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Additive manufacturing of polymers — Qualification principles —

Part 1: General principles and preparation of test specimens for PBF-LB

Fabrication additive de polymères — Principes de qualification —

Partie 1: Principes généraux et préparation des éprouvettes pour PBF-LB

Reference number
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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).

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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 ISO/TC 261, *Additive manufacturing*, and ISO/TC 61/SC 9, 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).

This first edition of ISO/ASTM 52936-1 cancels and replaces ISO 27547-1:2010, which has been technically revised.

The main changes are as follows:

— new standard number and title to make clear its status as additive manufacturing standard;

— requirements for conditions revised to allow use of state of the art machines;

— Annex B deleted because this procedure is not state of the art anymore.

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Introduction

Many factors in an additive manufacturing test specimen-preparation process can influence the properties of the test specimens prepared and hence the measured values obtained when the test specimens are used in a test method. The mechanical properties of such test specimens are in fact strongly dependent on the conditions of the process used to prepare the test specimens. Exact definition of each of the main parameters of the process is a basic requirement for reproducible operating conditions.

It is important in defining test specimen-preparation conditions to consider any influence the conditions could have on the properties to be determined. Test specimens prepared by additive manufacturing techniques can show differences in molecular morphology (as with crystalline and semicrystalline polymers), differences in powder morphology (after undergoing a sintering process, for instance), differences in thermal history and differences in thickness of the layers, test specimen orientation or test specimen location, used to prepare the specimen. Only if each of these is controlled can differences in the values of the properties measured be avoided.

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Additive manufacturing of polymers — Qualification principles —

Part 1: General principles and preparation of test specimens for PBF-LB

1 Scope

This document specifies the general principles to be followed when test specimens of thermoplastic materials are prepared by laser-based powder bed fusion (PBF-LB/P), which is commonly known as laser sintering. The (PBF-LB/P) process is used to prepare test specimens layer upon layer in which thermal energy selectively fuses regions of a powder bed. This document provides a basis for establishing reproducible and reportable sintering conditions. Its purpose is to promote uniformity in describing the main process parameters, build orientation of the sintering process and also to establish uniform practice in reporting sintering conditions.

This document does not specify the test procedure itself.

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 3167, *Plastics — Multipurpose test specimens*

ISO 20753, *Plastics — Test specimens*

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

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

ISO/ASTM 52925, *Additive manufacturing of polymers — Feedstock materials — Qualification of materials for laser-based powder bed fusion of parts*

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 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/

3.1
laser wavelength
wavelength at the peak intensity of the laser

Note 1 to entry: Laser wavelength is expressed in nanometres.

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3.2
laser power
power of the laser beam at each defined process operation

Note 1 to entry: Laser power is expressed in watts.

Note 2 to entry: The laser power can be different when producing the contour (outline) of the test specimen and when hatching the part.

3.3
laser mode
parameter indicating which of the various electromagnetic standing waves that can be produced in the laser cavity is actually being used in a particular application

3.4
beam radius
radius of the laser beam at the point of interaction with the powder bed

Note 1 to entry: Beam radius is expressed in microns.

3.5
scan speed
speed of travel of the focal point of the laser beam across the surface of the parts being fabricated

Note 1 to entry: Scan speed is expressed in millimetres per second.

Note 2 to entry: A synonymous term is beam speed.

Note 3 to entry: The scan speed can be different when producing the contour (outline) of the test specimen and when hatching the part.

3.6
preheating temperature
temperature to which the build chamber is heated before the build cycle starts

Note 1 to entry: Preheating temperature expressed in degrees Celsius.

3.7
preheating time
length of time required for the powder bed to reach the *preheating temperature* (3.6)

Note 1 to entry: Preheating time is expressed in minutes.

Note 2 to entry: Since it is necessary to have a steady-state temperature throughout the whole build chamber, the preheating time can be rather long, often more than 30 min.

3.8
contour
track followed by the laser beam when producing the outline of each layer

3.9
hatching
closely spaced parallel laser paths used to fuse the bulk material in each layer

3.10
cool-down temperature
temperature of the powder bed when the parts are removed from the powder bed

Note 1 to entry: The cool-down temperature is measured at the centre of the surface of the powder bed.

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