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Geometrical product specifications (GPS) — Basic concepts —

Part 4: Geometrical characteristics for quantifying GPS deviations

Spécification géométrique des produits (GPS) — Concepts généraux —
Partie 4: Caractéristiques géométriques pour la quantification des écarts GPS

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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This document was prepared by Technical Committee is ISO/TC 213, *Dimensional and geometrical product specifications and verification*, in collaboration with Technical Committee CEN/TC 290, *Dimensional and geometrical product specification and verification*.

A list of all parts in the ISO 17450 series can be found on the ISO website.

Introduction

This document is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). The rules and principles given in this document apply to all segments of the ISO GPS matrix which are indicated with a filled dot (•).

The ISO/GPS matrix model 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 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 document to other standards and to the GPS matrix model, see Annex A.

Geometrical product specifications (GPS) — Basic concepts —

Part 4: Geometrical characteristics for quantifying GPS deviations

1 Scope

This document specifies general rules for quantifying GPS deviations for individual GPS characteristics.

NOTE GPS deviations can be local or global. A GPS characteristic defined from local GPS deviations is a parameter that transforms the set of local deviations into a global characteristic using a quantifying function (for more details, see Table 1).

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 25378, *Geometrical product specifications (GPS) — Characteristics and conditions — Definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in 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
local geometrical deviation
$d(P), d(P)_{A_n}$

local signed distance between a point, *P*, of an input feature and a point of the reference feature

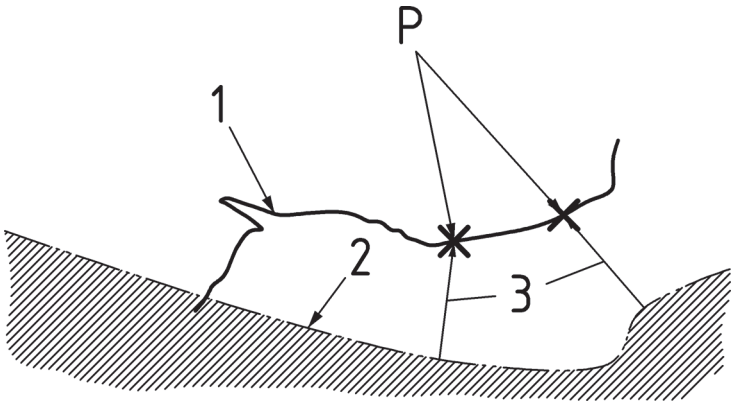
Note 1 to entry: $d(P)$ identifies any local geometrical deviation attached to any point (P) of the input feature.

Note 2 to entry: A local geometrical deviation, $d(P)_{A_n}$, can be located in an n-dimensional reference space, A_n, attached to the reference feature.

Note 3 to entry: A local geometrical deviation exists in any point of the input feature (see Figure 1). Each local geometrical deviation of a point of the input feature can be represented in a reference space, A_n, by the abscises of its corresponding point of the reference feature and by the ordinate corresponding to the local geometrical deviation.

Note 4 to entry: A local geometrical deviation can be described as an ordinate of a point of the variation curve whose abscises are defined in the reference space, A_n.

Note 5 to entry: A local geometrical deviation is equal to zero when the deviated feature crosses the reference feature.



Key

1 deviated feature (input feature)
2 reference feature
3 local geometrical deviation
P point of key 1 from which key 3 is defined

Figure 1 — Local geometrical deviation

3.2
reference space
A_n
space defined by *n* curvilinear axes attached to a reference feature in which for each point of an input feature a local deviation is defined

Note 1 to entry: *n* is equal to 1 for a reference line, or equal to 2 for a reference surface.

3.2.1
areal reference space
A_2
reference space (3.2) when the reference feature is a surface

Note 1 to entry: Reference space for a two-dimensional reference feature.

3.2.2
linear reference space
A_1
reference space (3.2) when the reference feature is a line

Note 1 to entry: Reference space for a one-dimensional reference feature.

3.2.3
two-directional reference space
combination of two *linear reference spaces* (3.2.2) of the same linear reference feature whose vectors normal to any point *P* of the reference feature are orthogonal

3.3
quantifying function
mathematical function using the complete set of local deviations to define a geometrical characteristic as a quantity

Note 1 to entry: A quantifying function can be a *rank-order characteristic* (3.4) (see Table 1).

3.4
rank-order characteristic
geometrical characteristic defined mathematically from a set of local geometrical deviations

Note 1 to entry: A rank-order characteristic is defined from a quantifying function. Several kinds of rank-order characteristics exist. The formulae describing them are given in Table 1.

3.4.1
maximum
characteristic maximum value of a set of local geometrical deviations

Note 1 to entry: See Table 1.

3.4.2
minimum
characteristic minimum value of a set of local geometrical deviations

Note 1 to entry: See Table 1.

3.4.3
average
characteristic average of a set of local geometrical deviations

Note 1 to entry: See Table 1.

3.4.4
median
characteristic median value of a set of local geometrical deviations

Note 1 to entry: The median value splits the population of local geometrical deviations into two equal portions (50 % above and 50 % below). Depending on the distribution of the population, the median value and the average value can be identical or different.

Note 2 to entry: See Table 1.

3.4.5
mid-range
characteristic mean of the *maximum* (3.4.1) and the *minimum* (3.4.2)

Note 1 to entry: See Table 1.

3.4.6
range
characteristic difference between the *maximum* (3.4.1) and the *minimum* (3.4.2)

Note 1 to entry: See Table 1.

3.4.7
maximum absolute deviation
characteristic maximum of absolute values of the *maximum* (3.4.1) and the *minimum* (3.4.2)

Note 1 to entry: See Table 1.

4 Geometrical characteristic

4.1 General

Several families of geometrical characteristics, as defined in ISO 25378, exist:

— intrinsic characteristic: size, form or surface texture characteristics;

— situation characteristics: location, orientation and run-out characteristics.

The specified associated feature to the input feature is the reference feature for a geometrical characteristic (see Figure 2).

NOTE 1 The reference feature is an associated feature. For more information, see ISO 5459.

NOTE 2 It is assumed that the reference feature has the extent necessary for all points on the input feature to have a corresponding point on the reference feature. In some cases, this requires a mathematical extension of the reference feature. The rules for this extension are not given in this document; they are in the standards for specific GPS characteristics.

The reference feature, to evaluate an intrinsic characteristic (size, form or surface texture characteristics), is unrelated to a datum system.

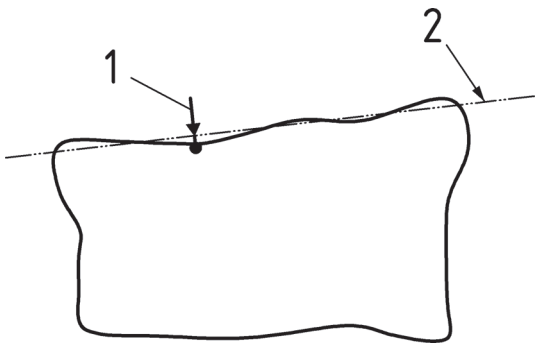
The reference feature, to evaluate a situation characteristic, is related to a datum system (defining orientation or location constraint).

The reference features can be

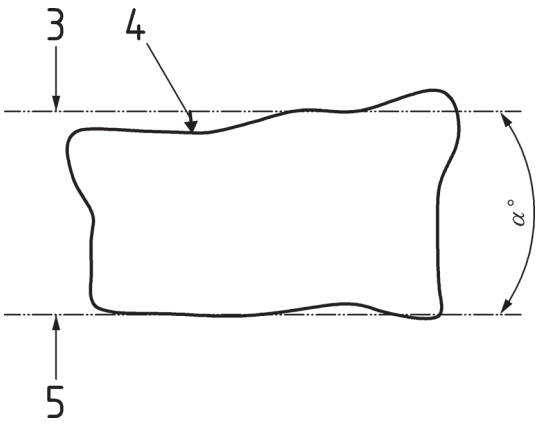
— totally constrained, where all non-redundant degrees of freedom are constrained, or

— partially constrained, where not all non-redundant degrees of freedom are constrained.

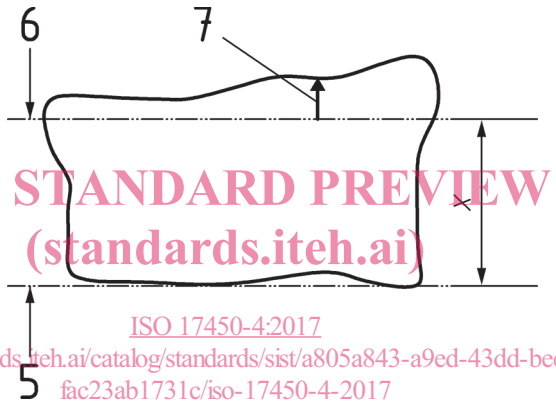
For a geometrical characteristic of form, orientation, location or run-out, the shape of the reference feature is by default the nominal shape of the toleranced feature. When the nominal shape of the toleranced feature belongs to a prismatic, or complex invariance class, then its definition is restricted to its nominal extent. To define any deviation from the reference feature, it is necessary to have a non-restricted definition of the reference feature. The extension of the reference feature compared to its nominal shape is defined by default as the continuity of the nominal shape curvature.



a) Without constraint (form deviation)



b) With orientation constraint (orientation deviation)



c) With location constraint (location deviation)

Key

1 local geometrical form deviation
2 reference feature unrelated to a datum system
3 reference feature, related to a datum system with orientation constraint (α°)
4 local geometrical orientation deviation
5 datum
6 reference feature related to a datum system with location constraint (X mm)
7 local geometrical location deviation

Figure 2 — Examples of reference features with different constraints for the same input feature

4.2 Types of geometrical characteristic

The local geometrical deviations are the basic elements used to establish a geometrical characteristic.

By convention, the positive direction is out of the material.

The default is defined as the minimum distance from a point of the toleranced feature to the reference feature (see Figure 3).