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Foreword

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The committee responsible for this document is ISO/TC 261, *Additive Manufacturingmanufacturing*, in cooperation with ASTM F 42 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.

ISO 17296 consists of the following parts, under the general title *Additive manufacturing — General principles*:

— *Part 1: Terminology*

— *Part 2: Overview of process categories and feedstock*

— *Part 3: Main characteristics and corresponding test methods*

— *Part 4: Overview of data processing*

Introduction

Additive manufacturing is the general term for those technologies that based on a geometrical representation creates physical objects by successive addition of material. These technologies are presently used for various applications in engineering industry as well as other areas of society, such as medicine, education, architecture, cartography, toys and entertainment.

During the development of additive manufacturing technology there have been numerous different terms and definitions in use, often with reference to specific application areas and trademarks. This is often ambiguous and confusing which hampers communication and wider application of this technology.

It is the intention of this international standardpart of ISO 17296 to provide a basic understanding of the fundamental principles for additive manufacturing processes, and based on this, to give clear definitions for terms and nomenclature associated with additive manufacturing technology. The objective of this standardization of terminology for additive manufacturing is to facilitate communication between people involved in this field of technology on a world-wide basis.

This international standardInternational Standard has been developed in close cooperation of ISO/TC 261 and ASTM- F 42 on 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. manufacturing.

Additive manufacturing — General principles — Part 1: Terminology

1 Scope

This part of ISO 17296 establishes and defines terms used in additive manufacturing (AM) technology, which applies the additive shaping principle and thereby builds physical 3D geometries by successive addition of material.

The terms have been classified into specific fields of application.

New terms emerging from the future work within ISO/TC 261 will be included in upcoming amendments and overviews of this ~~international standard~~International Standard.

2 Terms and definitions

2.1 General terms

2.1.1
3D printer, noun
machine used for *3D printing* (2.3.1)

2.1.2
additive manufacturing, noun
AM
process of joining materials to make *parts* (2.6.1) from 3D model data, usually *layer* (2.3.10) upon layer, as opposed to subtractive manufacturing and formative manufacturing methodologies

Note 1 to entry: Historical terms: additive fabrication, additive processes, additive techniques, additive layer manufacturing, layer manufacturing, solid freeform fabrication and freeform fabrication.

Note 2 to entry: The meaning of “additive”, “subtractive” and “formative” manufacturing methodologies are further discussed in Annex A.

2.1.3
additive system, noun
additive manufacturing system
additive manufacturing equipment
machine and auxiliary equipment used for *additive manufacturing* (2.1.2)

2.1.4
AM machine, noun
section of the *additive manufacturing system* (2.1.3) including hardware, machine control software, required set-up software and peripheral accessories necessary to complete a *build cycle* (2.3.3) for producing *parts* (2.6.1)

2.1.5
AM machine user, noun

operator of or entity using an *AM machine* (2.1.4)

2.1.6
AM system user, noun
additive system user
operator of or entity using an entire *additive manufacturing system* (2.1.3) or any component of an additive system

2.1.7
front, noun
<of a machine; -unless otherwise designated by the machine builder> side of the machine that the operator faces to access the user interface or primary viewing window, or both

2.1.8
material supplier, noun
provider of material/ *feedstock* (2.5.2) to be processed in *additive manufacturing system* (2.1.3)

2.1.9
multi-step process, noun
type of *additive manufacturing* (2.1.2) process in which *parts* (2.6.1) are fabricated in two or more operations where the first typically provides the basic geometric shape and the following consolidates the part to the fundamental properties of the intended material (metallic, ceramic, polymer or composite)

Note 1 to entry: Removal of the support structure and cleaning may be necessary, however in this context not considered as a separate process step.

Note 2 to entry: The principle of *single-step* (2.1.10) and multi-step processes are further discussed in Annex A.

2.1.10
single-step process, noun
type of *additive manufacturing* (2.1.2) process in which *parts* (2.6.1) are fabricated in a single operation where the basic geometric shape and basic material properties of the intended product are achieved simultaneously

Note 1 to entry: Removal of the support structure and cleaning may be necessary, however in this context not considered as a separate process step.

Note 2 to entry: The principle of single-step and *multi-step processes* (2.1.9) are further discussed in Annex A.

2.2 Process categories

2.2.1
binder jetting, noun
additive manufacturing (2.1.2) process in which a liquid bonding agent is selectively deposited to join powder materials

2.2.2
directed energy deposition, noun
additive manufacturing (2.1.2) process in which focused thermal energy is used to fuse materials by melting as they are being deposited

Note 1 to entry: "“Focused thermal energy"” means that an energy source (e.g., laser, electron beam, or plasma arc) is focused to melt the materials being deposited.

2.2.3
material extrusion, noun
additive manufacturing (2.1.2) process in which material is selectively dispensed through a nozzle or orifice

2.2.4
material jetting, noun
additive manufacturing (2.1.2) process in which droplets of build material are selectively deposited

Note 1 to entry: Example materials include photopolymer and wax.

2.2.5
powder bed fusion, noun
additive manufacturing (2.1.2) process in which thermal energy selectively fuses regions of a *powder bed* (2.5.8)

2.2.6
sheet lamination, noun
additive manufacturing (2.1.2) process in which sheets of material are bonded to form an object

2.2.7
vat photopolymerization, noun
additive manufacturing (2.1.2) process in which liquid photopolymer in a vat is selectively cured by light-activated polymerization

2.3 Processing: General

2.3.1
3D printing, noun
fabrication of objects through the deposition of a material using a print head, nozzle, or another printer technology

Note 1 to entry: Term often used in a non-technical context synonymously with *additive manufacturing* (2.1.2); until present times this term has in particular been associated with machines that are low end in price and/or overall capability.

2.3.2
build chamber, noun
enclosed location within the *additive manufacturing system* (2.1.3) where the *parts* (2.6.1) are fabricated

2.3.3
build cycle, noun
single process cycle in which one or more components are built up in *layers* (2.3.10) in the process chamber of the *additive manufacturing system* (2.1.3)

2.3.4
build envelope, noun

largest external dimensions of the x-, y-, and z-axes within the *build space* (2.3.6) where *parts* (2.6.1) can be fabricated

Note 1 to entry: The dimensions of the build space will be larger than the build envelope.

2.3.5
build platform, noun
<of a machine> base which provides a surface upon which the building of the *part/s* (2.6.1), is started and supported throughout the build process

Note 1 to entry: In some systems, the parts ~~(2.6.1)~~ are built attached to the build platform, either directly or through a support structure. In other systems, such as *powder bed* (2.5.8) systems, no direct mechanical fixture between the build and the platform may be required.

2.3.6
build space, noun
location where it is possible for *parts* (2.6.1) to be fabricated, typically within the *build chamber* (2.3.2) or on a *build platform* (2.3.5)

2.3.7
build surface, noun
area where material is added, normally on the last deposited *layer* (2.3.10) which becomes the foundation upon which the next layer is formed

Note 1 to entry: For the first layer, the build surface is often the *build platform* (2.3.5).

Note 2 to entry: In the case of direct energy deposition processes, the build surface can be an existing part onto which material is added.

Note 3 to entry: If the orientation of the material deposition or consolidation means, or both, is variable, it may be defined relative to the build surface.

2.3.8
build volume, noun
total usable volume available in the machine for building *parts* (2.6.1)

2.3.9
feed region, noun
<in *powder bed fusion* (2.2.5)> location/s in the machine where *feedstock* (2.5.2) is stored and from which a portion of the feedstock is repeatedly conveyed to the powder bed during the *build cycle* (2.3.3)

2.3.10
layer, noun
<matter> material laid out, or spread, to create a surface

2.3.11
machine coordinate system, noun
three-dimensional coordinate system as defined by a fixed point on the *build platform* (2.3.5) with the three principal axes labelled x-, y-, and z-, with rotary axis about each of these axis labelled A, B, and C, respectively, where the angles between x-, y- and z- can be Cartesian or defined by the machine manufacturer

Note 1 to entry: Machine coordinate system is fixed relative to the machine, as opposed to coordinate systems associated with the *build surface* (2.3.7) which can be translated or rotated. Machine coordinate system is illustrated in ISO/ASTM 52921~~[2].~~,[6]

2.3.12
manufacturing lot, noun
set of manufactured *parts* (2.6.1) having commonality between *feedstock* (2.5.2), *production run* (2.3.19), *additive manufacturing system* (2.1.3) and *post-processing* (2.5.6) steps (if required) as recorded on a single manufacturing work order

Note 1 to entry: *Additive manufacturing system* (2.1.3) could include one or several *AM machines* (2.1.4) and/or post-processing ~~(2.5.6)~~ machine units as agreed by *AM* (2.1.2) provider and customer.

2.3.13
origin, noun
zero point
(0, 0, 0) <when using x-, y-, and z-coordinates>
designated universal reference point at which the three primary axes in a coordinate system intersect

Note 1 to entry: Coordinate system can be Cartesian or as defined by the machine manufacturer. The concept of origin is illustrated in ISO/ASTM 52921~~[2].~~,[6]

2.3.14
build origin, noun
origin (2.3.13) most commonly located at the centre of the *build platform* (2.3.5) and fixed on the build facing surface, but could be defined otherwise by the build set-up

2.3.15
machine origin, noun
machine home
machine zero point
origin (2.3.13) as defined by the machine manufacturer

2.3.16
overflow region, noun
<in *powder bed fusion* (2.2.5) systems> location/s in the machine where excess powder is stored during a *build cycle* (2.3.3)

Note 1 to entry: For certain machine types the overflow region may consist of one or more dedicated chambers or a powder recycling system.

2.3.17
part location, noun
location of the *part* (2.6.1) within the *build volume* (2.3.8)

Note 1 to entry: The part location is normally specified by the x-, y- and z-coordinates for the position of the *geometric centre* (2.4.9) of the part's *bounding box* (2.4.3) with respect to the build volume ~~(2.3.8)~~ *origin* (2.3.13). Part location is illustrated in ISO/ASTM 52921~~[2].~~,[6]

2.3.18
process parameters, noun
set of operating parameters and system settings used during a *build cycle* (2.3.3)

2.3.19

production run, noun
all *parts* (2.6.1) produced in one *build cycle* (2.3.3) or sequential series of build cycles using the same *feedstock* (2.5.2) batch and process conditions

2.3.20
system set-up, noun
configuration of the *additive manufacturing system* (2.1.3) for a build

2.3.21
***x*-axis,** noun
<of a machine; -unless otherwise designated by the machine builder> axis in the *machine coordinate system* (2.3.11) that runs parallel to the *front* (2.1.7) of the machine and perpendicular to the *y-axis* (2.3.22) and *z-axis* (2.3.23)

Note 1 to entry: <unless otherwise designated by the machine builder> The positive *x*-direction runs from left to right as viewed from the front of the machine while facing toward the *build volume* (2.3.8) *origin* (2.3.13).

Note 2 to entry: It is common that the *x*-axis is horizontal and parallel with one of the edges of the *build platform* (2.3.5).

2.3.22
***y*-axis,** noun
<of a machine; -unless otherwise designated by the machine builder> axis in the *machine coordinate system* (2.3.11) that runs perpendicular to the *z-axis* (2.3.23) and *x-axis* (2.3.21)

Note 1 to entry: <unless otherwise designated by the machine builder> The positive direction is defined in ISO 841[31] to make a right hand set of coordinates. In the most common case of an upwards *z*-positive direction, the positive *y*-direction will then run from the front to the back of the machine as viewed from the front of the machine.

Note 2 to entry: In the case of building in the downwards *z*-positive direction, the positive *y*-direction will then run from the back of the machine to the front as viewed from the front of the machine.

Note 3 to entry: It is common that the *y*-axis is horizontal and parallel with one of the edges of the *build platform* (2.3.5).

2.3.23
***z*-axis,** noun
<of a machine; -unless otherwise designated by the machine builder>, axis in the *machine coordinate system* (2.3.11) that run perpendicular to the *x-axis* (2.3.21) and *y-axis* (2.3.22)

Note 1 to entry: <unless otherwise designated by the machine builder> The positive direction is defined in ISO 841[31] to make a right hand set of coordinates. For processes employing planar, layerwise addition of material, the positive *z*-direction will then run normal to the *layers* (2.3.10).

Note 2 to entry: For processes employing planar layerwise addition of material, the positive *z*-direction, is the direction from the first layer to the subsequent layers.

Note 3 to entry: Where addition of material is possible from multiple directions (such as with certain *directed energy deposition* (2.2.2) systems), the *z*- axis may be identified according to the principles in ISO 841[3] (section , (4.3.3))[1] which addresses “swivelling or gimballing.”

