

INTERNATIONAL STANDARD

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Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems

*Spécification géométrique des produits (GPS) — Tolérancement
géométrique — Références spécifiées et systèmes de références
spécifiées*



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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 5459 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 5459:1981), which has been technically revised.

Introduction

ISO 5459 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences the chain links 1 to 3 of the chain of standards on datums.

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

For more detailed information of the relation of this International Standard to the GPS matrix model, see Annex G.

For the definitive presentation (proportions and dimensions) of symbols for geometrical tolerancing, see ISO 7083.

The previous version of ISO 5459 dealt only with planes, cylinders and spheres being used as datums. There is a need to consider all types of surfaces, which are increasingly used in industry. The definitions of classes of surfaces as given in Annex B are exhaustive and unambiguous.

This edition of ISO 5459 applies new concepts and terms that have not been used in previous ISO GPS standards. These concepts are described in detail in ISO/TR 14638, ISO 17450-1 and ISO 17450-2; therefore, it is recommended to refer to these standards when using ISO 5459.

This International Standard provides tools to express location or orientation constraints, or both, for a tolerance zone. It does not provide information about the relationship between datums or datum systems and functional requirements or applications.

Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems

1 Scope

This International Standard specifies terminology, rules and methodology for the indication and understanding of datums and datum systems in technical product documentation. This International Standard also provides explanations to assist the user in understanding the concepts involved.

This International Standard defines the specification operator (see ISO 17450-2) used to establish a datum or datum system. The verification operator (see ISO 17450-2) can take different forms (physically or mathematically) and is not the subject of this International Standard.

NOTE The detailed rules for maximum and least material requirements for datums are given in ISO 2692.

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 128-24:1999, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

ISO 1101:2004, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 1101:2004/Amd 1:—¹⁾, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out — Amendment 1: Representation of specifications in the form of a 3D model*

ISO 2692:2006, *Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)*

ISO 3098-0, *Technical product documentation — Lettering — Part 0: General requirements*

ISO 3098-5, *Technical product documentation — Lettering — Part 5: CAD lettering of the Latin alphabet, numerals and marks*

ISO 14660-1:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 1: General terms and definitions*

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 and uncertainties*

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

1) To be published.

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1101, ISO 2692, ISO 14660-1, ISO 17450-1, ISO 17450-2 and the following apply.

3.1 situation feature
point, straight line, plane or helix from which the location and orientation of features, or both, can be defined

3.2 datum feature
real (non-ideal) integral feature used for establishing a datum

NOTE 1 A datum feature can be a complete surface, a portion of a complete surface, or a feature of size.

NOTE 2 An illustration showing the relations between datum feature, associated feature and datum is given in Figure 4.

3.3 associated feature
associated feature for establishing a datum

ideal feature which is fitted to the datum feature with a specific association criterion

NOTE 1 The type of the associated feature is by default the same as the type of the nominal integral feature used to establish the datum (for an exception see 7.4.2.5).

NOTE 2 The associated feature for establishing a datum simulates the contact between the real surface of the workpiece and other components.

NOTE 3 An illustration showing the relations between datum feature, associated feature and datum is given in Figure 4.

3.4 datum
one or more situation features of one or more features associated with one or more real integral features selected to define the location or orientation, or both, of a tolerance zone or an ideal feature representing for instance a virtual condition

NOTE 1 A datum is a theoretically exact reference; it is defined by a plane, a straight line or a point, or a combination thereof.

NOTE 2 The concept of datums is inherently reliant upon the invariance class concept (see Annex A and Annex B).

NOTE 3 Datums with maximum material condition (MMC) or least material condition (LMC) are not covered in this International Standard (see ISO 2692).

NOTE 4 When a datum is established, for example, on a complex surface, the datum consists of a plane, a straight line or a point, or a combination thereof. The modifier [SL], [PL] or [PT], or a combination thereof, can be attached to the datum letter to limit the situation feature(s) taken into account relative to the surface.

NOTE 5 An illustration showing the relation between datum feature, associated feature and datum is given in Figure 4.

3.5 primary datum
datum that is not influenced by constraints from other datums

3.6 secondary datum
datum, in a datum system, that is influenced by an orientation constraint from the primary datum in the datum system

3.7

tertiary datum

datum, in a datum system, that is influenced by constraints from the primary datum and the secondary datum in the datum system

3.8

single datum

datum established from one datum feature taken from a single surface or from one feature of size

NOTE The invariance class of a single surface can be complex, prismatic, helical, cylindrical, revolute, planar or spherical. A set of situation features defining the datum (see Table B.1) corresponds to each type of single surface.

3.9

common datum

datum established from two or more datum features considered simultaneously

NOTE To define a common datum, it is necessary to consider the collection surface created by the considered datum features. The invariance class of a collection surface can be complex, prismatic, helical, cylindrical, revolute, planar or spherical (see Table B.1).

3.10

datum system

set of two or more situation features established in a specific order from two or more datum features

NOTE To define a datum system, it is necessary to consider the collection surface created by the considered datum features. The invariance class of a collection surface can be complex, prismatic, helical, cylindrical, revolute, planar or spherical (see Table B.1).

3.11

datum target

portion of a datum feature which can nominally be a point, a line segment or an area

NOTE Where the datum target is a point, a line or an area, it is indicated as a datum target point, a datum target line or a datum target area, respectively.

3.12

moveable datum target

datum target with a controlled motion

3.13

collection surface

two or more surfaces considered simultaneously as a single surface

NOTE 1 Table B.1 is used to determine the invariance class of a datum or datum systems when using a collection of surfaces.

NOTE 2 Two intersecting planes may be considered together or separately. When the two intersecting planes are considered simultaneously as a single surface, that surface is a collection surface.

3.14

feature of size

geometrical shape defined by a linear or angular dimension which is a size

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

[ISO 14660-1:1999, 2.2]

NOTE In this International Standard, features which are not features of size according to ISO 14660-1 are used to establish a datum as a feature of size, e.g. a truncated sphere (see the example in C.1.4).

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3.15

objective function

objective function for association

formula that describes the quality of association

NOTE 1 In this International Standard, the term “objective function” refers to “objective function for association”.

NOTE 2 The objective functions are usually named and mathematically described: maximum inscribed, minimum zone, etc.

3.16

association

operation used to fit ideal feature(s) to non-ideal feature(s) according to an association criterion

[ISO 17450-1:—, 3.2]

3.17

constraint

limitation on the associated feature

EXAMPLE Orientation constraint, location constraint, material constraint or intrinsic characteristic constraint.

3.17.1

orientation constraint

limitation to one or more rotational degrees of freedom

3.17.2

location constraint

limitation to one or more translational degrees of freedom

3.17.3

material constraint

additional condition to the location of the associated feature, relative to the material of the feature, while optimizing an objective function

NOTE For example, an association constraint can be that all distances between the associated feature and the datum feature are positive or equal to zero, i.e. the associated feature is outside the material.

3.17.4

intrinsic characteristic constraint

additional requirement applied to the intrinsic characteristic of an associated feature whether it is considered fixed or variable

3.18

association criterion

objective function with or without constraints, defined for an association

NOTE 1 Several constraints may be defined for an association.

NOTE 2 Association results (associated features) may differ, depending upon the choice of association criterion.

NOTE 3 Default association criteria are defined in Annex A.

3.19

integral feature

surface or line on a surface

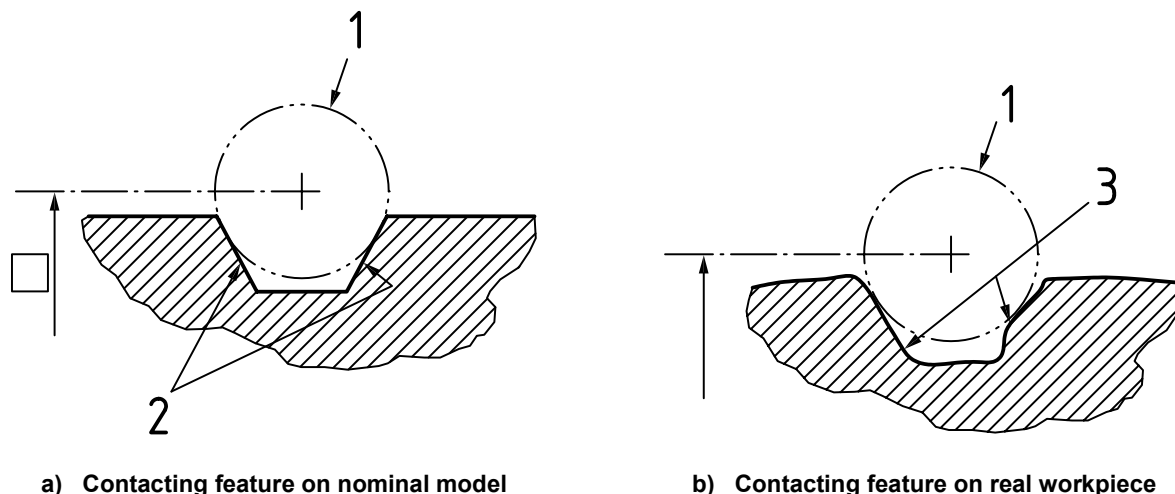
NOTE An integral feature is intrinsically defined.

[ISO 14660-1:1999, 2.1.1]

3.20 contacting feature

ideal feature of any type which is different from the nominal feature under consideration and is associated with the corresponding datum feature

See Figure 1.



Key

- 1 contacting feature: ideal sphere in contact with the datum feature or the feature under consideration
- 2 features under consideration: nominal trapezoidal slot (collection of two non-parallel surfaces)
- 3 datum feature: real feature corresponding to the trapezoidal slot (collection of two non-parallel surfaces)

Figure 1 — Example of a contacting feature

3.21 invariance class

group of ideal features for which the nominal surface is invariant for the same degrees of freedom

NOTE There are seven invariance classes (see Annex B).

3.22 theoretically exact dimension

TED

dimension indicated on technical product documentation, which is not affected by an individual or general tolerance

NOTE 1 For the purpose of this International Standard, the term “theoretically exact dimension” has been abbreviated TED.

NOTE 2 A theoretically exact dimension is a dimension used in an operation (e.g. association, partition, collection, ...).

NOTE 3 A theoretically exact dimension can be a linear dimension or an angular dimension.

NOTE 4 A TED can define

- the extension or the relative location of a portion of one feature,
- the length of the projection of a feature,
- the theoretically exact orientation or location of one feature relative to one or more other features, or
- the nominal shape of a feature.

NOTE 5 A TED is indicated by a value in a rectangular frame.

[ISO 1101:2004/Amd 1:—, 3.7]