INTERNATIONAL STANDARD

ISO
14405-1

Geometrical product specifications (GPS) — Dimensional tolerancing —

Part 1:
Linear sizes

Spécification géométrique des produits (GPS) — Tolérancement dimensionnel —

Partie 1: Tailles linéaires

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Foreword

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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 specifications and verification*.

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

— *Part 1: Linear sizes*

— *Part 2: Dimensions other than linear 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 D.

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.

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Geometrical product specifications (GPS) — Dimensional tolerancing —

Part 1:
Linear sizes

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 feature of size types "cylinder" and "two parallel opposite planes". 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;

  — section size;

  — portion size;

— global size;

  — direct global linear size;

    — least-squares size;

    — maximum inscribed size;

    — minimum circumscribed 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.

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:—[1], *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

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:—[2], *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 17450-2:—[3], *Geometrical product specifications (GPS) — General concepts — Part 2: Basic tenets, specifications, operators and uncertainties*

ISO 81714-1:—[4], *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

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1) To be published. (Revision of ISO 8015:1985)

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

3) To be published. (Revision of ISO/TS 17450-2:2002)

4) To be published. (Revision of ISO 81714-1:1999)

3 Terms and definitions

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

[ISO 17450-2:—, 3.5.2]

3.2
feature of size
geometrical shape defined by a linear or angular dimension which is a **size** (3.8)

NOTE 1   The features of size can be a cylinder, a sphere, two parallel opposite surfaces, a cone or a wedge.

NOTE 2   In International Standards such as ISO 286-1 and ISO/R 1938, the meanings of the terms "plain workpiece" and "single features" are close to that of "feature of size".
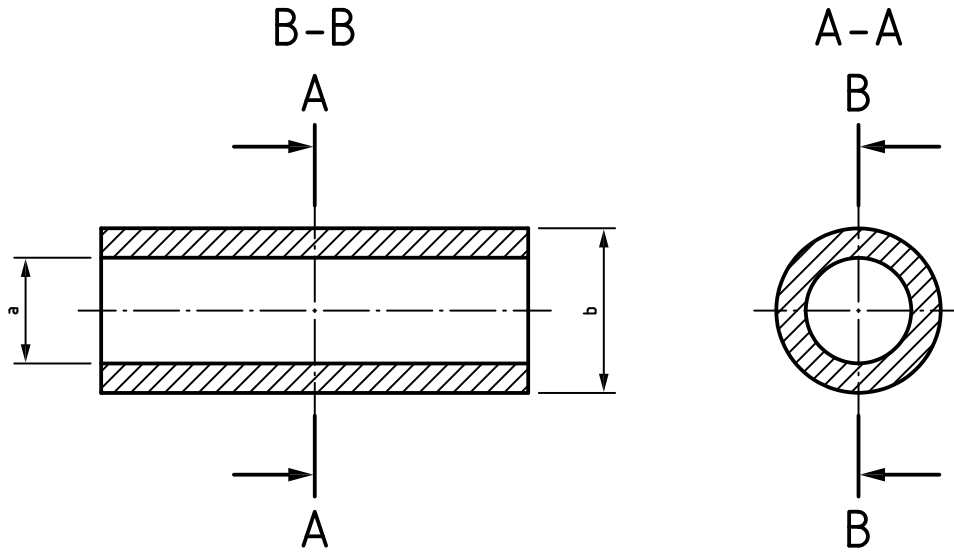
[ISO 14660-1:1999, 2.2]

NOTE 3   The types of feature of size covered by this part of ISO 14405 are given in Figures 1 and 2.
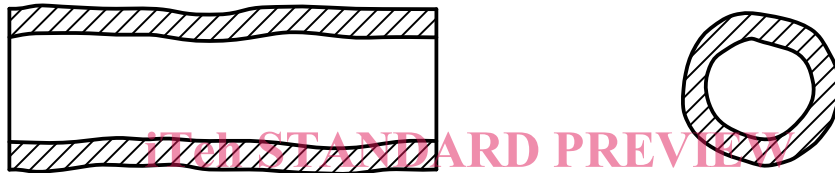

a) Nominal features of size (internal and external)

b) Extracted feature
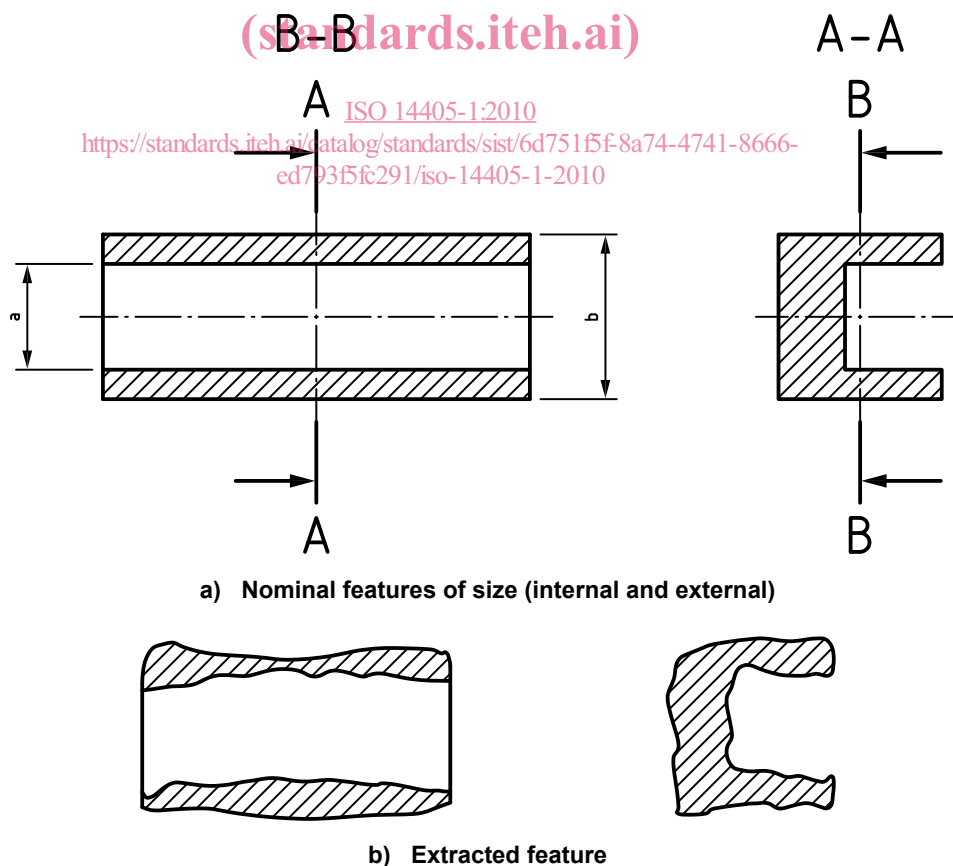
ᵃ   Size of internal feature of size.

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
ULS
largest permissible size of a **feature of size** (3.2)

[ISO 286-1:2010, 3.2.3.1]

3.4
lower limit of size
LLS
smallest permissible size of a **feature of size** (3.2)

[ISO 286-1:2010, 3.2.3.2]

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

NOTE 1   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   The default specification operator applies when the ISO basic GPS specification is used on the drawing.

NOTE 3   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   The ISO default specification operator for size is given in this part of ISO 14405 (see 5.2).

NOTE 5   Adapted from ISO 17450-2:—. The definition and first note are identical and the original second note and examples are not included here. Notes 2 to 4 have been added.

3.6
drawing-specific default GPS specification operator
specification operator required by technical documentation, applicable only for the actual specification and containing only default specification operations in the default order

NOTE 1   See ISO 8015.

NOTE 2   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 including one or more special specification operations

NOTE 1   The special specification operator is defined by a GPS specification.

NOTE 2   A special specification operator may be a complete specification operator or an incomplete specification operator.

EXAMPLE 1   The specification for a shaft of $\varnothing 30 \pm 0,1$ Ⓔ 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.

[ISO 17450-2:—, 3.3.7]

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   In this part of ISO 14405, 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   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.

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

See Figure B.1.

NOTE   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   For a given feature, an infinity of local sizes exists.

NOTE 2   In this part of ISO 14405, "local size" is used instead of "local linear size".

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

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

NOTE 1   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   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.

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

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

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

NOTE 3   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   A portion size is a **local size** (3.10) for the complete toleranced **feature of size** (3.2).
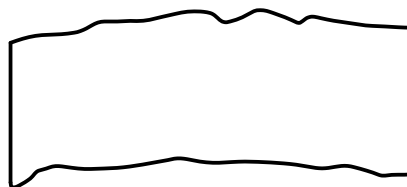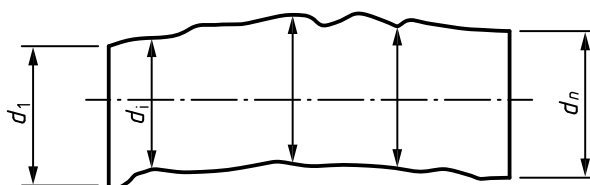
3.10.4
spherical size
⟨local size⟩ diameter of the maximum inscribed sphere

NOTE   This local size, defined by a sphere, applies to the feature of size types "cylinder" and "two parallel opposite planes".
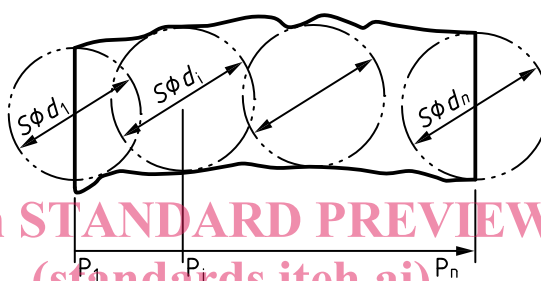
See Figure 3 c).

a) Extracted feature under consideration which could be either an internal or external feature and either a cylinder or two opposite planes
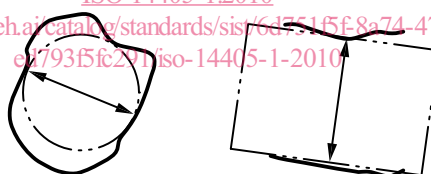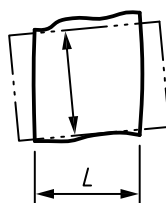
b) Two-point size

c) Spherical size

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)

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