

ISO/ASTM FDIS 52927:2023(E)

© ISO/ASTM 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 ~~ASTM International~~
CP 401 • Ch. de Blandonnet 8 ~~100 Barr Harbor Drive, PO Box C700~~
CH-1214 Vernier, Geneva ~~West Conshohocken, PA 19428-2959, USA~~
Phone: +41 22 749 01 11 ~~Phone: +610 832 9634~~

Fax: +41 22 749 09 47 Fax: +610 832 9635
Email: copyright@iso.org Email: lchooper@astm.org
Website: www.iso.org Website: www.astm.org

E-mail: copyright@iso.org
Website: www.iso.org

Published in Switzerland

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

ISO/ASTM FDIS 52927

<https://standards.itih.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Line spacing: single

Formatted: Header distance from edge: 1.27 cm, Footer distance from edge: 0.5 cm

Commented [eXtyle1]: Not found: "ISO/ASTM 2023"

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Indent: Left: 0 cm, Right: 0 cm, Space Before: 0 pt, Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Commented [eXtyle2]: The URL <http://www.astm.org> has been redirected to <https://www.astm.org/>. Please verify the URL.

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

Contents

Foreword vi

Introduction..... viii

1 Scope 1

2 Normative references 1

3 Terms and definitions..... 1

4 Main characteristics and corresponding test methods 2

4.1 General 2

4.2 Selection criteria..... 3

5 Part and process testing — Specifications and quality criteria..... 3

5.1 General 3

5.2 Testing the feedstocks 3

5.3 Monitoring the process..... 3

5.4 Testing the part..... 4

Annex A (normative) Test methods for metallic materials..... 5

Annex B (normative) Test methods for polymer materials 12

Annex C (normative) Test methods for ceramic materials 16

Bibliography 20

Foreword — v

Introduction — vi

1 — Scope — 1

2 — Normative references — 1

3 — Terms and definitions — 1

4 — Main characteristics and corresponding test methods — 1

4.1 — General — 1

4.2 — Selection criteria — 2

5 — Part and process testing — Specifications and quality criteria — 2

5.1 — General — 2

5.2 — Testing the feedstocks — 3

5.3 — Monitoring the process — 3

5.4 — Testing the part — 3

Annex A (normative) Test methods for metallic materials — 4

A.1 — General — 4

A.2 — Surface requirements — 4

A.3 — Geometric requirements — 4

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Left, Line spacing: single

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

ISO/ASTM FDIS 52927:2023(E)

A.4 Mechanical requirements 5

A.5 Physical and chemical property requirements 5

A.5.1 General 5

A.5.2 Specificities for additive manufacturing 6

A.5.2.1 General 6

A.5.2.2 Processing 6

A.5.2.3 Post-processing 6

A.6 Performance criteria and quality characteristics 6

A.6.1 General 6

A.6.2 Specificities for additive manufacturing 6

A.7 Specific comment on characteristics 8

A.7.1 General 8

A.7.2 Hardness 8

A.7.3 Tensile strength 8

A.7.4 Impact strength 9

A.7.5 Compressive strength 9

A.7.6 Fatigue strength 9

A.7.7 Crack extension 10

Annex B (normative) Test methods for polymer materials 11

B.1 General 11

B.2 Surface requirements 11

B.3 Geometric requirements 11

B.4 Mechanical requirements 12

B.5 Formed material requirements 12

B.5.1 General 12

B.5.2 Specificities for additive manufacturing 12

B.5.2.1 General 12

B.5.2.2 Processing 12

B.5.2.3 Post-processing 12

B.6 Performance criteria and quality characteristics 13

B.6.1 General 13

B.6.2 Specificities for additive manufacturing 13

Annex C (normative) Test methods for ceramic materials 15

C.1 General 15

C.2 Surface requirements 15

C.3 Geometric requirements 15

C.4 Mechanical requirements 16

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Line spacing: single

iTeh Standards

(<https://standards.itih.ai>)

Document Preview

ISO/ASTM FDIS 52927

<https://standards.itih.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

ISO/ASTM FDIS 52927:2023 (E)

C.5 Formed material requirements 16

C.5.1 General 16

C.5.2 Specificities for additive manufacturing 16

C.5.2.1 General 16

C.5.2.2 Process 16

C.5.2.3 Post-processing 16

C.6 Performance criteria and quality characteristics 17

C.6.1 General 17

C.6.2 Specificities for additive manufacturing 17

Bibliography 19

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Left, Line spacing: single

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

ISO/ASTM FDIS 52927

<https://standards.itih.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

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 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).

~~Attention is drawn~~ISO draws attention to the possibility that ~~some of the elements~~implementation of this document may ~~be involve~~ the ~~subject~~use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights. ISO 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. ~~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~~This document ~~is 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~~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).

~~This~~The first edition of this document cancels and replaces the first edition ~~(of ISO 17296-3:2014)~~, which has been technically revised and merged with document ASTM F3122-14 and therefore re-designated and renamed to ISO/ASTM 52927.

The main changes compared to the previous edition are as follows:

- ~~The~~the main types of materials (metallic, polymers and ceramics) are separated in specific Annexes ~~annexes~~ following the main part containing general requirements;

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Line spacing: single

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: English (United Kingdom)

Field Code Changed

Formatted: English (United Kingdom)

Field Code Changed

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Commented [eXtyle3]: ISO/ASTM 52927: current stage is 50.00

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

ISO/ASTM FDIS 52927:2023(E)

— This version of this document includes the contents of ASTM F3122-14 and merges them with (formerly) ISO 17296-3.

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.

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Left, Line spacing: single

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

ISO/ASTM FDIS 52927

<https://standards.itih.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

Introduction

Additive manufacturing is a process of joining materials to make parts from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing and formative methodologies. It is used to manufacture prototypes and production parts.

This document aims to offer recommendations and advice to machine manufacturers, feedstock suppliers, AM system users, part providers, and customers, to improve communication between these stakeholders concerning test methods.

This document has been developed within a set of consistent documents from terminology to test methods and data exchange.

Additive manufacturing processes require the selective application of thermo-physical and/or chemical mechanisms to generate the part. Thus, it is possible to produce parts with different characteristics, depending on the method and the process parameters used. However, complete testing of all characteristics for every part is neither cost-effective nor technologically feasible. Therefore, when formulating parts specifications, the nature and scope of testing is an important issue.

This document provides an overview of test methods for the characterization of the mechanical properties of metals, ceramics and polymers. It lists all the applicable standards based on specimens manufactured in a traditional process and gives the complement applicable when these specimens are manufactured by additive manufacturing.

At the time of publication of this document, the state of the art does not allow to describe all these specificities related to additive manufacturing. This document will therefore be regularly revised in order to incorporate the knowledge acquired in the field of additive manufacturing.

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Line spacing: single

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Space Before: 0 pt, Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

iteh Standards
(<https://standards.iteh.ai>)
Document Preview

ISO/ASTM FDIS 52927

<https://standards.iteh.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

Additive manufacturing — General principles — Main characteristics and corresponding test methods

1 Scope

This document specifies the principal requirements applied to the testing of parts produced by additive manufacturing processes.

This document:

- identifies quality characteristics for feedstock and parts and the corresponding test procedures,
- provides the specific procedures to build specimens using additive manufacturing process, and
- recommends the scope and content of test and supply agreements.

This document is aimed at machine manufacturers, feedstock suppliers, AM system users, part providers, and customers to facilitate the communication on main quality characteristics. It applies wherever additive manufacturing processes are used.

NOTE It is intended to include other characteristics such as thermal properties, electrical requirements and physical and physico-chemical properties based upon material types.

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.

~~<std>ISO/ASTM 52900, Additive manufacturing — General principles — Fundamentals and vocabulary</std>~~

~~<std>ISO 17295, Additive manufacturing — General principles — Part positioning, coordinates and orientation</std>~~

ISO/ASTM 52900, Additive manufacturing — General principles — Fundamentals and vocabulary

ISO/ASTM 52909, Additive manufacturing — Finished part properties — Orientation and location dependence of mechanical properties for metal powder bed fusion</std>

~~<std>ISO/ASTM 52915, Specification for additive manufacturing file format (AMF) Version 1.2</std>~~

~~<std>ISO/ASTM 52921, ISO/ASTM 52915, Specification for additive manufacturing file format (AMF) Version 1.2</std>~~

~~Standard terminology for additive manufacturing — Coordinate systems and test methodologies</std>~~

3 Terms and definitions

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

Formatted: Section start: New page, Header distance from edge: 1.27 cm, Footer distance from edge: 0.5 cm

Formatted: Main Title 1, Space After: 0 pt, Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

Commented [eXtyle4]: ISO/ASTM 52909: current stage is 50.20

Commented [eXtyle5]: The reference is to a withdrawn standard which has been replaced

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

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Font: Bold

Formatted: HeaderCentered

ISO and IEC maintain terminological 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/>

Commented [eXtyle6]: The URL <https://www.iso.org/obp> has been redirected to <https://www.iso.org/obp/ui>. Please verify the URL.

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

4 Main characteristics and corresponding test methods

4.1 General

This clause contains the general requirements and recommendations for the relevant tests, regardless of the material type.

For specific requirements and recommendations regarding tests and methods on specimens made of metallic materials, see [Annex A](#).

For specific requirements and recommendations regarding tests and methods on specimens made of polymer materials, see [Annex B](#).

For specific requirements and recommendations regarding tests and methods on specimens made of ceramic materials, see [Annex C](#).

Each development and fabrication phase of a part has a specific purpose. The acceptance criteria for each quality characteristic are determined based on the part requirements and these can influence the choice of additive manufacturing process. This document develops the following main quality characteristics:

- feedstock:
 - size and shape: powder particle size distribution, mean particle size, morphology;
 - packing and transport properties within the AM system: apparent and tap density, flowability, pourability, filament cast and helix;
 - chemistry: chemical composition, ash/carbon content.
- parts:
 - surface requirements: appearance and colour;
 - geometric and dimensional requirements: profile, roughness, size, shape, orientation, position, dimensional tolerancing;
 - mechanical requirements: hardness, tensile strength, impact strength, compressive strength, flexural strength, fatigue strength, creep, ageing, frictional coefficient, shear resistance, and crack extension;
 - physical and chemical properties: density, chemical composition, grain size, imperfections (e.g. porosity, cracks).

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

NOTE The following other characteristics of parts have been identified but, due to the specificity of additive manufacturing, will be provided in a future version of this document:

- thermal properties (e.g. operating temperature range, dimensional stability in heat, softening temperatures, melting point, specific heat, thermal conductivity, and coefficient of linear thermal expansion);

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Space Before: 0 pt, Line spacing: single

- electrical requirements (e.g. disruptive strength, dielectric properties, magnetic properties, and electrical conductivity);
- physical and physico-chemical properties (e.g. internal flaws, flammability, toxicity, chemical composition, chemical resistance, water absorption, crystalline structure, suitability for food, biocompatibility, sterility, photostability, translucence, solidification point, glass transition, and corrosion).

4.2 Selection criteria

Testing categories given in ~~Table A.1, Table B.1 and Table C.1~~ **Table A.1, Table B.1 and Table C.1** shall be applied to guide the relation between customer and part provider, applicable for metallic parts, polymer parts and ceramic parts respectively.

The choice of a testing category shall be subject to agreement between customer and part provider.

NOTE Test categories are defined according to the application and the type of material.

5 Part and process testing — Specifications and quality criteria

5.1 General

The quality of a part is determined by comparing its characteristics against an agreed set of requirements. The requirements shall be precisely specified within the purchase specification and include suitability for the intended application in conjunction with any specified geometric, material or performance requirements. Inspection and testing of the part and associated test specimens are performed to demonstrate compliance with the requirements.

NOTE 1 ISO/ASTM 52901 provides guidance on requirements for purchase specifications.

NOTE 2 A definition or discussion that lacks clarity can result in considerable additional costs and delays and/or inferior quality.

The form of specifications depends on the application, the nature of the features being tested, and the materials used. Specifications may also vary within one part (e.g. critical mass). Some intrinsic properties depend on the choice of material and the technology used. Relevant test procedures shall be stipulated and adhered to.

5.2 Testing the feedstocks

The condition of the feedstock can have a significant impact on the part properties. Significant variations can arise due to storage and reuse of the feedstock and variations between batches. Essential data relating to the feedstock shall be provided by the feedstock supplier.

5.3 Monitoring the process

All additive manufacturing processes are computer-assisted. This allows for the recording and statistical analyses of certain process-related data, such as process parameters and - in most cases - certain environmental conditions, which can be recorded at specified time intervals. The need to monitor the process depends on the required or anticipated reproducibility of the process and part quality for each application. Process monitoring can also be required by customer.

Where the process stability is assessed, at different intervals, consideration shall be given to selecting monitoring points where variables are consistent (e.g. constant geometry) such that any identified variations are indicative of process instability (e.g. mechanical properties, geometric features, chemical composition).

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: HeaderCentered, Left, Line spacing: single

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Default Paragraph Font

Formatted: Default Paragraph Font

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Line spacing: single

ISO/ASTM FDIS 52927:2023 (E)

Test specimens for process monitoring should be as representative as possible compared to the part. Complementary test specimens can be used to improve the testing of dimensional accuracy, reproduction accuracy and process stability. The shape of test specimen and the nature and frequency of testing shall be specified in agreement between the customer and part provider for each application in accordance with applicable standards.

5.4 Testing the part

Relevant testing standards are given in [Table A.5](#) for metallic parts, [Table B.5](#) for polymer parts and [Table C.5](#) for ceramic parts.

Tests and their acceptance criteria shall be set out in the purchase specification or agreement between customer and part provider prior to manufacturing.

Formatted: Font: Bold

Formatted: HeaderCentered

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at 0.71 cm

Formatted: Default Paragraph Font

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Default Paragraph Font

iTeh Standards (<https://standards.itih.ai>) Document Preview

ISO/ASTM FDIS 52927

<https://standards.itih.ai/catalog/standards/iso/66ba778c-bfb9-45d1-8b8c-04acd538ac88/iso-astm-fdis-52927>

Formatted: Font: 11 pt

Formatted: FooterPageRomanNumber, Space Before: 0 pt, Line spacing: single