INTERNATIONAL STANDARD

ISO 12180-1

First edition
2011-04-01

Geometrical product specifications (GPS) — Cylindricity —

Part 1: Vocabulary and parameters of cylindrical form

Spécification géométrique des produits (GPS) — Cylindricité —
Partie 1: Vocabulaire et paramètres de cylindricité

Reference number
ISO 12180-1:2011(E)

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

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 12180-1 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition of ISO 12180-1 cancels and replaces ISO/TS 12180-1:2003, which has been technically revised.

ISO 12180 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Cylindricity*:

— *Part 1: Vocabulary and parameters of cylindrical form*

— *Part 2: Specification operators*

Introduction

This part of ISO 12180 is a geometrical product specification (GPS) standard 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).

The ISO/GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO/GPS system of which this part of ISO 12180 is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this part of ISO 12180 and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this part of ISO 12180, unless otherwise indicated.

For more detailed information on the relationship of this part of ISO 12180 to other standards and the GPS matrix model, see Annex D.

This part of ISO 12180 defines terms and concepts necessary for defining the specification operators according to ISO 17450-2 for cylindricity of integral features.

Extracting data always involves applying a certain filtering process. An additional filtering of the extracted data might or might 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 influences the definition of cylindricity and the specification operators and, therefore, needs to be stated unambiguously.

This part of ISO 12180 is not intended to disallow any means of measuring cylindricity.

Geometrical product specifications (GPS) — Cylindricity —

Part 1:
Vocabulary and parameters of cylindrical form

1 Scope

This part of ISO 12180 defines the terms and concepts related to cylindricity 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 11562:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Metrological characteristics of phase correct filters*

ISO 12181-1:2011, *Geometrical product specifications (GPS) — Roundness — Part 1: Vocabulary and parameters of roundness*

ISO 12780-1:2011, *Geometrical product specifications (GPS) — Straightness — Part 1: Vocabulary and parameters of straightness*

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 17450-1:—[1)], *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 11562, ISO 12181-1, ISO 12780-1, ISO 14660-1, ISO 14660-2, ISO 17450-1 and the following apply.

1) To be published. (Revision of ISO/TS 17450-1:2005)

3.1 General terms

3.1.1
cylindricity
property of a cylinder

3.1.2
nominal cylinder
mathematically cylindrical form as specified by design intent

NOTE For the purposes of this part of ISO 12180, the term “form of a nominal cylinder” is understood to mean the form of a right circular cylinder (i.e. it has a right angle between the cylinder axis and every circular cross-section).

3.1.3
generatrix plane
half plane through the axis of the associated cylinder

3.2 Terms relating to the surface

3.2.1
extracted surface
〈cylindricity〉 digital representation of the real surface

NOTE The extraction conventions for cylindricity are given in ISO 12180-2. This extracted surface is an extracted integral feature as defined in ISO 14660-1.

3.2.2
cylindricity surface
extracted surface (type cylinder) intentionally modified by a filter

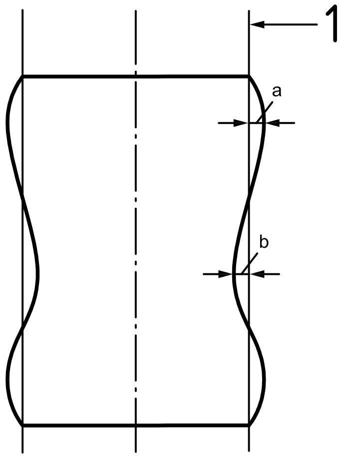
NOTE This is the surface to which the concepts and parameters of this part of ISO 12180 can be applied.

3.2.3
local cylindricity deviation
ΔC_{I}
deviation of a point on a cylindricity surface from the reference cylinder, the deviation being normal to the reference cylinder

See Figures 1 and 2.

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

NOTE 2 For the reference cylinder, see 3.3.1.



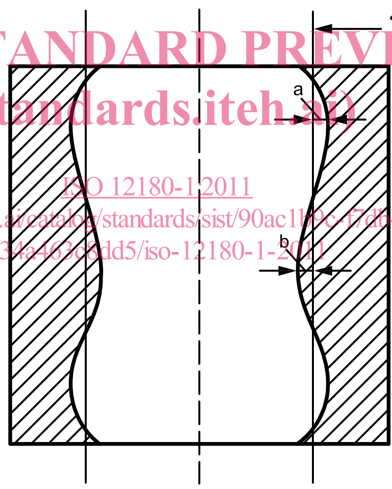
Key

1 reference cylinder

a Positive local deviation.

b Negative local deviation.

Figure 1 — Local form deviation of an external cylindrical feature



Key

1 reference cylinder

a Negative local deviation.

b Positive local deviation.

Figure 2 — Local form deviation of an internal cylindrical feature

3.2.4
extracted generatrix line
digital representation of the line of intersection of the real surface and a generatrix plane

NOTE The extraction conventions for cylindricity are given in ISO 12180-2. This extracted surface is an extracted integral feature as defined in ISO 14660-1.

3.2.5
generatrix profile
extracted generatrix line intentionally modified by a filter

3.2.6
local generatrix deviation
deviation of a point on a generatrix from the reference line, the deviation being normal to the reference line

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

NOTE 2 This definition is similar to ISO 12780-1:2011, definition 3.2.4: local straightness deviation.

3.3 Terms relating to the reference cylinder

3.3.1
reference cylinder
associated cylinder fitting the cylindricity surface in accordance with specified conventions, to which the deviations from cylindrical form and the cylindricity parameters are referred

3.3.1.1
minimum zone reference cylinders
two coaxial cylinders enclosing the cylindricity surface and having the least radial separation

NOTE The abbreviated term MZ is used to refer to minimum zone reference elements.

3.3.1.1.1
outer minimum zone reference cylinder
outer cylinder of the minimum zone reference cylinders

3.3.1.1.2
inner minimum zone reference cylinder
inner cylinder of the minimum zone reference cylinders

3.3.1.1.3
mean minimum zone reference cylinder
arithmetic mean cylinder of the minimum zone reference cylinders

3.3.1.2
least squares reference cylinder
cylinder for which the sum of the squares of the local cylindricity deviations is a minimum

NOTE The abbreviated term LS is used to refer to least squares reference elements and the abbreviated term G (for Gaussian), is used as a prefix for parameters based on least squares reference elements.

3.3.1.3
minimum circumscribed reference cylinder
smallest possible cylinder that can be fitted around the cylindricity surface

NOTE The abbreviated term MC is used to refer to minimum circumscribed reference elements.

3.3.1.4
maximum inscribed reference cylinder
largest possible cylinder that can be fitted within the cylindricity surface

NOTE 1 Cases exist where the maximum inscribed reference cylinder is not unique.

NOTE 2 The abbreviated term MI is used to refer to maximum inscribed reference elements.

3.3.2
associated derived axis of a cylindrical feature
axis of the reference cylinder(s)

3.4 Terms relating to the circumference and the generatrix

3.4.1
generatrix wavelength
length of a generatrix divided by the number of sinusoidal undulations along that generatrix

NOTE The number of sinusoidal undulations is not necessarily an integer.

3.5 Terms relating to parameters

3.5.1 General parameters

3.5.1.1
peak-to-valley cylindricity deviation
value of the largest positive local cylindricity deviation added to the absolute value of the largest negative local cylindricity deviation

NOTE 1 The peak-to-valley cylindricity deviation is defined for all reference cylinders.

NOTE 2 The peak-to-valley cylindricity deviation is the only parameter that is defined for minimum zone, maximum inscribed and minimum circumscribed reference cylinders.

NOTE 3 The modifier GT is used in specifications to indicate that a form tolerance applies to the peak-to-valley deviation relative to the least squares reference element.

3.5.1.2
peak-to-reference cylindricity deviation
value of the largest positive local cylindricity deviation from the least squares reference cylinder

NOTE 1 The peak-to-reference cylindricity deviation is only defined for least squares reference cylinders.

NOTE 2 The modifier GP is used in specifications to indicate that a form tolerance applies to the peak-to-reference deviation relative to the least squares reference element.

3.5.1.3
reference-to-valley cylindricity deviation
absolute value of the largest negative local cylindricity deviation from the least squares reference cylinder

NOTE 1 The reference-to-valley cylindricity deviation is only defined for least squares reference cylinders.

NOTE 2 The modifier GV is used in specifications to indicate that a form tolerance applies to the reference-to-valley deviation relative to the least squares reference element.

3.5.1.4
root-mean-square cylindricity deviation
ΔC_{rms}
square root of the sum of the squares of the local cylindricity deviations from the least squares reference cylinder

NOTE 1 The root-mean-square cylindricity deviation is only defined for least squares reference cylinders.

NOTE 2 The modifier GQ is used in specifications to indicate that a form tolerance applies to the root-mean-square deviation relative to the least squares reference element.

NOTE 3 The root-mean-square cylindricity deviation is given by:

$$\Delta C_{\mathrm{rms}} = \sqrt{\frac{1}{A}\int_{A} \Delta C_{\mathrm{I}}^{2}\, \mathrm{d}A}$$