

| Main steps | Aspects taken into account | Factors / measures |
|-------------|--------------------------------------|---|
| Supervision | Monitoring of the production process | Monitoring and management of workplace / process / organization modification, regulatory and technological monitoring, Sampling, atmospheric dosimetry, area of surface contamination |

4.2 Chemical hazard methodology

The steps for assessing and controlling the risk of exposure to hazardous chemical agents are described in Figure 2:

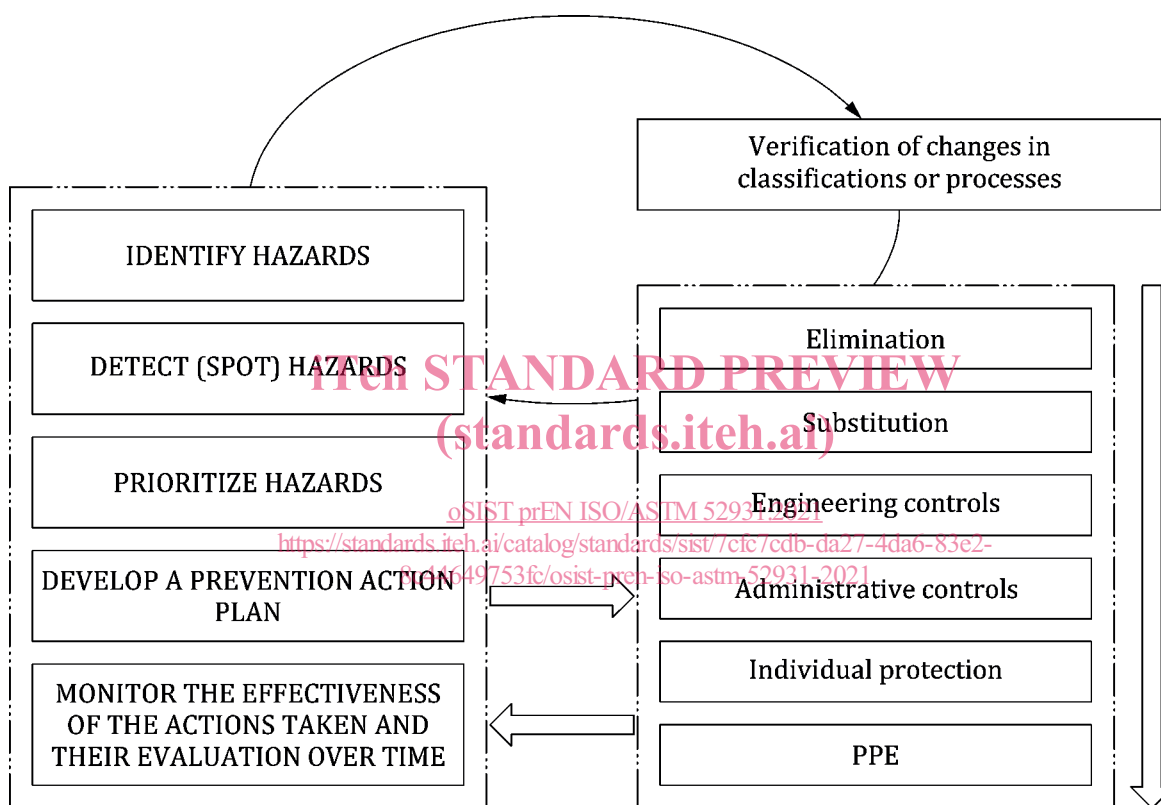


Figure 2 — Main steps of a chemical risks prevention process

5 Source data

5.1 General

Applicable local regulations shall be considered (see Directive 89/391/EEC, in Europe, and OSHA, in USA).

5.2 Input products and by-products

5.2.1 Safety data sheet

See information given in Annex A.

5.2.2 Product technical datasheet

The product technical datasheet should also contain information about particle size distribution.

Technical specification of metal powders should be provided in accordance with ISO/ASTM 52907:2019, Annex A.

5.3 Process

5.3.1 General

The instructions for proper installation, use and maintenance of the machine shall be followed. The user should ensure that the combination of feedstock and machine has been taken into account. The end user shall perform a specific risk assessment, preferably with the support of the machine manufacturer and of the supplier of the feedstock(s).

5.3.2 Means of storage and implementation

For the regular use of metallic powders, national regulations and organisational policies related to hazardous substances shall be observed. This would include registering of the material in the organization and risk assessments for the individual processes performed with the material based on information from the safety data sheets. This would provide hierarchical control for the following, as a minimum:

- powder identification;
- storage location;
- storage requirements (legal aspects, safety aspects and powder quality aspects);
- manual handling requirements;
- maximum volume/s of powder for each process;
- use of ancillary equipment (wet separators etc),
- housekeeping requirements;
- PPE requirements.

5.4 Feedback from experience

5.4.1 Incident reports

When an incident occurs for an operator of a facility, the company shall provide to the inspector of the facilities a report analysing the causes of the incident, its effects and consequences on people and the environment. The description in the incident report shall contain the equipment involved in the incident:

When an incident occurs for an operator of a facility, the company should provide a report analysing the causes of the incident, its effects and consequences on people and the environment. The description useful for in the incident report is:

- description of the process and its equipment: implementation, products involved, operating conditions in normal operation, procedures, rules, control operations, maintenance, cleaning, etc;
- security measures (prevention, protection), procedures, qualifications, training;
- circumstances, context and chronology of the incident: