
**Geometrical product specifications
(GPS) — Geometrical tolerancing
— Tolerances of form, orientation,
location and run-out**

*Spécification géométrique des produits (GPS) — Tolérancement
géométrique — Tolérancement de forme, orientation, position et
battement*



Reference number
ISO 1101:2017(E)



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verifications*.

This fourth edition cancels and replaces the third edition (ISO 1101:2012), which has been technically revised.

It also incorporates the Technical Corrigendum ISO 1101:2012/Cor.1:2013.

The main changes are as follows.

- Tools have been added to specify the filtering of the tolerated feature and a line type has been designated for its illustration.
- Tools have been added to tolerance associated features.
- Tools have been added to specify form characteristics by specifying the reference feature association and the specified parameter.
- Tools have been added to specify the constraints to the tolerance zone.
- The rules for specifications using “all around” or “all over” modifiers have been clarified.
- The direction of the tolerance zone in the case of roundness tolerances for revolute surfaces that are neither cylindrical nor spherical, e.g. cones shall now always be indicated to avoid an exception to the general rule that specifications for integral features apply perpendicular to the surface.
- The “from-to” symbol has been retired and replaced by the “between” symbol.

Introduction

This document is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences chain links A, B and C of the chain of standards on form, orientation, location and run out.

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

For more detailed information on the relation of this document to the GPS matrix model, see [Annex G](#).

This document represents the initial basis and describes the required fundamentals for geometrical tolerancing. Nevertheless, it is advisable to consult the separate standards referenced in [Clause 2](#) and in [Tables 3](#) and [4](#) for more detailed information.

For the presentation of lettering (proportions and dimensions), see ISO 3098-2.

All figures in this document for the 2D drawing indications have been drawn in first-angle projection with dimensions and tolerances in millimetres. It should be understood that third-angle projection and other units of measurement could have been used equally well without prejudice to the principles established. For all figures giving specification examples in 3D, the dimensions and tolerances are the same as for the similar figures shown in 2D.

The figures in this document represent either 2D drawing views or 3D axonometric views on 2D drawings and are intended to illustrate how a specification can be fully indicated with visible annotation. For possibilities of illustrating a specification where elements of the specification may be available through a query function or other interrogation of information on the 3D CAD model and rules for attaching specifications to 3D CAD models, see ISO 16792.

The figures in this document illustrate the text and are not intended to reflect an actual application. Consequently, the figures are not fully dimensioned and specified, showing only the relevant general principles. Neither are the figures intended to imply a particular display requirement in terms of whether hidden detail, tangent lines or other annotations are shown or not shown. Many figures have lines or details removed for clarity, or added or extended to assist with the illustration of the text. See [Table 1](#) for the line types used in definition figures.

In order for a GPS specification to be unambiguous, the partition defining the boundary of the toleranced feature, as well as the filtering, has to be well defined. Currently, the detailed rules for partitioning and the default for filtering are not defined in GPS standards.

For a definitive presentation (proportions and dimensions) of the symbolization for geometrical tolerancing, see ISO 7083 and [Annex F](#).

[Annex A](#) has been provided for information only. It presents previous drawing indications that have been omitted here and are no longer used.

For the purposes of this document, the terms “axis” and “median plane” are used for derived features of perfect form, and the terms “median line” and “median surface” for derived features of imperfect form. Furthermore, the following line types have been used in the explanatory illustrations, i.e. those representing non-technical drawings for which the rules of ISO 128 (all parts) apply.

Table 1

| Feature level | Feature type | Details | Line type | |
|---|------------------|--|---|--|
| | | | Visible | Behind plane/surface |
| Nominal feature | integral feature | point line/axis surface/plane | wide continuous | narrow dashed |
| | derived feature | point line/axis surface/plane | narrow long dashed dotted | narrow dashed dotted |
| Real feature | integral feature | surface | wide freehand con- tinuous | narrow freehand dashed |
| Extracted feature | integral feature | point line surface | wide short dashed | narrow short dashed |
| | derived feature | point line surface | wide dotted | narrow dotted |
| Filtered feature | integral feature | line surface | continuous narrow | continuous narrow |
| Associated feature | integral feature | point straight line plane | wide doubled-dashed double-dotted | narrow dou- ble-dashed dou- ble-dotted |
| | derived feature | point straight line (axis) plane | narrow long dashed double-dotted | wide dashed double-dotted |
| | datum | point line/axis surface/plane | wide long dashed double-short dashed | narrow long dashed double-short dashed |
| Tolerance zone limits, tolerance planes | | line surface | continuous narrow | narrow dashed |
| Section, illustration plane, drawing plane, aid plane | | line surface | narrow long dashed short dashed | narrow dashed short dashed |
| Extension, dimension, leader and reference lines | | line | continuous narrow | narrow dashed |

Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out

IMPORTANT — The illustrations included in this document are intended to illustrate the text and/or to provide examples of the related technical drawing specification; these illustrations are not fully dimensioned and toleranced, showing only the relevant general principles. In particular, many illustrations do not contain filter specifications. As a consequence, the illustrations are not a representation of a complete workpiece, and are not of a quality that is required for use in industry (in terms of full conformity with the standards prepared by ISO/TC 10 and ISO/TC 213), and as such are not suitable for projection for teaching purposes.

1 Scope

This document defines the symbol language for geometrical specification of workpieces and the rules for its interpretation.

It provides the foundation for geometrical specification.

The illustrations in this document are intended to illustrate how a specification can be fully indicated with visible annotation (including e.g. TEDs).

NOTE 1 Other International Standards referenced in [Clause 2](#) and in [Tables 3](#) and [4](#) provide more detailed information on geometrical tolerancing.

NOTE 2 This document gives rules for explicit and direct indications of geometrical specifications. Alternatively, the same specifications can be indicated indirectly in accordance with ISO 16792 by attaching them to a 3D CAD model. In this case, it is possible that some elements of the specification are available through a query function or other interrogation of information on the model instead of being indicated using visible annotation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 128-24:1999, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

ISO 1660, *Technical drawings — Dimensioning and tolerancing of profiles*

ISO 2692:2014, *Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)*

ISO 5458, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Positional tolerancing*

ISO 5459, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems*

ISO 8015:2011, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

ISO 10579:2010, *Geometrical product specifications (GPS) — Dimensioning and tolerancing — Non-rigid parts*

ISO 13715, *Technical drawings — Edges of undefined shape — Vocabulary and indications*

ISO 16610 (all parts), *Geometrical product specifications (GPS) — Filtration*

ISO 17450-1:2011, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 17450-2, *Geometrical product specifications (GPS) — General concepts — Part 2: Basic tenets, specifications, operators, uncertainties and ambiguities*

ISO 17450-3, *Geometrical product specifications (GPS) — General concepts — Part 3: Toleranced features*

ISO 22432, *Geometrical product specifications (GPS) — Features utilized in specification and verification*

ISO 25378:2011, *Geometrical product specifications (GPS) — Characteristics and conditions — definitions*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 8015, the ISO 16610 series, ISO 17450-1, ISO 17450-2, ISO 17450-3, ISO 22432, ISO 25378 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/>

3.1 tolerance zone

space limited by and including one or two ideal lines or surfaces, and characterized by one or more linear dimensions, called a tolerance

Note 1 to entry: See also [4.4](#).

3.2 intersection plane

plane, established from an extracted feature of the workpiece, identifying a line on an extracted surface (integral or median) or a point on an extracted line

Note 1 to entry: The use of intersection planes makes it possible to define toleranced features independent of the view.

Note 2 to entry: For areal surface texture, the intersection plane can be used to define the orientation of the evaluation area, see ISO 25178-1.

3.3 orientation plane

plane, established from an extracted feature of the workpiece, identifying the orientation of the tolerance zone

Note 1 to entry: The use of an orientation plane makes it possible to define the direction of the planes or cylinder that limit the tolerance zone independent of the TEDs (for location) or of the datum (for orientation). The orientation plane is only used for this purpose when the toleranced feature is a median feature (centre point, median straight line) and the tolerance zone is defined by two parallel straight lines or two parallel planes or, for a centre point, a cylinder.

Note 2 to entry: The use of an orientation plane also makes it possible to define the orientation of a rectangular restricted area.

3.4

direction feature

ideal feature, established from an extracted feature of the workpiece, identifying the direction of local deviations

Note 1 to entry: The direction feature can be a plane, a cylinder or a cone.

Note 2 to entry: For a line in a surface, the use of a direction feature makes it possible to change the direction of the width of the tolerance zone.

Note 3 to entry: The direction feature is used when the tolerance value applies in a specified direction instead of normal to the specified geometry.

Note 4 to entry: The direction feature is constructed from the datum indicated in the second compartment of the direction feature indicator. The geometry of the direction feature depends on the geometry of the tolerated feature.

3.5

compound continuous feature

single feature composed of more than one single feature joined together without gaps

Note 1 to entry: A compound continuous feature can be closed or not.

Note 2 to entry: A non-closed compound continuous feature can be defined using the “between” symbol (see 9.1.4) and, if applicable, the UF modifier.

Note 3 to entry: A closed compound continuous feature can be defined using the “all around” symbol (see 9.1.2) and the UF modifier. In this case, it is a set of single features whose intersection with any plane parallel to a collection plane is a line or a point.

Note 4 to entry: A closed compound continuous feature can be defined using the “all over” symbol (see 9.1.2) and the UF modifier.

3.6

collection plane

plane, established from a feature on the workpiece, defining a closed compound continuous feature

Note 1 to entry: The collection plane is always used when the “all around” symbol is applied.

3.7

theoretically exact dimension

TED

linear or angular dimension used in GPS operations to define theoretically exact geometry, extents, locations and orientations of features

Note 1 to entry: For the purpose of this document, the term “theoretically exact dimension” has been abbreviated as TED.

Note 2 to entry: A TED can be used to define the following:

- the nominal shape and dimensions of features;
- the definition of theoretically exact features (TEF);
- the location and dimensions of portions of features, including restricted tolerated features;
- the length of projected tolerated features;
- the relative location and orientation of two or more tolerance zones;
- the relative location and orientation of datum targets, including moveable datum targets;
- the location and orientation of tolerance zones relative to datums and datum systems;
- the direction of the width of tolerance zones.