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Geometrical product specifications (GPS) — Dimensional tolerancing —

Part 3: Angular sizes

Spécification géométrique des produits (GPS) — Tolérancement dimensionnel —

Partie 3: Tailles angulaires

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.

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).

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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.

The committee responsible for this document is 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*

— *Part 3: Angular sizes*

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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 14638). In the general GPS matrix, it influences chain links “Symbols and indications”, “Feature requirements” and “Feature properties” of the size chain of standards.

The ISO/GPS Masterplan given in ISO 14638 gives an overview of the ISO/GPS system of which this part of ISO 14405 is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this part of ISO 14405 and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this part of ISO 14405, unless otherwise indicated.

For more detailed information on the relation of this part of ISO 14405 to other standards and to the GPS matrix model, see Annex D.

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Geometrical product specifications (GPS) — Dimensional tolerancing —

Part 3: Angular sizes

1 Scope

This part of ISO 14405 establishes the default specification operator for angular size and defines a number of special specification operators for features of angular size: cone (truncated, i.e. frustum, or not), wedge (truncated or not), two opposite straight lines (intersection of a wedge/truncated wedge and a plane perpendicular to the intersection straight line of the two planes of the wedge/truncated wedge, intersection of a cone/frustum and a plane containing the axis of revolution of the cone/frustum). See Figure 1 and Figure 2.

This part of ISO 14405 also defines the specification modifiers and the drawing indications for these angular sizes.

This part of ISO 14405 covers the following angular sizes:

- local angular size:
  - angular size between two lines;
  - portion angular size;
- global angular size:
  - direct global angular size:
    - least squares angular size;
    - minimax angular size;
  - rank order angular size/indirect global angular size:
    - maximum angular size;
    - minimum angular size;
    - average angular size;
    - range of angular sizes;
    - mid-range angular size;
    - median angular size;
    - standard deviation of angular size.

This part of ISO 14405 defines the meaning of tolerances of angular sizes indicated as

- + and/or - limit deviations, e.g. 0°/-0,5°, or
- indicated with upper limit of size (ULS) and/or lower limit of size (LLS), e.g. 35° max. or 15° min., 34°/36°,

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— with or without modifiers.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 17450-1, *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 specification (GPS) — General concepts — Part 3: Toleranced Features*

ISO 14405-1:2016, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO 14405-2, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 2: Dimensions other than linear sizes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8015, ISO 17450-1, ISO 17450-2, ISO 17450-3, ISO 14405-1, ISO 14405-2 and the following apply.

For association criteria, it is assumed that the terms “least squares” and “Gaussian” are equivalent, as well as “minimax” and “Chebyshev”. In this document, the terms “least squares” and “minimax” are retained. The least squares criterion is understood without material constraint throughout this part of ISO 14405.

3.1
angular size
angular dimension of a cone or between two coplanar opposite straight lines or between two opposite non parallel planes

Note 1 to entry: The angular size is defined from nominal features or from associated features which are angular features of size.

Note 2 to entry: See example of angular size on Figure 1 and Figure 2.

Note 3 to entry: Definition of “angular feature of size (feature of angular size)” is given in ISO 17450-1, the angle dimension cannot be 0° or 180°.

Note 4 to entry: Angular features of size are of two types.

— Revolute angular feature of size: a cone or a frustum. Two opposite straight lines are established from a longitudinal section of a cone/frustum with a plane containing the associated axis of revolution of the cone/frustum.

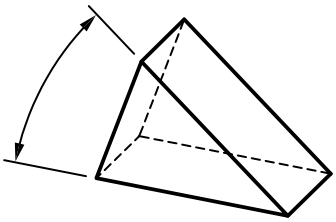
— Prismatic angular feature of size: a wedge (truncated or not). Two opposite straight lines are established from a cross section of a wedge/truncated wedge with a plane perpendicular to the intersection straight line of the two associated planes of the wedge/truncated wedge.

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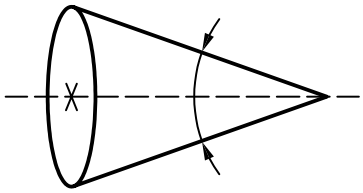
Note 5 to entry: Figure 1 and Figure 2 illustrate angular features of size type wedge, cone, frustum and two lines.

Note 6 to entry: Figure 3a and Figure 3b illustrate the case of an angular feature of size and an angular distance between two planes which is not an angular feature of size and shows that an angular feature of size exists when the material directions are opposed (when one of the features is rotated around their intersection line to coincide with the other feature, then the material is on the opposite sides for the two features). See also Annex B.

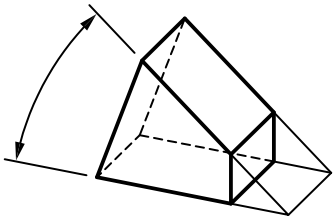
Note 7 to entry: Envelope requirement cannot be applied for angular features of size.



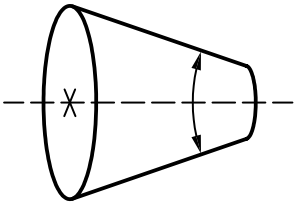
a) Wedge



b) Cone

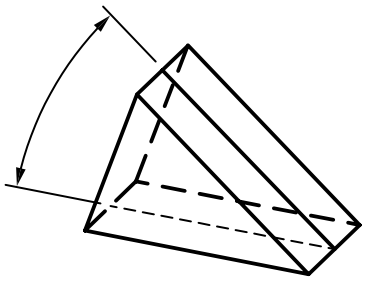


c) Truncated wedge

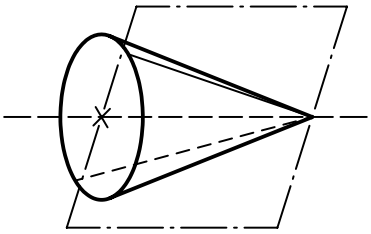


d) Frustum

Figure 1 — Examples of areal angular features of size



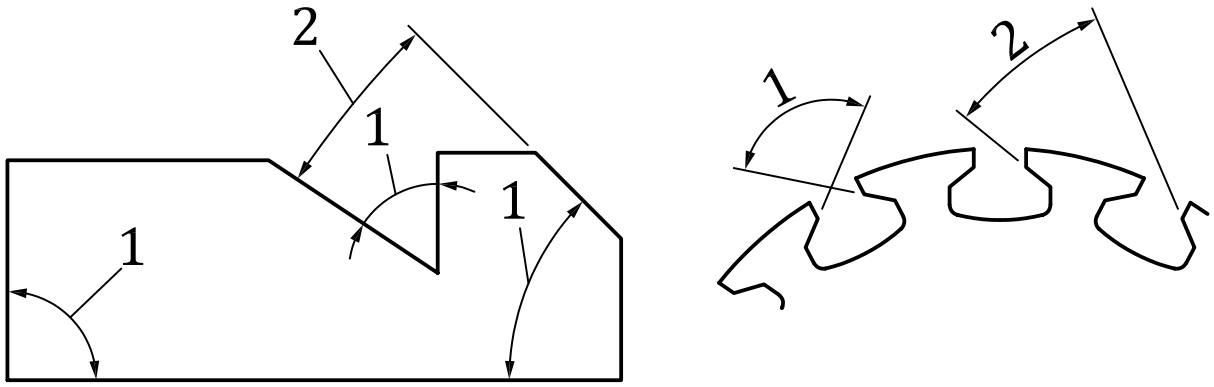
a) Two opposite lines of a wedge



b) Two opposite generatrix lines of a cone

Figure 2 — Examples of angular features of size

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a) Example # 1 **b) Example # 2**

Key

1 Feature of angular size

2 Non-feature of angular size

Figure 3 — Examples of possible angular features of size

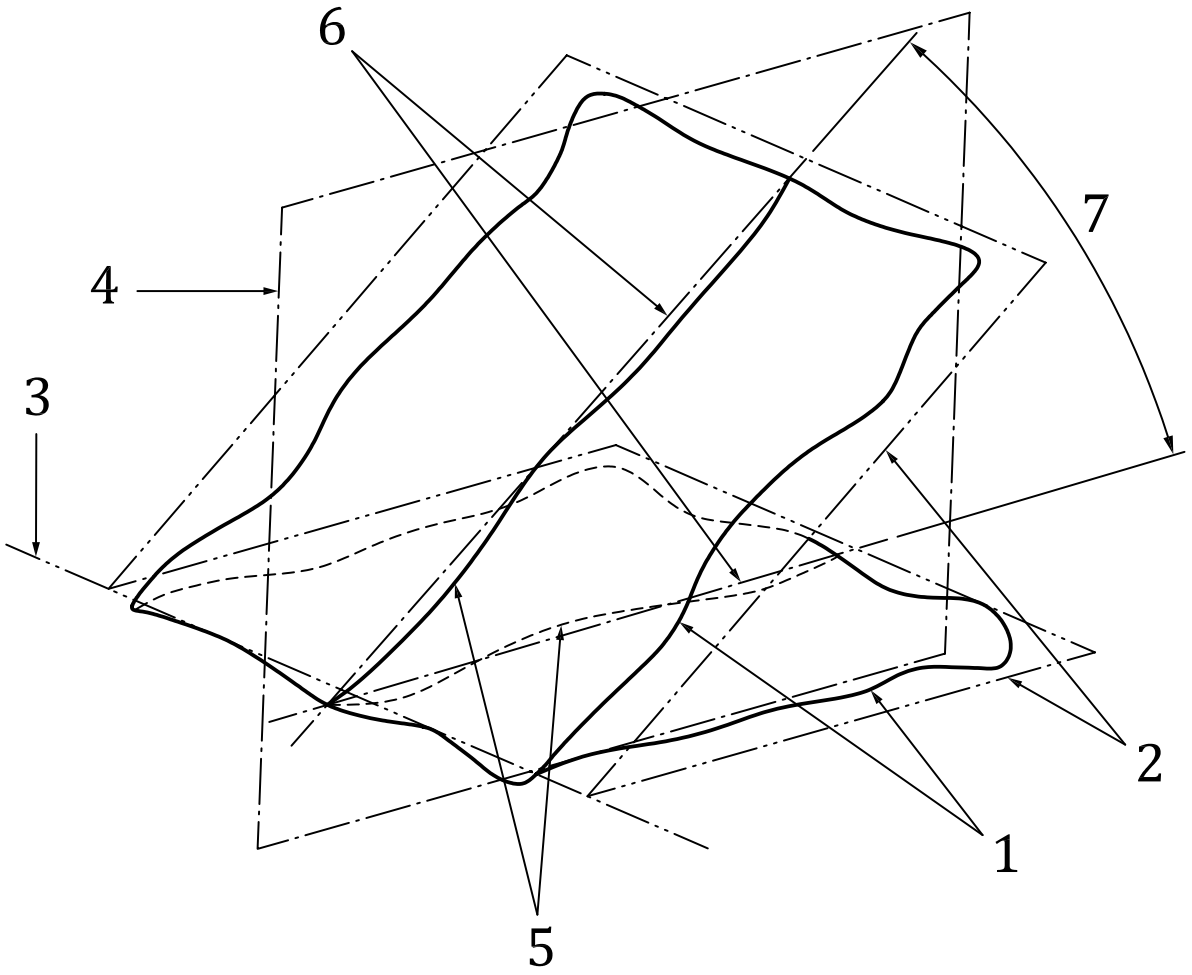
3.2
local angular size
local angular size characteristic
angular size characteristic having a unique value for a specific location and a non-unique value along and/or around the angular feature of size

Note 1 to entry: For a given feature, an infinite number of local angular sizes exists.

Note 2 to entry: In Figure 4, an example of local angular size is shown.

Note 3 to entry: Two local angular size associations can be specified: least squares local angular size and minimax local angular size. See Annex A.

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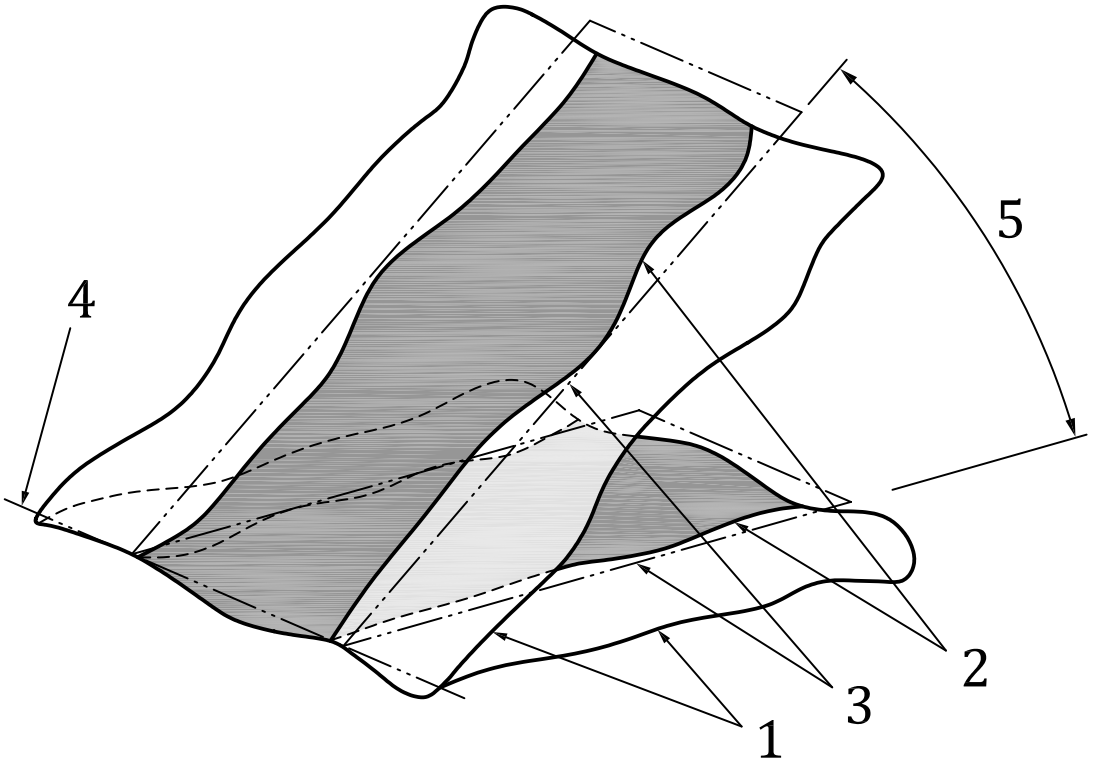


Key

1 real angular feature of size
2 associated planes with (1)
3 intersection straight line of (2)
4 perpendicular cross section to (3)
5 two extracted lines
6 two associated straight lines
7 two-line angular size

Figure 4 — Two-line angular size

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Key

1 real angular feature of size
2 portion of (1)
3 associated planes with (2)
4 intersection straight line of (3)
5 portion angular size

Figure 5 — Portion angular size

3.2.1
two-line angular size
local angular size between two lines
angle between two associated straight lines established from two extracted lines obtained from the intersection with an intersection plane defined from the associated angular feature of size

Note 1 to entry: See Figure 4.

Note 2 to entry: The process for establishing the two-line angular size depends on the invariance class of the feature: revolute surface or prismatic surface.

Note 3 to entry: The default specification operator defining the two-line angular size is described in Annex A.

3.2.1.1
two-line revolute angular size
two-line angular size (3.2.1) where the straight lines are associated with two extracted lines resulting from the intersection of an extracted revolute feature with a plane containing its associated axis

Note 1 to entry: The axis of the associated revolute feature is the "directly associated median line" described in ISO 22432:2011, 3.5.1.2.4.

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3.2.1.2
two-line prismatic angular size
two-line angular size (3.2.1) where the straight lines are associated with two extracted lines resulting from the intersection of two extracted surfaces with a plane perpendicular to their associated straight line of intersection

3.2.2
portion angular size
global angular size (3.3) for a given portion of the extracted angular feature of size

Note 1 to entry: A portion angular size is a local angular size when taking into account the complete angular feature of size and a global angular size when taking into account only the specific portion.

Note 2 to entry: See Figure 5.

Note 3 to entry: A portion angular size can be a *direct global angular size* (3.3.1) or an *indirect global angular size* (3.3.2).

Note 4 to entry: The operator for defining a portion is not covered by this part of ISO 14405.

3.3
global angular size
global angular size characteristic
angular size characteristic having one unique value for the entire toleranced angular feature of size

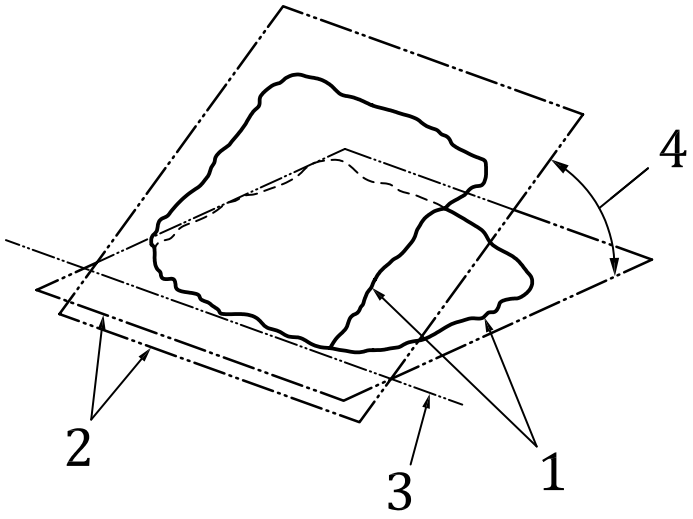
3.3.1
direct global angular size
direct global angular size characteristic
global angular size defined from one association on the angular feature of size

Note 1 to entry: If the angular feature of size is a cone, the associated feature is a cone. If the angular feature of size is a wedge, the associated features are a pair of planes. One plane is associated independently to each side of the wedge.

Note 2 to entry: See Figure 6.

Note 3 to entry: Different association criteria lead to different results. The association criteria described in this part of ISO 14405 are the least squares criterion and minimax criterion.

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Key

1 real angular features of size
2 associated planes with (1)
3 intersection straight line of (2)
4 direct global angular size defined in a plane perpendicular to the intersection straight line

Figure 6 — Direct global angular sizes

3.3.1.1
least squares global angular size
direct global angular size using the least squares association criterion

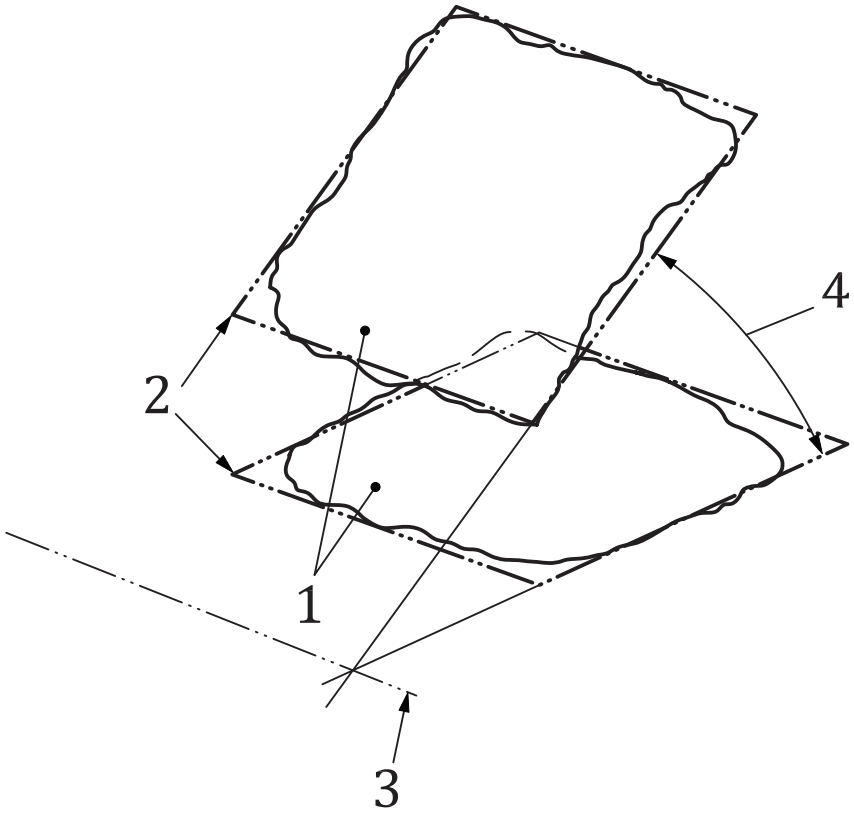
Note 1 to entry: See Figure 7 and Figure 9.

3.3.1.2
minimax global angular size
direct global angular size using the minimax association criterion

Note 1 to entry: See Figure 8 and Figure 10.

Note 2 to entry: Figure 7 to Figure 10 are the illustrations of two global angular sizes defined on the same real angular feature of size.

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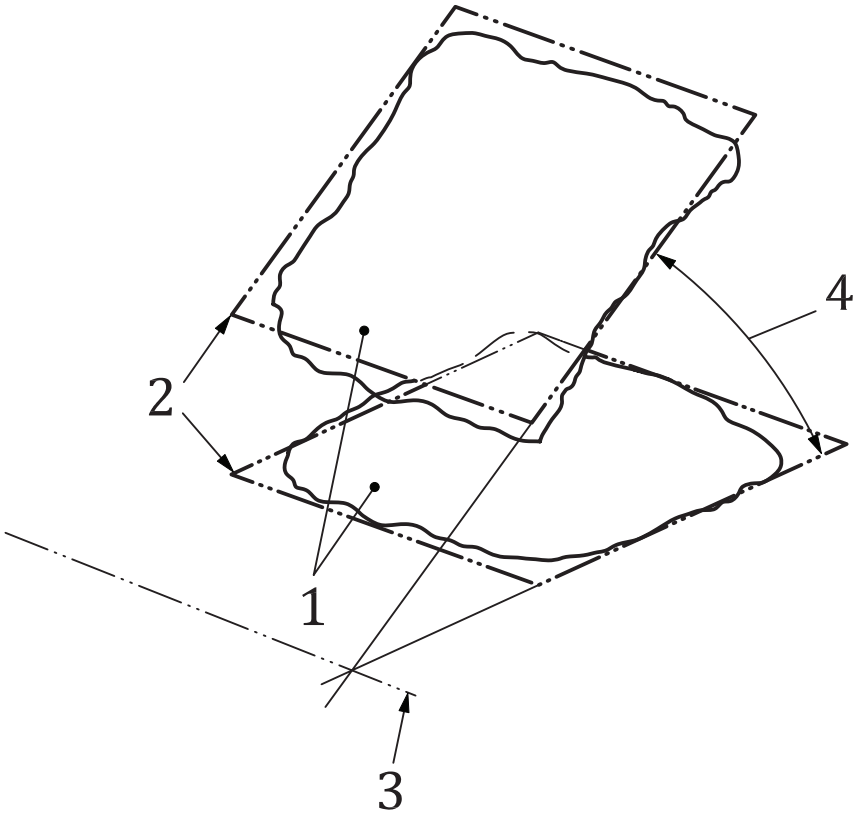


Key

1 real angular features of size
2 associated planes with (1)
3 intersection straight line of (2)
4 least squares global angular size

Figure 7 — Least squares global angular size 3D view

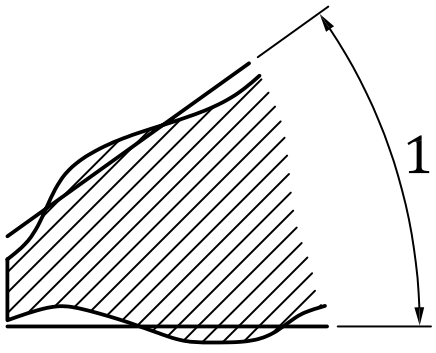
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Key

1 real angular features of size
2 associated planes with (1)
3 intersection straight line of (2)
4 minimax global angular size

Figure 8 — Minimax global angular size 3D view

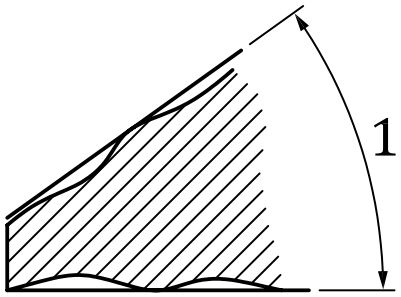


Key

1 least squares global angular size

Figure 9 — Least squares global angular size 2D view

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Key

1 minimax global angular size

Figure 10 — Minimax global angular size 2D view

3.3.2
indirect global angular size
indirect global angular size characteristic
rank-order angular size
rank order angular size characteristic
global angular size defined mathematically from a homogeneous set of local size values obtained along and/or around the angular feature of size

Note 1 to entry: A rank-order angular size can define a unique value along and/or around the angular feature of size from a local angular size for a portion or for the entire angular feature of size.

Note 2 to entry: A rank-order angular size can define a local angular size from another local angular size (for example a rank order angular size from a two-line angular size taken in any portion).

Note 3 to entry: For further details on the subtypes of rank order size, see ISO 14405-1.

Note 4 to entry: A rank-order angular size can be, for example, the average of all two-line angular size values on an extracted conical surface.

4 Specification modifiers and symbols

For the purposes of this part of ISO 14405, the specification modifiers and symbols given in Table 1 and Table 2 apply. To define in a dimensional specification a specific type of angular size characteristic available for upper and/or lower limit specification, modifiers or symbols shall be used in the sequence given in Table 3 (see also Annex C).

The combination of these modifiers and symbols is described in Clause 5 and Clause 6.

Rules for the presentation of graphical symbols are given in ISO 14405-1:2016, Annex A and Annex E.

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