International Standard

ISO/ASTM 52941

# Additive manufacturing for aerospace — System performance and reliability tests for laser metal powder-bed fusion machines for metallic materials

*Fabrication additive pour l'aérospatiale — Essais de performance et de fiabilité du système pour machines de fusion laser sur lit de poudre pour les matériaux métalliques*

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# Foreword

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This document was prepared by ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM F 42, *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, 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 second edition cancels and replaces the first edition (ISO/ASTM 52941:2020), which has been technically revised.

The main changes are as follows:

— title changed from "*Additive manufacturing — System performance and reliability — Acceptance tests for laser metal powder-bed fusion machines for metallic materials for aerospace application*" to "*Additive manufacturing for aerospace — System performance and reliability tests for laser metal powder-bed fusion machines for metallic materials*";

— extension of the scope of application to non-aerospace applications if this is part of a contract;

— normative references has been updated;

— 6.2 has been revised;

— test report has been revised;

— example of a test report in Annex A slightly revised;

— editorial changes.

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.

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# Additive manufacturing for aerospace — System performance and reliability tests for laser metal powder-bed fusion machines for metallic materials

## 1 Scope

This document specifies requirements and test methods for the qualification and re-qualification of laser beam machines for metal powder bed fusion additive manufacturing for aerospace applications.

This document can also be applied to non-aerospace applications if this is part of a contract.

It can also be used to verify machine features during periodic inspections or following maintenance and repair activities.

## 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 11146 (all parts), *Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation ratios*

ISO 11554, *Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam radiant power, radiant energy and temporal characteristics*

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

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

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/ASTM 52900, ISO 17295 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 https://www.electropedia.org/

**3.1**
**scanning speed**
relative linear speed of the laser beam movement in the plane of the build surface

Note 1 to entry: For powder bed fusion processes, unless otherwise designated by the machine manufacturer the plane of the build surface is identical to the XY plane.

**3.2**
**warm-up time**
time from switching on the machine until the required temperature has been reached such that the build cycle can be started

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**3.3**
**feeding platform**
platform that moves incrementally to supply powder to the *powder spreading device* (3.4)

**3.4**
**powder spreading device**
powder supply mechanism, which distributes the powder to form a new layer in the powder bed

**3.5**
**rated laser power**
maximum power capability as specified by the laser manufacturer

**3.6**
**minimum beam waist position**
focal spot location at which the beam has the most concentrated energy and the smallest cross-sectional area

## 4 Equipment

Equipment shall be installed, operated and maintained according to the documented instructions.

## 5 Environmental and operational conditions

The environmental and operational conditions during qualification testing shall meet the requirement ranges if specified by the machine manufacturer and shall conform to the conditions which are specified by a machine user during production, as examples the following:

a) temperature;

b) humidity;

c) services/utilities (e.g. supply of electrical power, compressed air, shielding gas, water);

d) shocks/vibrations;

e) chamber pressure;

f) process gas purity.

Health and safety measures relating to laser radiation and to fire and explosion protection shall be observed.

## 6 Qualification testing

### 6.1 General

The qualification testing of laser beam machines for metal powder bed fusion additive manufacturing shall include, at a minimum, the requirements specified in 6.2 to 6.7.

The measurement shall be performed with a calibrated measuring instrument according to the measuring instrument instructions.

### 6.2 Laser beam tests

#### 6.2.1 Testing the laser power for continuous wave lasers

The laser power shall be measured. The measurement should be performed according to ISO 11554, as applicable.

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