



SLOVENSKI STANDARD
SIST-TP CEN/TR/ISO/ASTM 52912:2020

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Aditivna proizvodnja - Konstruiranje - Proizvodnja delov s funkcijsko porazdeljenimi lastnostmi (ISO/ASTM/TR 52912:2020)

Additive manufacturing - Design - Functionally graded additive manufacturing (ISO/ASTM/TR 52912:2020)

Technischer Bericht für die Gestaltung von additiv gefertigten, gradierten Bauteilen (ISO/ASTM/TR 52912:2020)

Fabrication additive - Conception - Fabrication additive à gradient fonctionnel (ISO/ASTM/TR 52912:2020)

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3D-tiskanje

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Additive manufacturing - Design - Functionally graded
additive manufacturing (ISO/ASTM/TR 52912:2020)

Fabrication additive - Conception - Fabrication additive
à gradient fonctionnel (ISO/ASTM/TR 52912:2020)

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gefertigten, gradierten Bauteilen (ISO/ASTM/TR
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Contents	Page
European foreword.....	3

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[SIST-TP CEN/TR/ISO/ASTM 52912:2020](https://standards.iteh.ai/catalog/standards/sist/d88a3474-cdf9-457c-be43-5029cb97665b/sist-tp-cen-tr-iso-astm-52912-2020)
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European foreword

This document (CEN/TR/ISO/ASTM 52912:2020) has been prepared by Technical Committee ISO/TC 261 "Additive manufacturing" in collaboration with Technical Committee CEN/TC 438 "Additive Manufacturing" the secretariat of which is held by AFNOR.

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**Additive manufacturing — Design
— Functionally graded additive
manufacturing**

*Fabrication additive — Conception — Fabrication additive à gradient
fonctionnel*

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviations	1
5 Concept of Functionally Graded Additive Manufacturing (FGAM)	3
5.1 General.....	3
5.2 Homogeneous compositions — Single Material FGAM.....	3
5.3 Heterogeneous compositions — Multi-material FGAM.....	4
6 Advances of functionally graded additive manufacturing	8
6.1 General.....	8
6.2 AM and FGAM process.....	8
6.3 Material extrusion.....	9
6.4 Powder bed fusion.....	12
6.5 Directed energy deposition.....	13
6.6 Sheet lamination.....	14
7 Current limitations of FGAM	16
7.1 General.....	16
7.2 Material limitations.....	16
7.2.1 General.....	16
7.2.2 Defining the optimum material property distribution.....	17
7.2.3 Predicting the material properties of manufactured components.....	17
7.2.4 Material selection.....	17
7.2.5 Understanding differences and defining tolerances.....	17
7.3 Limitations of current additive manufacturing technologies.....	17
7.4 CAD Software limitations.....	18
7.4.1 General.....	18
7.4.2 Data exchange formats.....	19
8 Potential applications of FGAM	20
8.1 General.....	20
8.2 Biomedical applications.....	21
8.3 Aerospace applications.....	21
8.4 Consumer markets.....	21
9 Summary	22
Bibliography	23

ISO/ASTM TR 52912:2020(E)

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.

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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 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).

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.

Introduction

Functionally Graded Materials (FGMs) were developed in 1984 for a space plane project to sustain high thermal barriers to overcome the shortcomings of traditional composite materials (AZO Materials, 2002). Traditional composites [Figure 1 a)] are homogeneous mixtures, therefore involving a compromise between the desirable properties of the component materials. Functionally Graded Materials (FGMs) are a class of advanced materials with spatially varying composition over a changing dimension, with corresponding changes in material properties built-in^[56]. FGMs attain their multifunctional status by mapping performance requirements to strategies of material structuring and allocation [Figure 1 b)].

The manufacturing processes of conventional FGMs include shot peening, ion implantation, thermal spraying, electrophoretic deposition and chemical vapour deposition. Since additive manufacturing processes builds parts by successive addition of material, they provide the possibility to produce products with Functionally Graded properties, thereby introducing the concept often known as Functionally Graded Additive Manufacturing (FGAM). As this area of work is new, driven by academic research, and lacks available standardisation, there have been multiple different names proposed by different researchers in different publications as terms for this area, for example, functionally graded rapid prototyping (FGRP)^[56], varied property rapid prototyping (VPRP)^[57] and site-specific properties additive manufacturing^[72]. However, even if there clearly is a great need for clarification of key terms associated with FGAM, this document does not include any attempts of alignment in terminology. This document is an overview of state of the art and the possibilities for FGAM enabled by present AM process technology and thus a purely informative document. Since this overview is based on available publications, and in order to facilitate cross referencing from these publications, this document has used the terms concerning FGAM as they are used in the original publications.



Figure 1 — Allocation of materials in a traditional composite and an FGM composite

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