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Contents

Page

Foreword ... **iv**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Purpose ... **3**

5 Design opportunities and limitations ... **6**
5.1 General ... 6
5.2 Design opportunities ... 7
5.3 Design limitations ... 8

6 Design considerations ... **9**
6.1 General ... 9
6.2 Product considerations ... 9
6.3 Product usage considerations ... 10
6.3.1 General ... 10
6.3.2 Thermal environment ... 10
6.3.3 Chemical exposure ... 10
6.3.4 Radiation exposure ... 10
6.3.5 Other exposure ... 11
6.4 Sustainability considerations ... 11
6.5 Business considerations ... 12
6.6 Geometry considerations ... 14
6.7 Material property considerations ... 16
6.7.1 General ... 16
6.7.2 Mechanical properties ... 16
6.7.3 Thermal properties ... 17
6.7.4 Electrical properties ... 17
6.7.5 Other ... 17
6.8 Considerations related to different process categories ... 18
6.8.1 General ... 18
6.8.2 Specific considerations for different process categories ... 18
6.8.3 Other considerations ... 20
6.9 Communication considerations ... 20

7 Warnings to designers ... **21**

Bibliography ... **23**

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Foreword

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM 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.

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Additive manufacturing — Design — Requirements, guidelines and recommendations

CAUTION — 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 Health and Safety (H&S) practices and determine the applicability of limitations prior to use.

1 Scope

This document gives requirements, guidelines and recommendations for using additive manufacturing (AM) in product design.

It is applicable during the design of all types of products, devices, systems, components or parts that are fabricated by any type of AM system. This document helps determine which design considerations can be utilized in a design project or to take advantage of the capabilities of an AM process.

General guidance and identification of issues are supported, but specific design solutions and process-specific or material-specific data are not supported.

The intended audience comprises three types of users:

— designers who are designing products to be fabricated in an AM system and their managers;

— students who are learning mechanical design and computer-aided design; and

— developers of AM design guidelines and design guidance systems.

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/ASTM 52921 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 http://www.electropedia.org/

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3.1 Additive manufacturing process categories

3.1.1
binder jetting
additive manufacturing process in which a liquid bonding agent is selectively deposited to join powder materials

[SOURCE: ISO/ASTM 52900:—[1)], 3.2.1]

3.1.2
directed energy deposition
additive manufacturing process in which focused thermal energy is used to fuse materials by melting as they are being deposited

[SOURCE: ISO/ASTM 52900:—, 3.2.2 — Note 1 to entry has been deleted]

3.1.3
material extrusion
additive manufacturing process in which material is selectively dispensed through a nozzle or orifice

[SOURCE: ISO/ASTM 52900:—, 3.2.3]

3.1.4
material jetting
additive manufacturing process in which droplets of build material are selectively deposited

[SOURCE: ISO/ASTM 52900:—, 3.2.4 — Note 1 to entry has been deleted]

3.1.5
powder bed fusion
additive manufacturing process in which thermal energy selectively fuses regions of a powder bed

[SOURCE: ISO/ASTM 52900:—, 3.2.5]

3.1.6
sheet lamination
additive manufacturing process in which sheets of material are bonded to form an object

[SOURCE: ISO/ASTM 52900:—, 3.2.6 — “a part” has been replaced with “an object”]

3.1.7
vat photopolymerization
additive manufacturing process in which liquid photopolymer in a vat is selectively cured by light-activated polymerization

[SOURCE: ISO/ASTM 52900:—, 3.2.7]

3.2 Other definitions

3.2.1
design consideration
topic that can influence decisions made by a part designer

Note 1 to entry: The designer determines to what extent the topic can affect the part being designed and takes appropriate action.

1) Under preparation. Stage at the time of publication: ISO/DIS 52900:2018.

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3.2.2
process chain
sequence of manufacturing processes that is necessary for the part to achieve all of its desired properties

4 Purpose

4.1 This document provides requirements, guidelines and recommendations for designing parts and products to be produced by AM processes. Conditions of the part or product that favour AM are highlighted. Similarly, conditions that favour conventional manufacturing processes are also highlighted. The main elements include the following:

— the opportunities and design freedoms that AM offers designers (Clause 5);

— the issues that designers should consider when designing parts for AM, which comprises the main content of these guidelines (Clause 6); and

— warnings to designers, or "red flag" issues, that indicate situations that often lead to problems in many AM systems (Clause 7).

4.2 The overall strategy of design for AM is illustrated in Figure 1. It is a representative process for designing mechanical parts for structural applications, where cost is the primary decision criterion. The designer could replace cost with quality, delivery time, or other decision criterion, if applicable. In addition to technical considerations related to functional, mechanical or process characteristics, the designer should also consider risks associated with the selection of AM processes.

4.3 The process for identifying general potential for fabrication by AM is illustrated in Figure 2. This is an expansion of the "identification of general AM potential" box on the left side of Figure 1. As illustrated, the main decision criteria focus on material availability, whether or not the part fits within a machine's build volume, and the identification of at least one part characteristic (customization, lightweighting, complex geometry) for which AM is particularly well suited. These criteria are representative of many mechanical engineering applications for technical parts, but are not meant to be complete.

4.4 An expansion for the "AM process selection" box in Figure 1 is presented in Figure 3, illustrating that the choice of material is critical in identifying a suitable process or processes. If a suitable material and process combination can be identified, then consideration of other design requirements can proceed, including surface considerations and geometry, static physical and dynamic physical properties, among others. These figures are meant to be illustrative of typical practice for many types of mechanical parts, but should not be interpreted as prescribing necessary practice.

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