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

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

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

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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.

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order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn.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again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.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 12181-1 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition of ISO/TS 12181-1 cancels and replaces ISO 6318:1985, of which it constitutes a technical revision.

ISO/TS 12181 consists of the following parts, under the general title *Geometrical Product Specifications (GPS) — Roundness*:

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

## Introduction

This part of ISO/TS 12181 is a geometrical product specification (GPS) Technical Specification and is to be regarded as a general GPS document (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 12181 to other standards and the GPS matrix model, see Annex C.

This part of ISO/TS 12181 defines terms and concepts necessary for defining the specification operators according to ISO/TS 17450-2 for roundness 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 actual specification operator and, consequently, the actual definition of roundness. Therefore, the type of filtering needs to be stated unambiguously.

This part of ISO/TS 12181 is not intended to disallow any means of measuring roundness.

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# Geometrical Product Specifications (GPS) — Roundness —

## Part 1: Vocabulary and parameters of roundness

### 1 Scope

This part of ISO/TS 12181 defines the terms and concepts related to the roundness of individual integral features and covers complete roundness profiles 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 12181-2:2003, *Geometrical Product Specifications (GPS) — Roundness — Part 2: Specification operators*

ISO 14660-1:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 1: General terms and definitions* <https://standards.iteh.ai/catalog/standards/sist/a55a779d-6ede-4f22-a9a0-879c4ea089b2/iso-ts-12181-1-2003>

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 General terms and definitions

For the purposes of this part of ISO/TS 12181, 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

##### **roundness**

property of a circle

##### 3.1.2

##### **roundness axis**

axis of a feature associated to an integral feature

NOTE The integral feature can be a cylindrical surface or a surface of revolution.

1) To be published.

3.1.3

**roundness plane**

plane perpendicular to the roundness axis within the full extent of the feature

3.2 Terms relating to profiles

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 circumferential line**

(roundness) digital representation of the intersection of the real surface and the roundness plane

NOTE The extraction conventions for roundness are given in ISO/TS 12181-2. This extracted circumferential line is an extracted integral feature as defined in ISO 14660-1.

3.2.3

**roundness profile**

extracted circumferential line intentionally modified by a filter

NOTE This is the profile to which the concepts and parameters of this International Standard can be applied.

3.2.4

**local roundness deviation**

**LRD**

minimum distance from a point on a roundness profile to the reference circle

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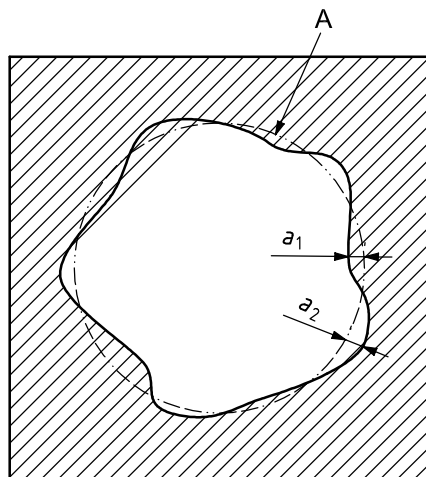
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See Figures 1 and 2.

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NOTE 1 For reference circle see 5.1.

NOTE 2 The deviation is negative if from the reference circle, the point lies in the direction of the material.

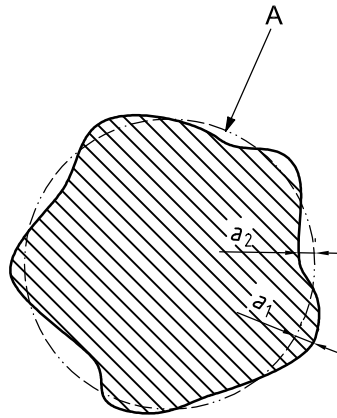


**Key**

- A reference circle
- $a_1$  positive local deviation
- $a_2$  negative local deviation

**Figure 1 — Local form deviation of an internal roundness feature**



**Key**

- A reference circle  
 $a_1$  positive local deviation  
 $a_2$  negative local deviation

**Figure 2 — Local form deviation of an external roundness feature**

### 3.3 Terms relating to the reference circle

#### 3.3.1

##### reference circle

associated circle fitting the roundness profile in accordance with specified conventions, to which the deviations from roundness and the roundness parameters are referred

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#### 3.3.1.1

##### minimum zone reference circles

##### MZCI

two concentric circles enclosing the roundness profile and having the least radial separation

#### 3.3.1.1.1

##### outer minimum zone reference circle

outer circle of the minimum zone reference circles

#### 3.3.1.1.2

##### inner minimum zone reference circle

inner circle of the minimum zone reference circles

#### 3.3.1.1.3

##### mean minimum zone reference circle

arithmetic mean circle of the minimum zone reference circles

#### 3.3.1.2

##### least squares reference circle

##### LSCI

circle such that the sum of the squares of the local roundness deviations is a minimum

#### 3.3.1.3

##### minimum circumscribed reference circle

##### MCCI

smallest possible circle that can be fitted around the roundness profile

**3.3.1.4**

**maximum inscribed reference circle**

**MICI**

largest possible circle that can be fitted within the roundness profile

NOTE Cases exist where MICI is not unique.

**3.3.2**

**associated derived centre**

centre of the reference circle(s)

**3.4 Terms relating to the circumference**

**3.4.1**

**undulations per revolution**

**UPR**

number of sinusoidal undulations contained in the roundness profile

**3.4.2**

**circumferential wavelength**

circumference of the reference circle divided by the UPR

**3.5 Terms relating to the filter function**

**3.5.1 General**

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If not otherwise specified, the details of the filter characteristics are as given in ISO/TS 12181-2.

NOTE Only the phase correct mean line filter is currently defined (see ISO 11562:1996). 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 standard, these new filters will be incorporated.

**3.5.2**

**wave filter**

filter operating on a closed 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

**3.5.3**

**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]

**3.5.4**

**undulation cut-off**

cut-off wavelength of the filter applied to the extracted circumferential line

NOTE These are usually defined in terms of undulations per revolution, UPR.

**3.5.5**

**transmission band for roundness profiles**

band of sinusoidal profile undulations which are transmitted by greater than a specified percentage by the filter, defined by the values of the upper and lower undulation cut-off

NOTE The specified percentage is usually 50 %.

## 3.6 Parameters

### 3.6.1 General parameters

#### 3.6.1.1

##### peak-to-valley roundness deviation (MZCI), (LSCI), (MCCI), (MICI)

*RONt*

value of the largest positive local roundness deviation added to the absolute value of the largest negative local roundness deviation

NOTE The peak-to-valley roundness deviation can be used for reference circles (MZCI), (LSCI), (MCCI) and (MICI).

#### 3.6.1.2

##### peak-to-reference roundness deviation (LSCI)

*RONp*

value of the largest positive local roundness deviation from the least squares reference circle

NOTE The peak-to-reference roundness deviation is only defined for least squares reference circles.

#### 3.6.1.3

##### reference-to-valley roundness deviation (LSCI)

*RONv*

absolute value of the largest negative local roundness deviation from the least squares reference circle

NOTE The reference-to-valley roundness deviation is only defined for least squares reference circles.

#### 3.6.1.4

##### root mean square roundness deviation (LSCI)

*RONq*

square root of the sum of the squares of the local roundness deviations from the least squares reference circle

NOTE The root mean square roundness deviation is only defined for least squares reference circles.

$$RONq = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} LRD^2 d\theta}$$

where

LRD is the local roundness deviation (see 4.4);

$\theta$  is the instantaneous angle in the roundness profile.

### 3.6.2 Other parameters of the extracted circumferential line

#### 3.6.2.1

##### dynamic content (Fourier transform) (MZCI), (LSCI), (MCCI), (MICI)

harmonic components (sinewaves) of which the extracted circumferential line is made up

NOTE 1 It is expressed as an amplitude and a phase for each UPR number.

NOTE 2 The amplitude for one or more UPR number(s) or the sum of the amplitudes of a number of UPR numbers can be specified.

NOTE 3 The parameters defined above can be specified including only a specific range of UPR numbers.

NOTE 4 The dynamic content can be used for all reference circles (MZCI), (LSCI), (MCCI) and (MICI).