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**Geometrical Product Specifications  
(GPS) — Flatness —**

**Part 1:  
Vocabulary and parameters of flatness**

*Spécification géométrique des produits (GPS) — Planéité —  
Partie 1: Vocabulaire et paramètres de planéité*

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 12781-1 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

ISO/TS 12781 consists of the following parts, under the general title *Geometrical Product Specifications (GPS) — Flatness*:

- *Part 1: Vocabulary and parameters of flatness*
- *Part 2: Specification operators*

## Introduction

This part of ISO/TS 12781 is a geometrical product specification (GPS) Technical Specification and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain link 2 of the chain of standards on form of a surface (independent of a datum).

For more detailed information on the relation of this part of ISO/TS 12781 to other standards and the GPS matrix model, see Annex C.

This part of ISO/TS 12781 defines terms and concepts necessary for defining the specification operators according to ISO/TS 17450-2 for flatness of integral features.

Extracting data will always involve applying a certain filtering process. An additional filtering of the extracted data may or may not be applied. This additional filter can be a mean line filter (Gaussian, spline, wavelet, etc.) or a non-linear filter (e.g. morphological filter). The type of filtering will influence the definition of flatness and the specification operators and, therefore, needs to be stated unambiguously.

This part of ISO/TS 12781 is not intended to disallow any means of measuring flatness.

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# Geometrical Product Specifications (GPS) — Flatness —

## Part 1: Vocabulary and parameters of flatness

### 1 Scope

This part of ISO/TS 12781 defines the terms and concepts related to flatness of individual complete integral features only.

### 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/TS 12780-2:2003, *Geometrical Product Specifications (GPS) — Straightness — Part 2: Specification operators*

ISO 14660-1:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 1: General terms and definitions*

ISO 14660-2:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 2: Extracted median line of a cylinder and a cone, extracted median surface, local size of an extracted feature*

ISO/TS 17450-1:—<sup>1)</sup>, *Geometrical Product Specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14660-1, ISO 14660-2, ISO/TS 17450-1 and the following apply.

#### 3.1 General terms

##### 3.1.1

##### **flatness**

property of a plane

##### 3.1.2

##### **nominal plane**

the mathematically defined plane as specified by the design

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1) To be published.

### 3.2 Terms relating to the surface

#### 3.2.1

##### **real surface of a workpiece**

integral feature part of a real surface of a workpiece limited by the adjacent real (integral) features

[ISO 14660-1:1999, definition 2.4]

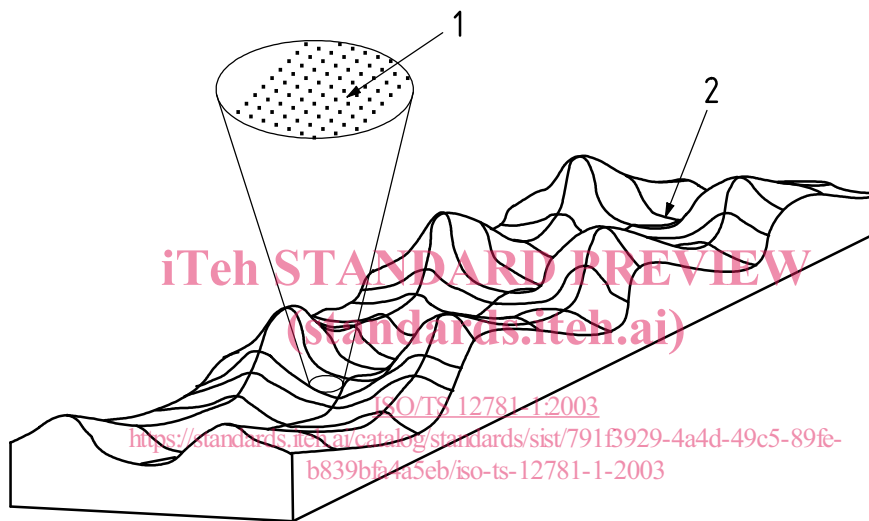
#### 3.2.2

##### **extracted surface**

(flatness) digital representation of the real surface.

See Figure 1.

NOTE The extraction conventions for flatness are given in ISO/TS 12781-2. This extracted surface is an extracted integral feature as defined in ISO 14660-1.



#### Key

- 1 extracted surface
- 2 real surface

**Figure 1 — Extracted surface**

#### 3.2.3

##### **flatness surface**

extracted surface (type plane) intentionally modified by a filter

NOTE 1 This is the surface to which the concepts and parameters of this part of ISO/TS 12781 can be applied

NOTE 2 The areal Gaussian filter is a convolution of two orthogonal profile Gaussian filters.

#### 3.2.4

##### **local flatness deviation**

##### **LFD**

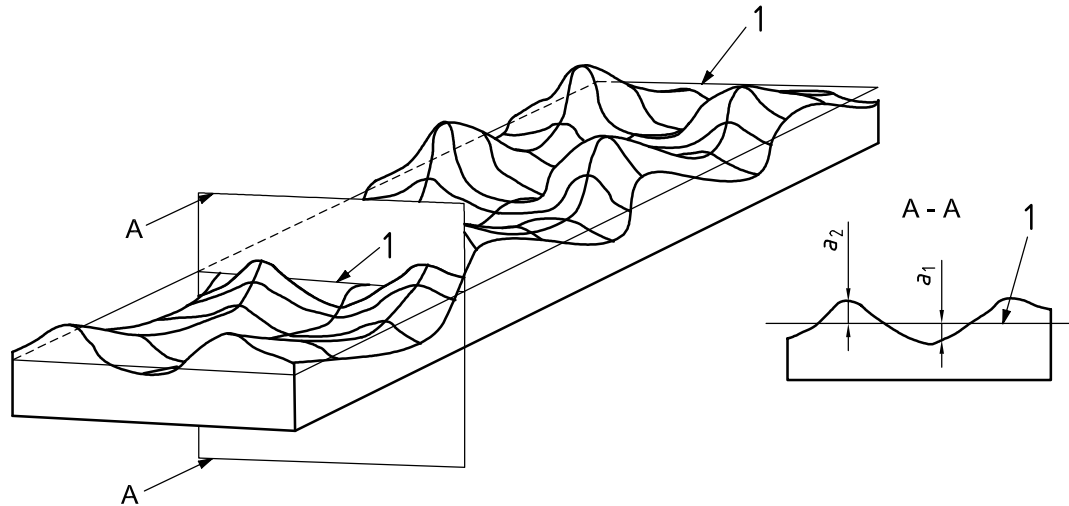
deviation of a point on a flatness surface from a reference plane, the deviation being normal to the reference plane

See Figure 2.

NOTE 1 The deviation is negative if from the reference plane the point lies in the direction of the material.

NOTE 2 See 3.3.1 for reference plane.



**Key**

- $a_1$  negative local flatness deviation
- $a_2$  positive local flatness deviation
- 1 any reference plane

**Figure 2 — Local form deviation for flatness**

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**3.2.5****straightness profile**

extracted line intentionally modified by a filter

[ISO/TS 12780-1:2003, definition 3.2.3] <https://standards.iteh.ai/catalog/standards/sist/791f3929-4a4d-49c5-89fe-b839bfa4a5eb/iso-ts-12781-1-2003>

**3.3 Terms relating to the reference plane****3.3.1****reference plane**

associated plane fitting the flatness surface in accordance with specified conventions, to which the deviations from flatness and the flatness parameters are referred

**3.3.1.1****minimum zone reference planes****MZPL**

two parallel planes enclosing the flatness surface and having the least separation

See Figure 3.

**3.3.1.1.1****outer minimum zone reference plane**

minimum zone reference plane outside the material

See Figure 3.

**3.3.1.1.2****inner minimum zone reference plane**

minimum zone reference plane inside the material

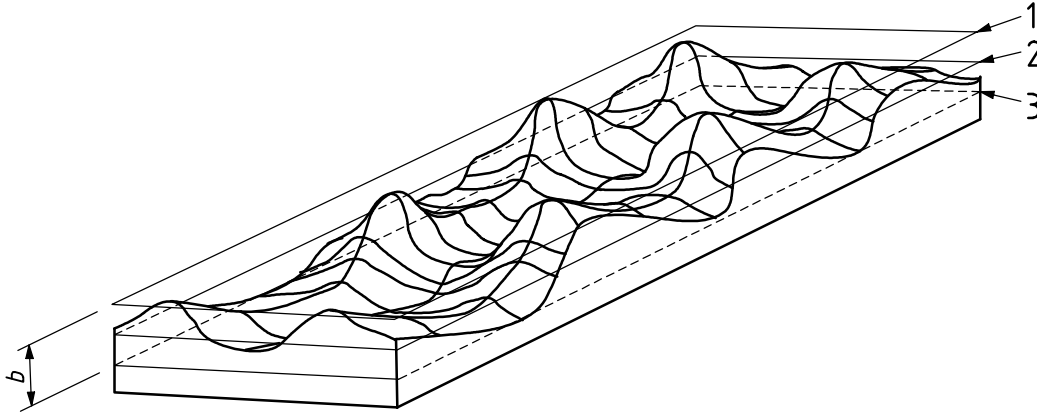
See Figure 3.

3.3.1.1.3

**mean minimum zone reference plane**

arithmetic mean plane of the minimum zone reference planes

See Figure 3.



**Key**

- b* least separation
- 1 outer minimum zone reference plane
- 2 mean minimum zone reference plane
- 3 inner minimum zone reference plane

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**Figure 3 — Minimum zone reference planes**

[ISO/TS 12781-1:2003](https://standards.iteh.ai/catalog/standards/sist/791f3929-4a4d-49c5-89fe-b839bfa4a5eb/iso-ts-12781-1-2003)

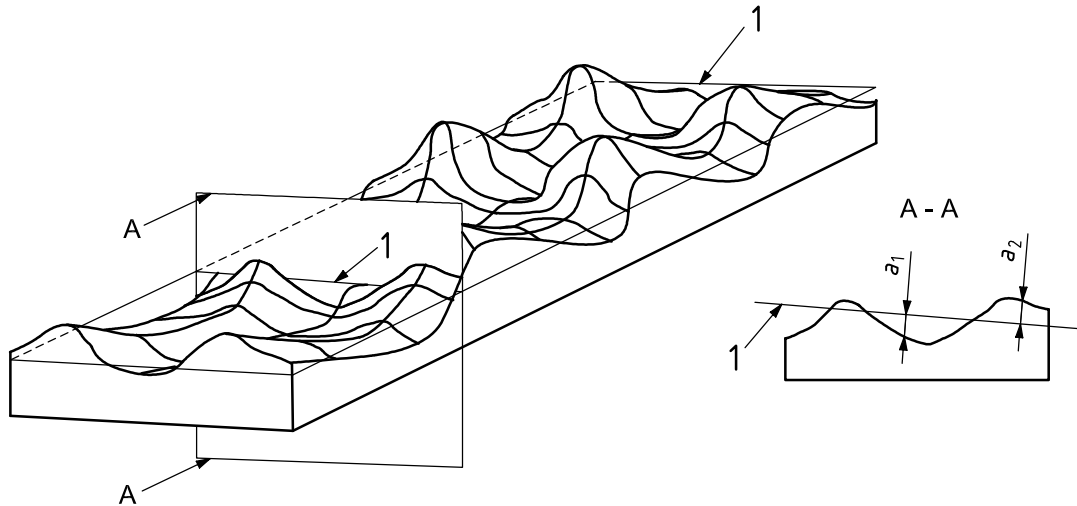
3.3.1.2

**least squares reference plane**

**LSPL**

plane such that the sum of the squares of the local flatness deviations is a minimum.

See Figure 4.

**Key**

- $a_1$  negative local flatness deviation
- $a_2$  positive local flatness deviation
- 1 Least squares reference plane

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 Figure 4 — Least squares reference plane  
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**3.4 Terms relating to the filter function**

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**3.4.1 General**

<https://standards.iteh.ai/catalog/standards/sist/791f3929-4a4d-49c5-89fe-b839bfa4a5eb/iso-ts-12781-1-2003>

If not otherwise specified, the details of the filter characteristics are as specified in ISO/TS 12780-2.

**NOTE** Only the phase correct mean line filter is currently defined (see ISO 11562:1996, definition 2.2). Consequently, the terms in this clause relate only to this type of filter. Other filter methods are currently being investigated by ISO. It is anticipated that in a future version of this part of ISO/TS 12781, these new filters will be incorporated.

**3.4.2****profile filter**

filter operating on an open profile, transmitting a range of sinusoidal undulations for which the ratio of output to input amplitude is defined, while attenuating (i.e. reducing) the ratio for undulations lying outside the range at either or both ends

[ISO/TS 12780-1:2003, definition 3.4.2]

**NOTE 1** The areal Gaussian filter is a convolution of two orthogonal profile Gaussian filters.

**NOTE 2** Other filter methods are currently being investigated by ISO. It is anticipated that in a future version of this part of ISO/TS 12781, these new filters will be incorporated. Some of these new filters are not a convolution of two orthogonal profile filters and so appropriate areal filter terms will be added where necessary.

**3.4.3****transmission characteristic of a filter**

characteristic which indicates the amount by which the amplitude of a sinusoidal profile is attenuated as a function of its wavelength

[ISO 11562:1996, definition 2.3]