International Standard

ISO 5459

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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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*, collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 290, *Dimensional and geometrical product specification and verification,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 5459:2011), which has been technically revised.

The main changes are as follows:

— update of the Normative references and Bibliography;

— addition of definitions 3.20, 3.20.1 and 3.20.2;

— in Table 1, update of the symbol of the datum feature indicator;

— in Table 1, addition of the symbol of single datum target indicator, moveable datum target indicator, restricted datum feature, indication of a situation feature and datum coordinate system indicator, and addition of a note;

— in Table 2, addition of [SV], [SF] and [SF*xx*], and addition of a note;

— in Clause 6, addition of a paragraph before the example in 6.1, update of 6.2.1 and 6.2.2, replacement of the first paragraph in 6.2.3 and 6.2.4, addition of the last paragraph in 6.3.2 and table titles added in 6.3.2 and subsequent tables renumbered;

— in Clause 7, addition of a note in 7.1, update of 7.2.1, 7.3, 7.4.2.1 and 7.4.2.2, update of the text and figures in 7.4.2.4 up to Figure 22, update of the first paragraph of 7.4.2.6, update of Figure 39, addition of a new rule 11 in 7.4.2.11 and a new rule 12 in 7.4.2.12;

— addition of a new Clause 8;

— in Annex A, update of the text between Figures A.1 and A.2, update of the first paragraph in A.2.1 and of Figure A.4, addition of Notes 1 and 2 in A.2.2.3, and update of the row for the plane in Table A.2;

— addition of a new Clause D.4;

— update of Annex F, addition of new Annexes G to J, update of Annex K giving the relation to the GPS matrix model.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences chain links A to C of the chains of standards on datums.

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 the specifications made in accordance with this document, unless otherwise indicated.

For more detailed information on the relationship of this document to other standards and the GPS matrix model, see Annex K.

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

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

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

This document 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 document.

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

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 128-2:2022, *Technical product documentation (TPD) — General principles of representation — Part 2: Basic conventions for lines*

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

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

ISO 4351, *Geometrical product specifications (GPS) — Association*

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1101, ISO 2692, ISO 4351, ISO 17450-1, ISO 17450-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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 to entry: A datum feature can be a complete surface, a portion of a complete surface, or a feature of size.

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

Note 3 to entry: 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 to entry: 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 to entry: The concept of datums is inherently reliant upon the invariance class concept (see Annexes A and B).

Note 3 to entry: Datums with maximum material condition (MMC) or least material condition (LMC) are not covered in this document (see ISO 2692).

Note 4 to entry: 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 identifier to limit the situation feature(s) taken into account relative to the surface.

Note 5 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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 to entry: Table B.1 is used to determine the invariance class of a datum or datum systems when using a collection of surfaces.

Note 2 to entry: 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
objective function
<association> formula that describes the goal of association from the datum feature and the ideal feature (associated feature)

Note 1 to entry: In this document, the term “objective function” refers to “objective function for association”.

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

[SOURCE: ISO 4351:2023, 3.6, modified — “datum feature” replaced “input feature”. Notes to entry added.]

3.15
constraint
set of restrictions on variability of the mathematical parameters describing an *associated feature* (3.3) in the optimization process

EXAMPLE Orientation constraint, location constraint, material constraint or intrinsic characteristic constraint are the different types of constraint.

[SOURCE: ISO 4351:2023, 3.9, modified — “constraint” replaced “association constraint” as the term and in the example. “intrinsic characteristic constraint” replaced “size constraint” in the example.]

3.15.1
orientation constraint
constraint (3.15) related to one or more rotational degrees of freedom of *associated feature* (3.3)

[SOURCE: ISO 4351:2023, 3.10, modified — “constraint” replaced “association constraint”.]

3.15.2
location constraint
constraint (3.15) related to one or more translational degrees of freedom of *associated feature* (3.3)

[SOURCE: ISO 4351:2023, 3.11, modified — “constraint” replaced “association constraint”.]

3.15.3
material constraint
constraint (3.15) on the *associated feature* (3.3), in relation to the material boundary of the *datum feature* (3.2)

EXAMPLE The outside material constraint implies that all distances between the associated feature and the datum feature are negative or equal to zero.

[SOURCE: ISO 4351:2023, 3.12, modified — “constraint” replaced “association constraint” and “datum feature” replaced “input feature”.]

3.15.4
intrinsic characteristic constraint
size constraint
association constraint (3.15) on an intrinsic characteristic of *associated feature* (3.3) whether it is considered fixed or variable

Note 1 to entry: The intrinsic characteristic of a cylinder is its diameter which is a size.

Note 2 to entry: In the collection surface, constituted by two parallel and not coaxial cylinders, there are more than one intrinsic characteristic (two diameters, the distance between their axes and the angle of 0°).

3.16
association criterion
objective function with or without constraints, defined for an association

Note 1 to entry: Several constraints may be defined for an association.

Note 2 to entry: Association results (associated features) may differ, depending upon the choice of association criterion.

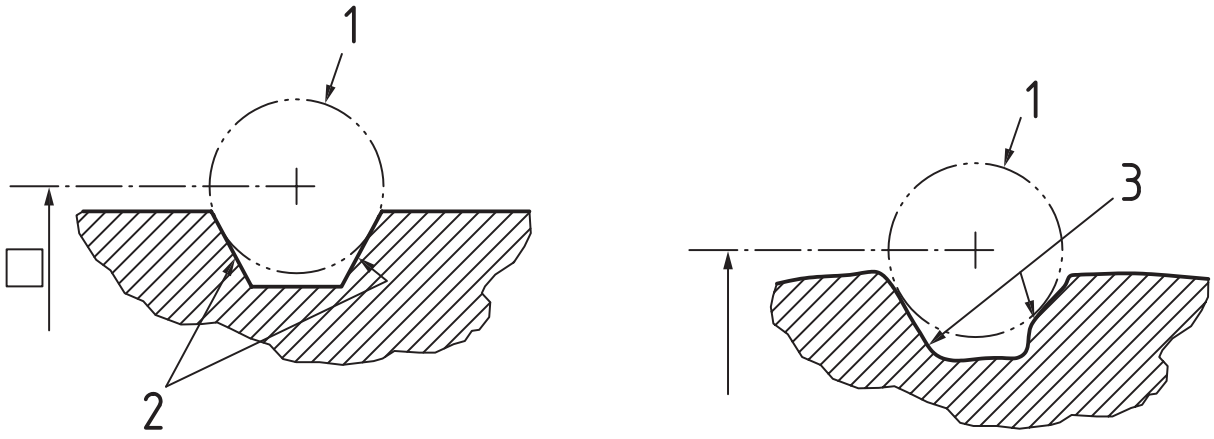
Note 3 to entry: Default association criteria are defined in Annex A.

3.17
integral feature
surface or line on a surface

Note 1 to entry: An integral feature is intrinsically defined.

3.18
contacting feature
ideal feature of any type which is different from the nominal feature under consideration and is associated with the corresponding datum feature

Note 1 to entry: See Figure 1.



a) Contacting feature on nominal model **b) Contacting feature on real workpiece**

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

3.19
invariance class
group of ideal features for which the nominal surface is invariant for the same degrees of freedom

Note 1 to entry: There are seven invariance classes (see Annex B).

3.20
datum coordinate system
coordinate system established from a single datum, a common datum or a datum system

Note 1 to entry: Using a datum coordinate system is optional.

3.20.1
datum coordinate system indicator
indication defining a coordinate system

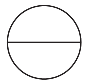
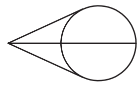
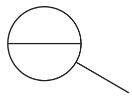
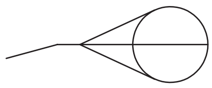
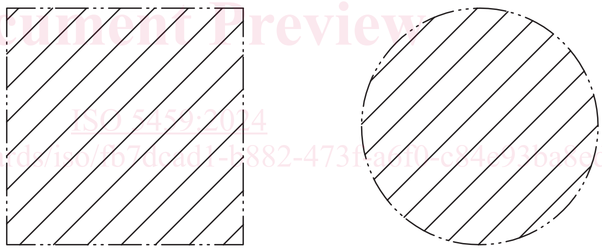
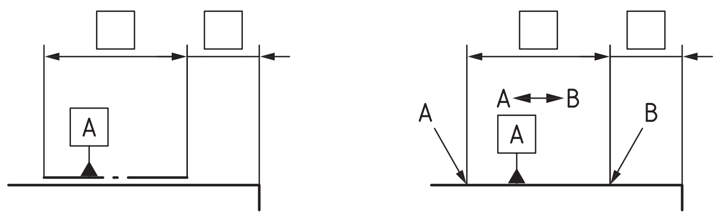
3.20.2
datum coordinate system identifier
label identifying a coordinate system

4 Symbols

Table 1 gives symbols to identify the datum feature and datum target used to establish a datum.

Table 2 gives the list of modifier symbols, which can be associated the datum identifier.

Table 1 — Datum features and datum target symbols

Description	Symbol	Sub-clause
Datum feature indicator		7.2.1
Datum feature identifier	Capital letter (A, B, C, AA, etc.)	7.2.2
Single datum target frame		7.2.3.2
Moveable datum target frame		7.2.3.2
Single datum target indicator[a]		7.2.3
Moveable datum target indicator[a]		7.2.3
Datum target point		7.2.3.3
Closed datum target line		7.2.3.3
Non-closed datum target line		7.2.3.3
Datum target area		7.2.3.3
Restricted datum feature		7.4.2.4

[a] The terminator of the leader line is dependent of the type of datum target.