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

**Part 2:
Specification operators**

*Spécification géométrique des produits (GPS) — Circularité —
Partie 2: Opérateurs de spécification*

**iTeh STANDARD PREVIEW
(standards.iteh.ai)**

ISO/TS 12181-2:2003

<https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/TS 12181-2:2003](https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003)

<https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003>

© ISO 2003

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Complete specification operator	1
5 Compliance with specification	5
Annex A (informative) Harmonic content of nominally round workpiece	6
Annex B (informative) Relation to the GPS matrix model	8
Bibliography	10

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/TS 12181-2:2003](https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003)

<https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003>

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 12181-2 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

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 3 of the chain of standards on form of line independent of 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 B.

This part of ISO/TS 12181 specifies the specification operators according to ISO/TS 17450-2 for roundness of integral features.

At the current state of development, ISO/TC 213 has not been able to reach a consensus on defaults for filter UPR, probe tip radius and method of association (reference circle). This means that a roundness specification should explicitly state which values are to be used for these specification operations in order for it to be unique.

Consequently, if a specification does not explicitly state which values are to be used for one or more of these operators, the specification is uncertain (see ISO/TS 17450-2) and a supplier can use any value for the operator(s) not specified when proving conformance.

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 roundness and the specification operators and, therefore, needs to be stated unambiguously.

NOTE 1 Stylus filtering is not sufficient on its own to smooth a profile. In certain circumstances it can create spurious high-frequency content, thus giving incorrect values. To correct this, a longwave pass filter is employed. A Gaussian filter is used, since this is the current state-of-the-art in ISO standards. This filter has some shortcomings, e.g. it can distort, rather than eliminate some roughness features and it can distort, rather than transmit correctly some waviness features. It is envisioned that new filters under development within ISO will provide better solutions for several of these issues.

NOTE 2 If a smaller tip radius than the one specified is used for a given cut-off length, the resulting measured value will generally be higher. This effect is usually insignificant. If a larger tip radius is used, the resulting measured value will generally be lower. The amount of change is heavily dependent on the surface measured.

NOTE 3 The measuring force of zero N is chosen to eliminate effects of elastic deformation of the workpiece from the specification operator. On metal surfaces with adequate thickness, the effect of normally occurring measuring forces will be negligible.

NOTE 4 Aliasing and other problems during extraction (see Annex A) due to the higher harmonic content of the skin model, in the roundness directions, can cause specification uncertainty.

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 12181-2:2003

<https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-08d5b7d9df9/iso-ts-12181-2-2003>

Geometrical Product Specifications (GPS) — Roundness —

Part 2: Specification operators

1 Scope

This part of ISO/TS 12181 specifies the complete specification operator for roundness of integral features only and covers complete roundness profiles only, i.e. geometrical characteristics of features of the type circle.

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 11562:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Metrological characteristics of phase correct filters*

ISO/TS 12181-1:2003, *Geometrical Product Specifications (GPS) — Roundness — Part 1: Vocabulary and parameters of roundness*

ISO 14253-1:1998, *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformance or non-conformance with specifications*

ISO/TS 17450-2:2002, *Geometrical Product Specifications (GPS) — General concepts — Part 2: Basic tenets, specification, operators and uncertainties*

3 Terms and definitions

For the purposes of this part of ISO/TS 12181, the terms and definitions given in ISO/TS 12181-1 and ISO/TS 17450-2 apply.

4 Complete specification operator

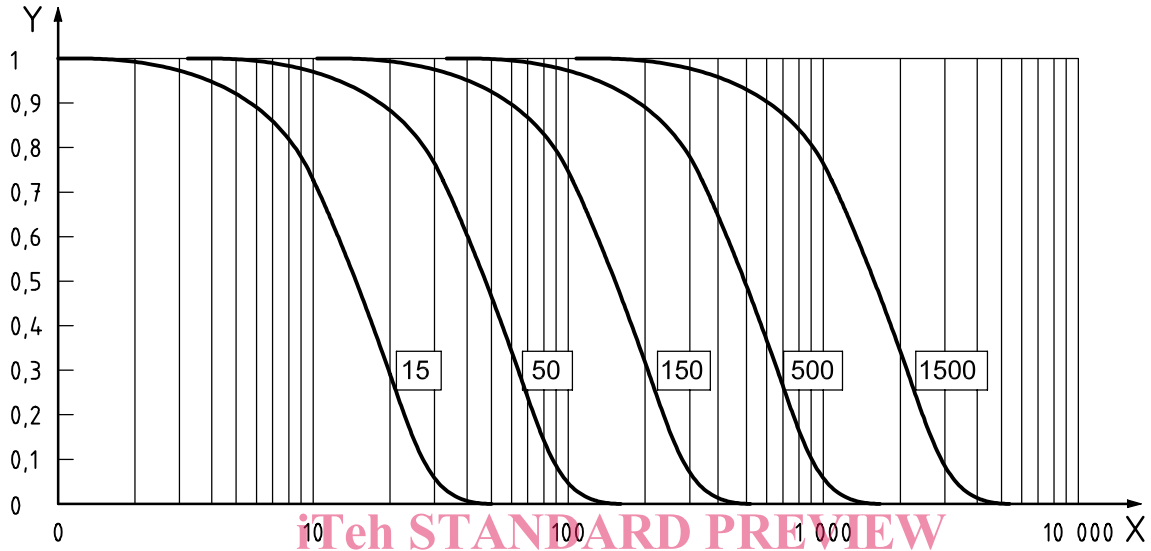
4.1 General

The complete specification operator (see ISO/TS 17450-2) is a full ordered set of unambiguous specification operations in a well-defined order. The complete specification operator defines the transmission band for the roundness profile, together with an appropriate stylus tip geometry.

4.2 Transmission band

4.2.1 Longwave-pass filter

The longwave-pass filter shall be a phase correct filter (according to ISO 11562) transmitting waves from 1 UPR and attenuating profile undulations progressively in the undulation region around the cut-off frequency (in UPR) (see Figure 1).



Key

X undulations per revolution, UPR

Y transmission, UPR

STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 12181-2:2003

[https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-](https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-0815b7d91699/iso-ts-12181-2-2003)

[0815b7d91699/iso-ts-12181-2-2003](https://standards.iteh.ai/catalog/standards/sist/c90f8331-e104-41fc-b4e8-0815b7d91699/iso-ts-12181-2-2003)

NOTE Other filter values than those shown in this figure can be used if necessary for the application.

Figure 1 — Transmission characteristic for longwave-pass filter having cut-off frequencies $f_c = 15$ UPR; 50 UPR; 150 UPR; 500 UPR; 1 500 UPR

The attenuation function is given by:

$$\frac{a_1}{a_0} = e^{-\pi \left(\frac{\alpha \times f}{f_c} \right)^2}$$

where

$$\alpha = \sqrt{\frac{\ln(2)}{\pi}} = 0,4697$$

a_0 = amplitude of sine wave undulation before filtering;

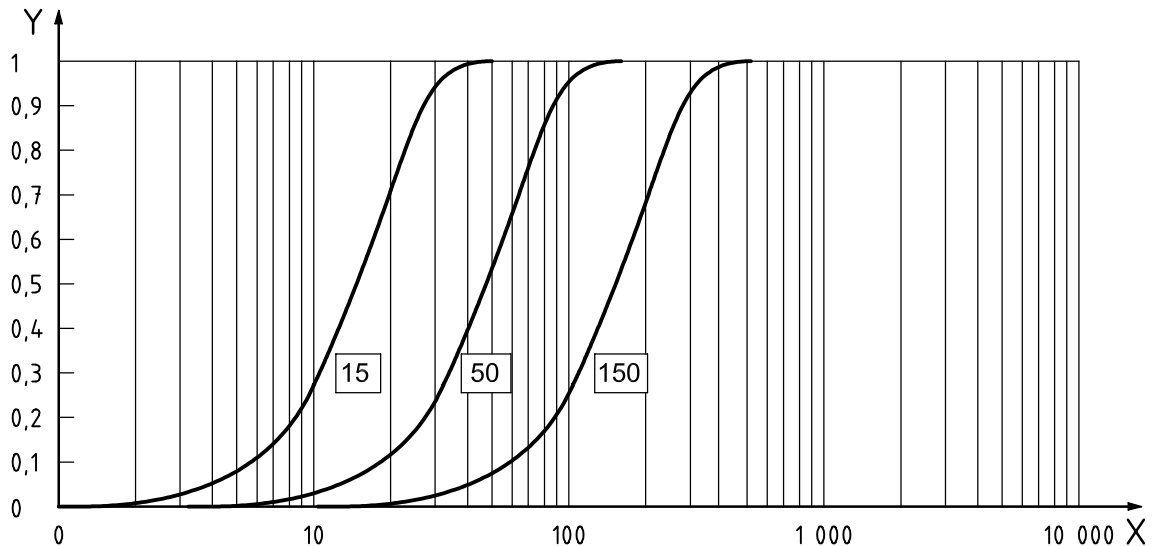
a_1 = amplitude of this sine wave undulation after filtering;

f_c = cut-off frequency (in UPR) of the longwave-pass filter;

f = frequency of the sine wave (in UPR).

4.2.2 Shortwave-pass filter

The shortwave-pass filter shall be a phase correct filter (according to ISO 11562) attenuating waves from 1 UPR up to the cut-off frequency (in UPR). It transmits undulations shorter than the cut-off frequency (in UPR) (see Figure 2).



Key

X undulations per revolution, UPR
Y transmission, UPR

NOTE Other filter values than those shown in this figure can be used if necessary for the application.

Figure 2 — Transmission characteristic for shortwave-pass filter having cut-off frequencies $f_c = 15$ UPR; 50 UPR; 150 UPR

The attenuation function is given by:

$$\frac{a_2}{a_0} = 1 - e^{-\pi \left(\frac{\alpha \times f}{f_c} \right)^2}$$

where

$$\alpha = \sqrt{\frac{\ln(2)}{\pi}} = 0,4697$$

a_0 = amplitude of sine wave undulation before filtering;

a_2 = amplitude of this sine wave after filtering;

f_c = cut-off frequency (in UPR) of the longwave-pass filter;

f = frequency of the sine wave (in UPR).