INTERNATIONAL STANDARD

ISO 17450-1

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Geometrical product specifications (GPS) — General concepts —

Part 1: Model for geometrical specification and verification

Spécification géométrique des produits — Concepts généraux —

Partie 1: Modèle pour la spécification et la vérification géométriques

Reference number
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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.

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 17450-1 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition of ISO 17450-1 cancels and replaces ISO/TS 17450-1:2005, which has been technically revised. It also incorporates the Technical Corrigendum ISO/TS 17450-1:2005/Cor.1:2007.

ISO 17450 consists of the following parts, under the general title *Geometrical product specifications (GPS) — General concepts*:

— *Part 1: Model for geometrical specification and verification*

— *Part 2: Basic tenets, specifications, operators, uncertainties and ambiguities*

Introduction

This part of ISO 17450 is a geometrical product specification (GPS) document and is to be regarded as a global GPS document (see ISO/TR 14638). It influences all chain links of the chains of standards.

The ISO/GPS Masterplan given in ISO/TR 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 and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated. For more detailed information on the relationship of this part of ISO 17450 to other standards and to the GPS matrix model, see Annex F.

In a market environment of increased globalization, the exchange of technical product information is of high importance and the need to express unambiguously the geometry of mechanical workpieces of vital urgency. Consequently, codification associated with the macro- and micro-geometry of workpiece specifications needs to be unambiguous and complete if the functional geometrical variation of parts is to be limited; in addition, the language ought to be applicable to CAx systems.

The aim of ISO/TC 213 is to provide the tools for a global and “top-down” approach to GPS. These tools form the basis of new standards specifying a common language for geometrical definition. This language can be used by design (assemblies and individual workpieces), manufacturing and inspection, to describe the measurement procedure, regardless of the media (e.g. a paper drawing, numerical drawing or exchange file) used. The tools are based on the characteristics of features, as well as on the constraints between the features and on feature operations, used for the creation of different geometrical features.

Geometrical product specifications (GPS) — General concepts —

Part 1: Model for geometrical specification and verification

1 Scope

This part of ISO 17450 provides a model for geometrical specification and verification and defines the corresponding concepts. It also explains the mathematical basis of the concepts associated with the model and defines general terms for geometrical features of workpieces.

This part of ISO 17450 defines the fundamental concepts for the GPS system in order to:

— provide nonambiguous GPS language to be used in design, manufacturing and verification,

— identify features, characteristics and rules to provide the basis for specifications,

— provide a complete symbology language to indicate GPS specifications,

— provide simplified symbology by defining default rules, and

— provide consistent rules for verification.

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/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 99 and the following apply.

3.1
real surface
⟨of a workpiece⟩ set of features which physically exist and separate the entire workpiece from the surrounding medium

3.2
surface model
model representing the set of physical limits of the virtual or the real workpiece

NOTE 1 This model applies to all closed surfaces.

NOTE 2 The surface model allows the definition of single features, sets of features, and/or portions of features. The total product is modelled by a set of surface models corresponding to each workpiece.

3.2.1
nominal model
⟨of a workpiece⟩ model of the perfect shape defined by the designer

NOTE The nominal model represents the design intent.

3.2.2
non-ideal surface model
skin model
⟨of a workpiece⟩ model of the physical interface of the workpiece with its environment

NOTE See Clause 5.

3.3
geometrical feature
point, line, surface, volume or a set of these items

NOTE 1 The non-ideal surface model is a particular type of geometrical feature, corresponding to the infinite set of points defining the interface between the workpiece and its surroundings.

NOTE 2 A geometrical feature can be an ideal feature or a non-ideal feature, and can be considered as either a single feature or a compound feature.

3.3.1
ideal feature
feature defined by a parametrized equation

NOTE 1 The expression of the parametrized equation depends on the type of ideal feature and on its intrinsic characteristics.

NOTE 2 By default, an ideal feature is infinite. To change its nature, it is appropriate to specify this by adding the term “restricted” as in “restricted ideal feature”.

3.3.1.1
attribute of an ideal feature
property intrinsically attached to an ideal element

NOTE 1 Four levels of attributes can be defined for an ideal feature: 1) shape; 2) dimensional parameters from which a size can be defined in the case of dimensional feature; 3) situation feature; and 4) skeleton (when the size is set equal to zero).

NOTE 2 If the ideal feature is a feature of size, then one of parameters of the shape can be considered as a size.

3.3.1.1.1
dimensional parameter
linear or angular dimension of an ideal feature used in the expression of its parametrized equation

NOTE A dimensional parameter can correspond to a size of a feature of size.

3.3.1.1.2
skeleton feature
geometrical feature resulting from the reduction of a feature of size when its size is set equal to zero

NOTE 1 In the nominal model, the skeleton feature is a geometrical attribute of a nominal integral feature. A nominal integral feature and its skeleton belong to the same invariance class and have the same situation feature.

NOTE 2 In the non-ideal feature, several possible skeleton features exist for the same integral feature.

EXAMPLE In case of a torus, there are two dimensional parameters, one of which is a size (the small diameter of the torus). Its skeleton is a circle; its situation features are a plane (containing the circle) and a point (centre of the circle).

3.3.1.1.3
situation feature
point, straight line, plane or helix, from which the location and/or orientation of a geometrical feature can be defined

See Figures 1 to 4.

NOTE 1 A situation feature is a geometrical attribute of an ideal feature.

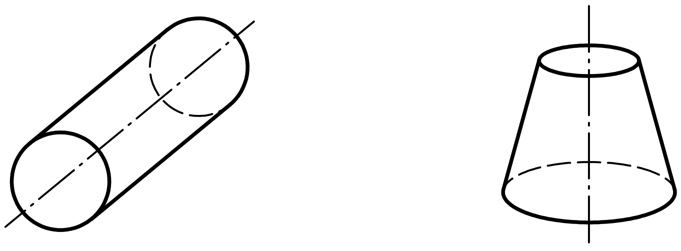
NOTE 2 No dimensional parameters are linked to a situation feature.

NOTE 3 In many cases, instead of using the situation helix, the axis of a situation helix is used.

EXAMPLE In the case of a torus, there are two dimensional parameters, one of which is a size (the small diameter of the torus). Its skeleton is a circle and its situation features are a plane (containing the circle) and a point (centre of the circle).

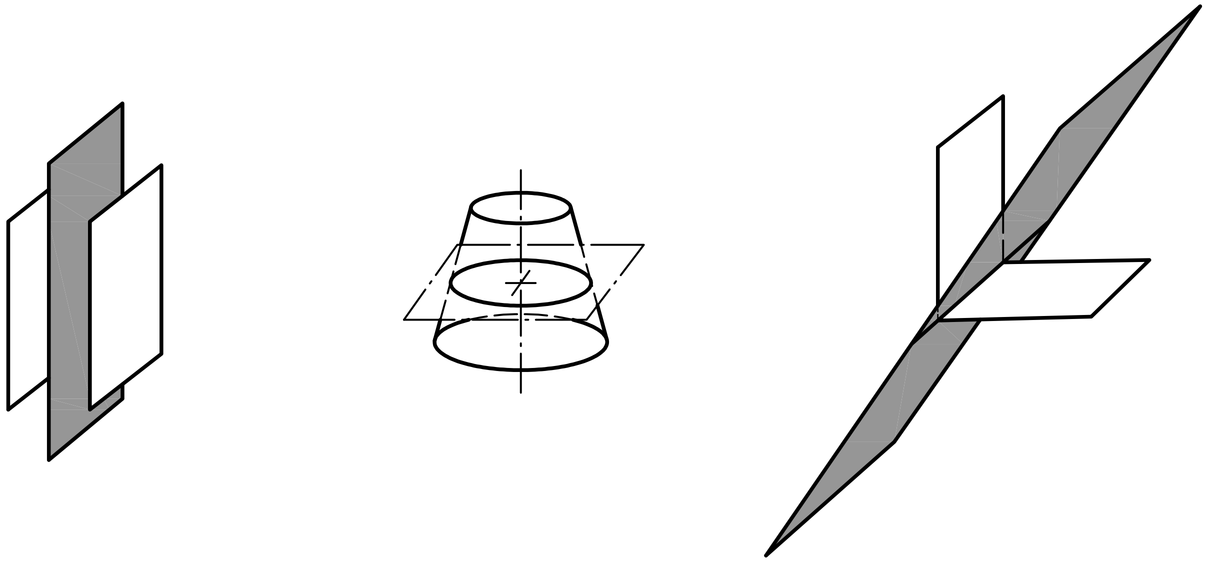
a) Situation point for a sphere **b) Situation point for a cone**

Figure 1 — Example of situation points



a) Situation straight line for a cylinder **b) Situation straight line for a cone**

Figure 2 — Example of situation straight lines



a) Situation plane for a plane pair

b) Situation plane for a cone

c) Situation plane for two non-parallel planes

Figure 3 — Examples of situation planes

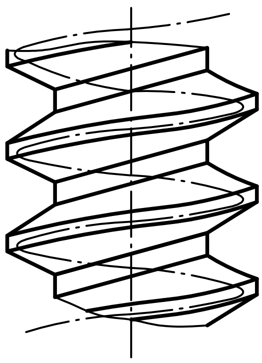


Figure 4 — Example of a situation helix

3.3.1.1.4
shape
⟨of an ideal feature⟩ mathematical generic description defining the ideal geometry of a feature

NOTE An ideal feature of preset shape can be qualified or named.

EXAMPLE 1 Planar shape, cylindrical shape, spherical shape, conical shape.

EXAMPLE 2 A surface can be qualified as a “plane surface” or be directly named “plane”.

3.3.1.2
invariance class
group of ideal features defined by the same displacement(s) of the ideal feature for which the feature is kept identical in the space

NOTE See Annex E.

3.3.1.3
type
⟨of an ideal feature⟩ name given for a set of shapes of an ideal feature

NOTE 1 See Tables 2 and 5.

NOTE 2 From a type of an ideal feature, a particular feature can be defined by giving value(s) to intrinsic characteristic(s).

NOTE 3 The type defines the parametrized equation of the ideal feature.

3.3.1.4
nature
⟨of an ideal feature⟩ property of an ideal feature to be a point, a line, a surface, or a volume or a set of these items

EXAMPLE The nature of a cylinder is a surface. The content of a sphere is a volume.

3.3.1.5
feature of size
feature of linear size or feature of angular size

3.3.1.5.1
feature of linear size
feature of size with linear size
geometrical feature, having one or more intrinsic characteristics, only one of which may be considered as a variable parameter, that additionally is a member of a "one parameter family", and obeys the monotonic containment property for that parameter

See Figure 5.

NOTE 1 A feature of size can be a sphere, a circle, two straight lines, two parallel opposite planes, a cylinder, a torus, etc. In former standards, wedges and cones were considered as features of size, and torus size was not mentioned.

NOTE 2 There are restrictions when there are more than one intrinsic characteristic (e.g. torus).

NOTE 3 A feature of size is particularly useful for the expression of material requirements, i.e. least material requirement (LMR) and maximum material requirement (MMR).

NOTE 4 In Figure 5, the diameter of the sphere is an example of a size of a feature of linear size; the geometrical feature used to establish the feature of size is its skeleton feature. In the case of the sphere, the skeleton feature is a point.

EXAMPLE 1 A single cylindrical hole or shaft is a feature of linear size. Its linear size is its diameter.

EXAMPLE 2 A compound feature consisting of two single parallel planes such as a groove or a key is a feature of linear size. Its linear size is its width.