



**SLOVENSKI STANDARD**  
**oSIST prEN ISO/ASTM 52924:2020**  
**01-junij-2020**

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**Aditivna proizvodnja - Kvalifikacijska načela - Klasifikacija lastnosti delov za aditivno proizvodnjo polimernih delov (ISO/ASTM/DIS 52924:2020)**

Additive manufacturing - Qualification principles - Classification of part properties for additive manufacturing of polymer parts (ISO/ASTM/DIS 52924:2020)

Additive Fertigung - Qualifizierungsgrundsätze - Güteklassen für additiv gefertigte Kunststoffbauteile (ISO/ASTM/DIS 52924:2020)

Fabrication additive - Principes de qualification - Classification des propriétés de la pièce pour la fabrication additive de pièces en polymère (ISO/ASTM/DIS 52924:2020)

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# DRAFT INTERNATIONAL STANDARD

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### Additive manufacturing — Qualification principles — Classification of part properties for additive manufacturing of polymer parts

ICS: 25.030

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## ISO/ASTM DIS 52924:2020(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.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. 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](http://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](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is 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.

This is the first edition of this document.

## Introduction

The goal of this document is to improve the communication between providers and users of additive manufactured polymer parts in relation to the part quality to be supplied. For this purpose, quality criteria and part properties are categorised into a system of quality classes.

In the additive manufacturing processes relevant for polymers, the part properties depend very heavily on the machine systems, the material and the process control used. Typically, the process control can be optimised for productivity or quality. These goals are in principle contradictory in the context of the performance of a specific machine.

The property classes listed in this standard help to make clear the differences in quality. The property classes enable the user to define part specifications for manufacturing.

Along with the specification of the property classes, this standard states which property classes can be achieved with typical materials. Test specimens and their arrangement in the build space are specified (The related CAD data are included with this document as positioned STL data.). The determination of the mechanical tensile properties, the dimensional accuracy and the part density with the aid of these test specimens is described to make possible the assignment to property classes for the related characteristic values.

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# Additive manufacturing — Qualification principles — Classification of part properties for additive manufacturing of polymer parts

## 1 Scope

This document establishes the required or the achievable classes of part properties for additive manufactured polymer parts in order to get a common understanding on part quality. It is aimed at providers of manufacturing services for polymer parts who use additive manufacturing machines and at the customers for these services. Designers of parts as well as buyers and providers of manufacturing services can specify, in a traceable manner, the required or the achievable level of part properties with the aid of this standard.

This document applies to parts that have been manufactured from a thermoplastic polymer by means of powder bed fusion with laser for polymers (PBF-LB/P), alternatively named laser sintering (LS) or material extrusion (MEX). Its applicability to other processes for polymers shall be checked in the specific case.

NOTE Laser sintering is also known as *selective laser sintering* (SLS®).

NOTE The process called *material extrusion* (MEX) in ISO/ASTM 52900 is also known as *fused layer modelling* (FLM), *fused layer manufacturing* or *fused deposition modelling* (FDM) or *fused filament fabrication* (FFF).

The classification of part properties apply to parts that have not been post-processed after unpacking from the build space and after removing possible support structures.

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## 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 37:2017, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 291:2008, *Plastics — Standard atmospheres for conditioning and testing*

ISO 527-1:2012, *Plastics - Determination of tensile properties - Part 1: General principles*

ISO 3167:2014, *Plastics — Multipurpose test specimens*

ISO 10350-1:2017, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 20457:2018, *Plastics moulded parts — Tolerances and acceptance conditions*

ISO/ASTM 52900:2018, *Additive manufacturing; General principles — Terminology*

ISO/ASTM 52921:2013-06, *Standard terminology for additive manufacturing - Coordinate systems and test methodologies*

## 3 Terms and definitions

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

## ISO/ASTM DIS 52924:2020(E)

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1 part density

$\rho$   
ratio of part mass,  $m$ , and measured part volume,  $V$ , of a laser sintered or material extruded part

$$\rho = \frac{m}{V} \quad (1)$$

Note 1 to entry: The part is generally cubeshaped.

### 3.2 laser sintered as manufactured

state of a cooled part after the end of the laser sintering process immediately after unpacking

Note 1 to entry: Laser sintered parts as manufactured are generally dry.

Note 2 to entry: The laser sintered part as manufactured state exists for the materials PA12, PA11, PP, PE, PAEK, TPE in the following conditions:

- The build job is cooled to room temperature in a nitrogen atmosphere, where the supply of air during cooling until the parts are unpacked shall be avoided if possible or reduced to a minimum.
- The parts are unpacked within three days of the end of the build job.
- The parts have been subjected to the air for a maximum of 4 h since the start of part removal.
- The parts removed are stored with the exclusion of air, e.g., in air-tight and moisture-tight packaging.

### 3.3 nominal material density

$\rho_M$   
solid density of the feedstock, measured on a specimen free of pores

Note 1 to entry: In data sheets, the nominal material density is mostly stated as material density of compounded, injection molded or compression molded material.

### 3.4 relative part density

$D$   
ratio of part density,  $\rho$  (3.1), and nominal material density,  $\rho_M$  (3.3)

$$D = \frac{\rho}{\rho_M} \quad (2)$$

## 4 Symbols and abbreviations

### 4.1 Symbols

The following symbols are used throughout this standard:

Symbol	Designation	Unit
$D$	relative part density	%
$m$	part mass	g, kg
$V$	part volume	cm <sup>3</sup>

Symbol	Designation	Unit
$\rho$	part density	g/cm <sup>3</sup>
$\rho_M$	nominal material density	g/cm <sup>3</sup>

## 4.2 Abbreviations

The following abbreviations are used throughout this standard:

ABS	acrylonitrile butadiene styrene
LS	laser sintering
MEX	material extrusion
NW	non-tool related dimensions
PA6	polyamide 6
PA11	polyamide 11
PA12	polyamide 12
PAEK	polyaryletherketone
PC	polycarbonate
PE	polyethylene
PEI/PC	polyetherimide/polycarbonate blend
PP	polypropylene
TG	tolerance group
TPE	thermoplastic elastomer
TPA	thermoplastic copolyamide
TPC	thermoplastic polyester elastomer
TPU	thermoplastic polyurethane

## 5 Classification system

### 5.1 Definition of the classes of part property

Classes of part properties shall be established based on mechanical tensile properties, density and dimensional accuracy of manufactured parts.

To make the differences in quality during the additive manufacturing of polymer parts clearer and easier to communicate, the classification system shown in [Table 1](#) shall be used.

This system classifies typical value ranges for important part characteristics and assigns these ranges to common materials for the *laser sintering* and *material extrusion* processes.

The classification system contains eleven different classes of part properties that are sequentially numbered from 0 to 10.

Material characteristic values determined as per typical standards from the tensile test (ISO 527-1 or for elastic materials ISO 37) and the density measurement in [7.4](#) are used as characteristic values. At