INTERNATIONAL STANDARD

ISO 27547-1

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Plastics — Preparation of test specimens of thermoplastic materials using mouldless technologies —

Part 1:
General principles, and laser sintering of test specimens

Plastiques — Préparation des éprouvettes de matériaux thermoplastiques par des techniques sans moule —

Partie 1: Principes généraux, et frittage laser des éprouvettes

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 27547-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

ISO 27547 consists of the following part, under the general title *Plastics — Preparation of test specimens of thermoplastic materials using mouldless technologies*:

— *Part 1: General principles, and laser sintering of test specimens*

Further parts are planned covering other mouldless technologies.

Introduction

Many factors in a mouldless specimen-preparation process can influence the properties of the test specimens prepared and hence the measured values obtained when the specimens are used in a test method. The mechanical properties of such specimens are in fact strongly dependent on the conditions of the process used to prepare the 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 specimen-preparation conditions to consider any influence the conditions could have on the properties to be determined. Specimens prepared by mouldless techniques could 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 used to prepare the specimen. Each of these will have to be controlled to avoid differences in the values of the properties measured.

Plastics — Preparation of test specimens of thermoplastic materials using mouldless technologies —

Part 1: General principles, and laser sintering of test specimens

1 Scope

This part of ISO 27547 specifies the general principles of test-specimen preparation using mouldless techniques. Sometimes, these techniques are called “tool-less” methods. Common to all these techniques is the fact that the specimens are produced layer by layer. The shape and dimensions of the specimens are defined in terms of a numerical description using CAD techniques. This computer model of the specimen is “sliced” into layers by means of suitable software. The specimen-preparation process then builds up the specimens automatically, layer by layer, using the computer model and a suitable computer-controlled laser-sintering machine. The three software systems used (for CAD, slicing the specimen into layers and machine control) may be independent systems interfacing separately with the machine or they may be integrated with the machine.

This part of ISO 27547 also specifies the general principles to be followed when test specimens of thermoplastic materials are prepared by laser sintering. The laser-sintering process is used to prepare specimens layer-wise by sintering the particles of a thermoplastic powder using the energy of a laser beam.

This part of ISO 27547 provides a basis for establishing reproducible sintering conditions. Its purpose is to promote uniformity in describing the main parameters of the sintering process and also to establish uniform practice in reporting sintering conditions.

The particular conditions required for reproducible preparation of test specimens which will give comparable results will vary for each material used. These conditions shall be as given in the International Standard for the relevant material or shall be agreed upon between the interested parties.

2 Normative references

The following referenced documents are indispensable for the application 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 291, *Plastics — Standard atmospheres for conditioning and testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
laser wavelength
wavelength at the peak intensity of the laser used for sintering

NOTE It is expressed in nanometres.

3.2
laser power
power of the laser beam

NOTE 1 It is expressed in watts.

NOTE 2 The laser power is usually different when producing the contour (outline) of the specimen and when hatching the specimen. Both values are therefore reported.

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, determined in the way described in Annex B

NOTE It is expressed in millimetres.

3.5
beam speed
speed of travel of the laser beam across the surface of the specimen being prepared

NOTE 1 It is expressed in millimetres per second.

NOTE 2 The beam speed is usually different when producing the contour (outline) of the specimen and when hatching the specimen. Both values are therefore reported.

3.6
powder-dispenser speed
speed of the powder dispenser as it moves across the specimen-preparation chamber before preheating begins (see Figure A.1)

NOTE It is expressed in millimetres per minute.

3.7
preheating temperature
temperature to which the specimen-preparation chamber is heated before the specimen-preparation process starts

NOTE It is expressed in degrees Celsius.

3.8
preheating time
length of time the powder bed is heated before the specimen-preparation process starts

NOTE 1 It is expressed in minutes.

NOTE 2 The preheating time is rather long (approx. 30 min) as it is necessary to have a steady-state temperature which is the same throughout the whole specimen-preparation chamber.

3.9
temperature of the powder
temperature of the surface of the polymer powder

NOTE 1 It is expressed in degrees Celsius.

NOTE 2 Another important temperature is the controlled temperature of that part of the chamber near the sintered layer. It is also expressed in degrees Celsius.

3.10
contour
track followed by the laser beam when producing the outline of the specimen

NOTE For further details, see Annex A.

3.11
hatching
set of closely spaced parallel lines, within the contour line, along which the laser beam travels to produce the main body of the specimen

NOTE For further details, see Annex A.

3.12
cool-down temperature
temperature measured in the middle of the powder bed when the specimens are removed from the powder bed

NOTE It is expressed in degrees Celsius.

3.13
inert gas
inert gas which can be used to protect the polymer powder in the specimen-preparation chamber

3.14
layer thickness
thickness of the successive layers of powder used to prepare the specimen

NOTE 1 It is expressed in millimetres.

NOTE 2 The same layer thickness is used for every layer of a specimen.

3.15
overall layer-preparation time
overall time needed to prepare one layer

NOTE It is expressed in seconds.

3.16
post-completion layers
powder layers applied after completion of the sintering process

3.17
specimen orientation
orientation of the specimen in the powder bed

NOTE Designation of the specimen orientation is relative to the direction of the laser beam. Three different orientations are possible:

a) flatwise;

b) edgewise;

c) upright.

3.18
specimen position
position of each specimen within the chamber, as defined by the following three parameters:

a) the minimum distance allowed between any specimen and the chamber wall, expressed in mm;

b) the minimum distance allowed between two adjacent specimens, expressed in mm;

c) the number of specimens being produced in the run