DRAFT AMENDMENT

ISO 14405-1.2:2010/DAM 1

ISO/TC **213**

Secretariat: **DS**

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2014-01-21

Geometrical product specifications (GPS) — Dimensional tolerancing —

Part 1:
Linear sizes

AMENDMENT 1

Spécification géométrique des produits (GPS) — Tolérancement dimensionnel —

Partie 1: Tailles linéaires

AMENDEMENT 1

ICS: 17.040.10

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Reference number
ISO 14405-1.2:2010(E)/DAM 1

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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 14405-1 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specification and verification*.

This second edition cancels and replaces the first edition (ISO 14405-1:2010), clause 1, subclauses 3.1, 3.6, 3.11, 3.13, 5.3, 6.1, 6.2, 7.3, 7.8, tables 1 and 2 and figure(s) 3, 4, 9, 11, 12, 17, B.1 which have been technically revised. Clause 8, Figure 29, Annexes D and E have been added.

ISO 14405 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Dimensional tolerancing*:

— *Part 1: Linear sizes*

— *Part 2: Dimensions other than linear sizes*

— *Part 3: Angular sizes*

Introduction

This part of ISO 14405 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain links 1 to 3 of the chain of standards on size.

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 of the relation of this part of ISO 14405 to other standards and the GPS matrix model, see Annex F.

Produced workpieces exhibit deviations from the ideal geometric form. The real value of the dimension of a feature of size is dependent on the form deviations and on the specific type of size applied.

The type of size to be applied to a feature of size depends on the function of the workpiece.

The type of size can be indicated on the drawing by a specification modifier for controlling the feature definition and evaluation method to be used.

Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes

Part 1:
Linear sizes

IMPORTANT — The illustrations included in this International Standard 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. 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 part of ISO 14405 establishes the default specification operator for linear size and defines a number of special specification operators for linear size for features of size e.g. "cylinder", "sphere", "torus", "circle", "two parallel opposite planes", or "two parallel opposite straight lines".

It also defines the specification modifiers and the drawing indications for these linear sizes.

This part of ISO 14405 covers the following linear sizes:

- local size;
  - two-point size;
  - spherical size;
  - least material outer size;
  - section size;
  - portion size;
- global size;
  - direct global linear size;
    - least-squares size;
    - maximum inscribed size;
    - minimum circumscribed size;
    - minmax size;
  - indirect global linear size;
- calculated size;

- circumference diameter;
- area diameter;
- volume diameter;

— rank-order size;

- maximum size;
- minimum size;
- average size;
- median size;
- mid-range size;
- range size;
- quadratic range of sizes.

This part of ISO 14405 defines tolerances of linear sizes when there is:

— a + and/or – limit deviation (e.g. 0/–0,019) (see Figure 9);

— an upper limit of size (ULS) and/or lower limit of size (LLS) (e.g. 15,2 max., 12 min. or 30,2/30,181) (see Figure 11);

— an ISO tolerance class code in accordance with ISO 286-1 (e.g. 10 h6) (see Figure 10)

with or without modifiers (see Tables 1 and 2).

This part of ISO 14405 provides a set of tools to express several types of size characteristic. It does not present any information on the relationship between a function or a use and a size characteristic.

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 286-1:2010, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits*

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

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

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

ISO 17450-2:2012, *Geometrical product specifications (GPS) — General concepts — Part 2: Basic tenets, specifications, operators and uncertainties*

ISO 81714-1:2010, *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO 286-1, ISO 8015, ISO 14660-2, ISO 17450-1, ISO 17450-2 and the following apply.

3.1
specification modifier
GPS specification element that changes the default definition of the basic GPS specification when applied

NOTE Specification modifiers may be defined by International Standards, national standards or by company standards/documents.

[SOURCE: ISO 17450-2:2012, 3.4.2]

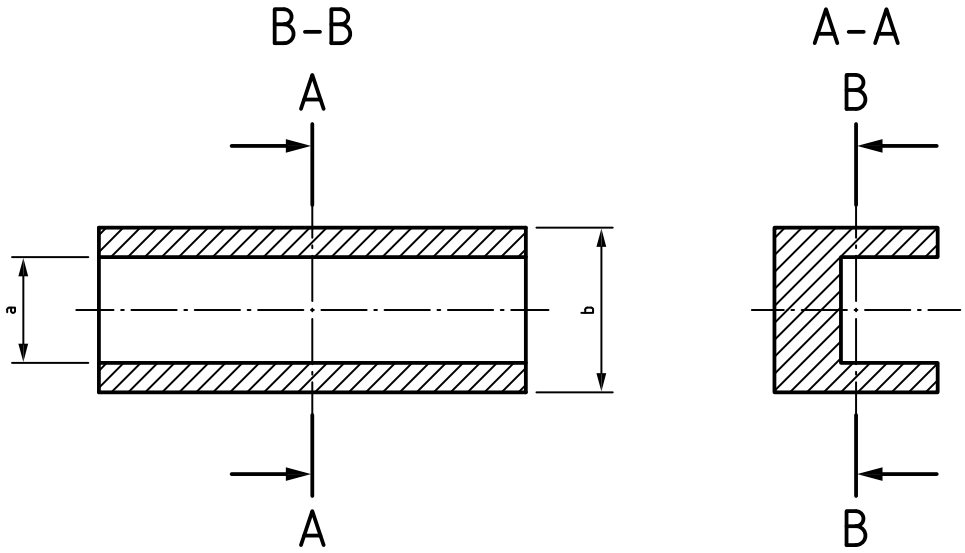
3.2
feature of size
feature of linear size or feature of angular size

[SOURCE: ISO 17450-1:2011, 3.3.1.5]

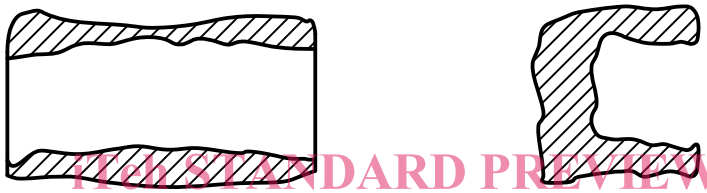
Note 1 to entry Figures 1 and 2 illustrate a feature of size, type cylinder or two parallel opposite planes..

Note 2 to entry This part of ISO 14405 only deals with features of linear size which can be a cylinder, a sphere, two parallel opposite planes, a circle (intersection of a revolute surface and a plane perpendicular to the axis of the associated surface), two parallel opposite straight lines (longitudinal section of a surface and a plane which is established symmetrically to the associated axis for a cylindrical surface or a plane perpendicular to the plane of a prismatic surface), two opposite circles (intersection of a pair of revolute surface and a plane perpendicular to the axis of the revolute surface.

Note 3 to entry Two opposite straight lines can be symmetrically established from the associated axis for a cylindrical surface or a plane perpendicular to the plane of a prismatic surface), two opposite circles (intersection of a pair of revolute surface and a plane perpendicular to the axis of the revolute surface or intersection of a collection of two single surfaces and a section feature which is a cylinder).



a) Nominal features of size (internal and external)

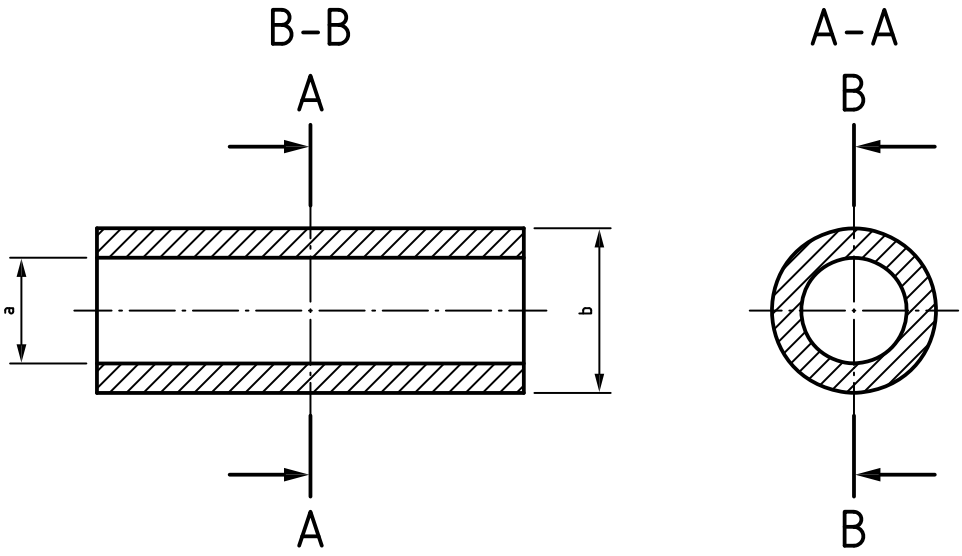


b) Extracted feature

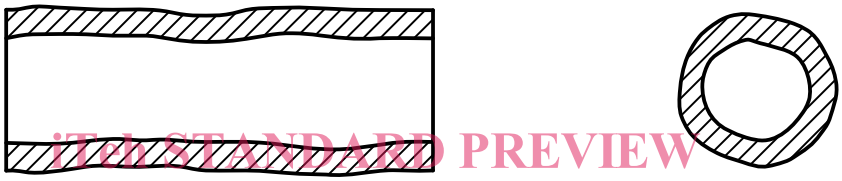
a Size of internal feature of size.

b Size of external feature of size.

Figure 1 — Feature of sizes relative to two opposite planes



a) Nominal features of size (internal and external)



b) Extracted feature

a Size of internal feature of size.

b Size of external feature of size.

Figure 2 — Example of feature of size relative to a cylinder

3.3
upper limit of size (characteristic)
ULS
largest permissible value applied to a **size characteristic** (3.9)

3.4
lower limit of size (characteristic)
LLS
smallest permissible value applied to a **size characteristic** (3.9)

3.5
default specification operator
ordered set of default specification operations only, in the default order

Note 1 to entry The default specification operator can be

— an ISO default specification operator specified by ISO International Standards, or

— a national default specification operator specified by national standards, or

— a company default specification operator specified by company standards/documents, or

— a drawing default specification operator indicated on the drawing according to one of the above.

Note 2 to entry The default specification operator applies when the ISO basic GPS specification is used on the drawing.

Note 3 to entry According to the ISO basic GPS specification for size, the tolerance is indicated by upper and/or lower deviation limits, or upper and/or lower limits of size (see Table 4), or by ISO tolerance codes in accordance with ISO 286-1 with no **specification modifiers** (3.1).

Note 4 to entry The ISO default specification operator for size is given in this part of ISO 14405 (see 5.2).

[SOURCE Adapted from ISO 17450-2:2012. The definition and note1 to entry are identical and the original second note and examples are not included here. Notes 2 to 4 to entry have been added].

3.6
drawing-specific default GPS specification operator
specification operator required by technical documentation, applicable or all basic GPS specifications of the actual drawing, and containing only default specification operations in the default order

Note 1 to entry See ISO 8015.

Note 2 to entry The drawing-specific default specification operator of size is indicated by a specific statement close to the title block (see 5.3).

3.7
special specification operator
specification operator which is required when a special GPS specification is used, including one or more special specification operations.

Note 1 to entry The special specification operator is defined by a GPS specification.

Note 2 to entry A special specification operator may be a complete specification operator or an incomplete specification operator.

Note 3 to entry A special specification operator can be established from a default operator by modifying one or more operations.

EXAMPLE 1 The specification for a shaft of ∅30 ± 0,1 Ⓔ is a special specification operator, because one of the specification operations, the association of the minimum circumscribed cylinder, is not a default specification operation.

EXAMPLE 2 The specification of *Ra* 1,5 using a 2,5 mm filter for a surface is a special specification operator, because one of the specification operations, the cut-off length used in the filtration, is not a default specification operation.

[SOURCE: ISO 17450-2:2012, 3.2.7]

3.8
size
intrinsic characteristic of a **feature of size** (3.2) that can be defined on a nominal feature or on an associated feature

Note 1 to entry In this part of ISO 14405, for example, the size corresponds to the diameter of a cylinder, or to the distance between two parallel opposite planes. Depending on the type of feature of size, the terms “diameter” and “distance” are synonyms for size.

Note 2 to entry A size is angular (e.g. angle of a cone) or linear (e.g. diameter of a cylinder). This part of ISO 14405 only deals with linear size.

Note 3 to entry One of the property of the feature of size is its unique nominal size along to it.

3.9
size characteristic
characteristic relative to a **size** (3.8) and defined from an extracted feature

See Figure B.1.

Note 1 to entry A size can be evaluated by more than one size characteristic (e.g. the two-point diameter or the diameter of the associated feature, taken on the extracted feature).

3.10
local size
local linear size
local size characteristic
local linear size characteristic
size characteristic (3.9) having by definition a non-unique result of evaluation along and/or around the **feature of size** (3.2)

Note 1 to entry For a given feature, an infinity of local sizes exists.

Note 2 to entry In this part of ISO 14405, “local size” is used instead of “local linear size”.

Note 3 to entry In Figure 3, examples of local size are shown. These examples do not take into account the **rank-order size** (3.11.2.2).

Note 4 to entry Elementary type of size characteristic are defined in Annex E.

3.10.1
two-point size
⟨local size⟩ distance between two opposite points taken on the **feature of size** (3.2)

Note 1 to entry A two-point size taken on cylinder can be called a “two-point diameter”. In ISO 14660-2, this is defined as a local diameter of an extracted cylinder.

Note 2 to entry A two-point size taken on two opposite planes can be called a “two-point distance”. In ISO 14660-2, this is defined as a local size of two parallel extracted surfaces.

Note 3 to entry

3.10.2
section size
global size (3.11) for a given cross section of the extracted feature

Note 1 to entry A section size is a **local size** (3.10) for the complete toleranced **feature of size** (3.2).

Note 2 to entry The cross section is defined with the same criterion as the one taken to define the **direct global size** (3.11.1).

Note 3 to entry On an extracted feature that corresponds to a cylinder, it is possible to define an infinite number of cross sections in which the diameter of the associated circle can be defined (with a specific association criterion). This is a section size.

3.10.3
portion size
global size (3.11) for a given portion of the extracted feature

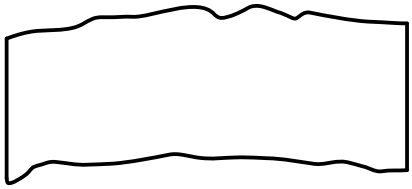
Note 1 to entry A portion size is a **local size** (3.10) for the complete toleranced **feature of size** (3.2).

3.10.4
spherical size
⟨local size⟩ diameter of the maximum inscribed sphere

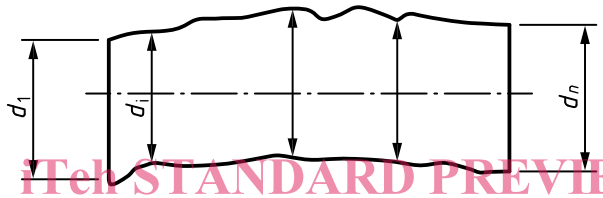
See Figure 3 c).

3.10.5
least outer material size
⟨local size⟩ distance between one point taken on the **feature of size** (3.2), and another point of it belonging to its opposite side obtained by maximizing the distance for internal feature of size (hole) or by minimizing the distance for an external feature of size (shaft)

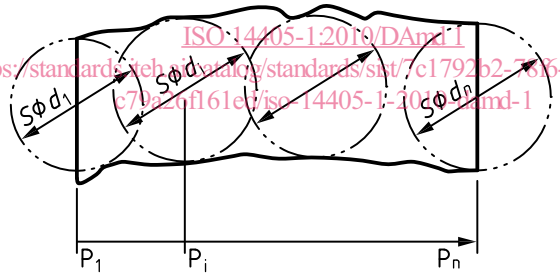
See Figure 3 f).



a) Extracted feature under consideration which could be either an internal or external feature and either a cylinder or two opposite planes



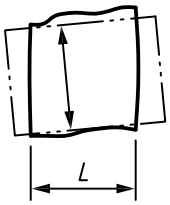
b) Two-point sizes – Extracted median line or surface (see ISO 14660-2)



c) Spherical sizes

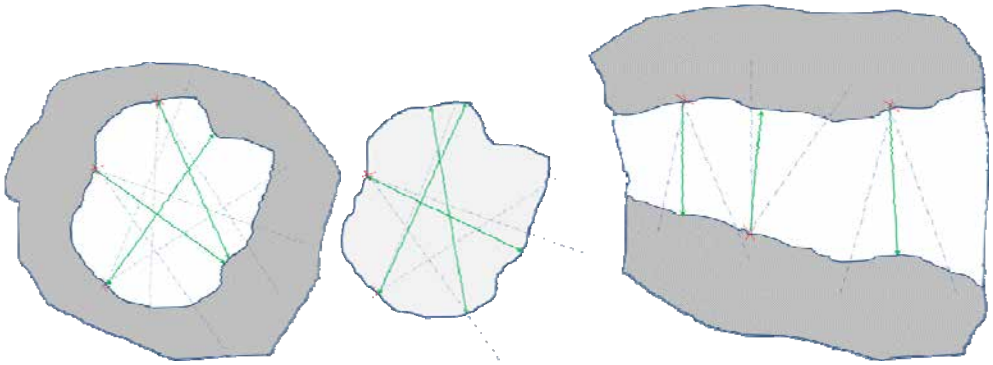
NOTE Any section size is given by the diameter of maximum inscribed circle defined in the corresponding cross section"

d) Section size obtained from a direct global size with maximum inscribed criterion (other criteria are possible)



NOTE Only a portion of the extracted feature of length L is considered.

e) Portion size from a direct global size with maximum inscribed criterion (other criteria are possible)



f) Size characteristic obtained from two spheres in contact with the feature of size by optimization in the space in two perpendicular directions of the dimension of the size itself

Key

d	size [in Figure 3 b)]
L	considered length of the portion of the cylinder
P	position
$S\varnothing d$	diameter of the maximum inscribed sphere

Figure 3 — Examples of local size

3.11
global size
global linear size
global size characteristic
global linear size characteristic
size characteristic (3.9) having by definition a unique result of evaluation along and around the toleranced **feature of size** (3.2)

3.11.1
direct global size
direct global linear size
direct global size characteristic
direct global linear size characteristic
global size (3.11) equals to the size of the associated feature, which is of the same geometrical type as the **feature of size** (3.2)

Note 1 to entry The different direct global linear sizes on the complete toleranced feature are given in Figure 4.

Note 2 to entry Different criteria may be used for this operation of association, and different results are obtained depending on the criterion chosen. The association criteria described in this part of ISO 14405 are total least-squares, maximum inscribed, minimum circumscribed and minmax criteria.

3.11.1.1
least-squares size
direct global size (3.11) for which the associated feature is established from the extracted feature(s) with the total least-squares criterion

Note 1 to entry In this part of ISO 14405, “total least-squares” is referred to only as “least-squares”. It minimizes the sum of the square of distances existing between the associated feature and the extracted feature with variation of its size, its location and its orientation.