DRAFT INTERNATIONAL STANDARD

ISO/DIS 5459.2

ISO/TC **213**	Secretariat: **BSI**
Voting begins on: **2017-11-20**	Voting terminates on: **2018-01-15**

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

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

ICS: 17.040.10; 01.100.20

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 5459.2:2017(E)

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Foreword

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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 voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

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

— the default association criteria has been changed by defining only one independently to the shape of the nominal integral feature;

— the representation and indication to identify the plane, the straight line and the point of a datum system, have been introduced;

— the default filtration method is now defined;

— it is allowed to change default filtration and association methods;

— it is allowed to define a coordinate system from a datum system.

Introduction

ISO 5459 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences the chain links A, B and C of the chain of standards on size, orientation, location, run-out, profile surface texture and areal surface texture.

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 standard unless otherwise indicated.

For more detailed information of the relation of this document to the GPS matrix model, see Annex I.

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

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.

Former practice of datums is given in Annex H.

Geometrical product specification (GPS) — Geometrical tolerances — Datum 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 a 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 128-24, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

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 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 17450-1, ISO 17450-2 and the following apply.

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

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

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

3.1
datum feature
real (non-ideal) integral feature used for establishing a single datum

Note 1 to entry: A datum feature can be a complete surface, a set of one or more portions 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 2.

3.2
datum target
specific portion, which is nominally a point, a line segment or an area, taken from a datum feature and which is totally located on the real workpiece

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.

3.3
moveable datum target
specific portion, which is nominally a point, a line segment or an area, taken from a datum feature and which has one freedom of translation along a defined path from other datums established on the real workpiece

3.4
associated feature (used for 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 7.5.2).

Note 2 to entry: The associated feature for establishing a datum simulates by default 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 2.

Note 4 to entry: An associated feature may have the same shape as the nominal integral datum feature or it may be another shape defined as a contacting feature (see 3.22 and Figure 1).

3.5
datum
set of one or more situation features (point, line, plane) issued from one or more associated integral features

Note 1 to entry: A datum can be used to locate or orientate an ideal feature (e.g. a tolerance zone, an intersection plane, an orientation plane, a reference feature or an ideal feature representing for instance a virtual condition).

Note 2 to entry: Datums with maximum material condition or least material condition (see ISO 2692) are not covered in this document.

Note 3 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 4 to entry: An illustration showing the relation between datum feature, associated feature and datum is given in Figure 2.

Note 5 to entry: Without qualifier, a datum is a single datum or a common datum.

3.6
single datum
datum established from one datum feature taken from one 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.

Note 2 to entry: See the rule in 7.4.

3.7
common datum
datum established from two or more datum features after simultaneous associations without specific order and with interrelated constraints

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

Note 2 to entry: See the rule in 7.4.

Note 3 to entry: The result of the common datum cannot be considered as a collection of the situation features of each associated feature. For example a common datum, established from two parallel non-coaxial cylinders, is a set of a plane and a straight line contained in the plane. See Examples 1 to 4 in 7.5.6.

3.8
datum system
set of one or more situation features (point, straight line, plane) resulting from one or more datums established in a specific order from one or more datum features

Note 1 to entry: To define a datum system, it is necessary to consider the collected surface created by the identified datum features to identify its invariance class (see Table B.1).

Note 2 to entry: A datum system can consist of one common datum or one single datum.

Note 3 to entry: The role of a datum system is described in 5.1.

3.9
datum section
specification element containing one, two or three datum indicators

Note 1 to entry: A datum section can be used as a part of a tolerance indicator, an intersection plane indicator, an orientation plane indicator, collection plane indicator or a direction feature indicator (see ISO 1101). See Figure 2.

3.10
datum indicator
specification element containing only one datum identifier

Note 1 to entry: See Figure 2.

3.11
datum identifier
label, designating a datum in a datum indicator, which is identical to the datum feature identifier in the case of a single datum, or which is a sequence of datum feature identifiers separated by an hyphen in the case of a common datum

Note 1 to entry: See Figure 2.

3.12
situation feature identifier
label, designating a situation feature (point, straight line or plane) related to a datum

3.13
datum feature identifier
label, defined by one or more capital letters, identifying the nominal integral feature, corresponding to a datum feature

Note 1 to entry: The same label is also used to identify a single datum.

Note 2 to entry: see Table 1 and Clause 6.

3.14
datum feature indicator
graphical symbol used to define an integral feature as a datum feature and containing a datum feature identifier

Note 1 to entry: See Table 1 and 5.2.

3.15
primary datum
datum indicated in the first datum indicator of the datum section

Note 1 to entry: A primary datum is not influenced by constraints from other datums (see 7.1).

3.16
secondary datum
datum indicated in the second datum indicator of the datum section

Note 1 to entry: A secondary datum is constrained at least in orientation from the primary datum (see 7.1).

3.17
tertiary datum
datum indicated in the third datum indicator of the datum section

Note 1 to entry: The tertiary datum is constrained at least in orientation from the primary datum and the secondary datum (see 7.1).

3.18
collected surface
two or more surfaces considered simultaneously as a surface

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

Note 2 to entry: Two intersecting planes may be considered simultaneously or sequentially (one after the other). When the two intersecting planes are considered simultaneously as a single surface, that surface is a collected surface.

3.19
objective function
objective function for association
formula that describes the goal of association

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.

3.20
(association) constraint
requirement to establish an associated feature

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

3.20.1
orientation constraint
constraint on one or more rotational degrees of freedom between the situation features of associated feature

3.20.2
location constraint
constraint on one or more translational degrees of freedom between the situation features of associated feature

3.20.3
material constraint
additional condition to the location of the associated feature, relative to the material of the feature, while optimizing an objective function

Note 1 to entry: 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.

3.20.4
intrinsic characteristic constraint
additional requirement applied to the intrinsic characteristic of an associated feature whether it is considered as fixed or variable

3.21
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.

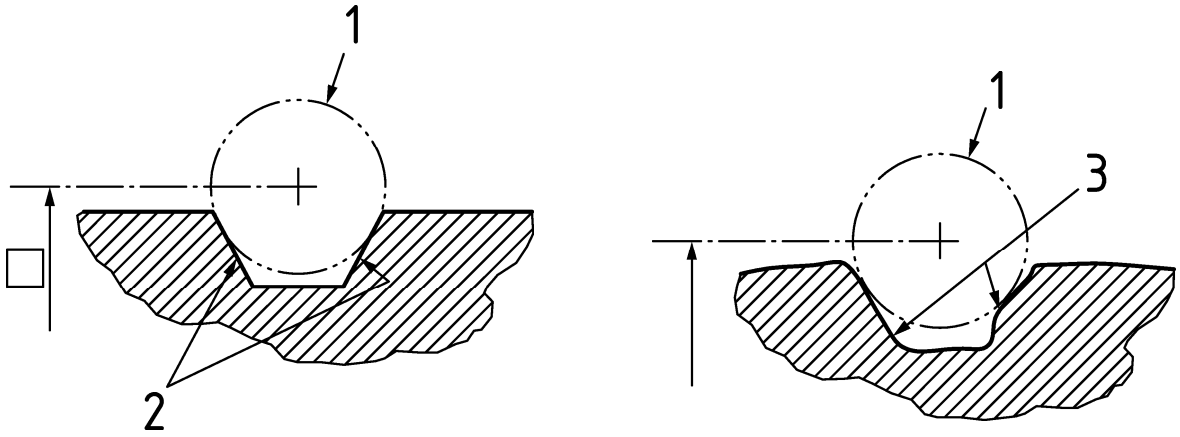
Note 3 to entry: Default association criteria are defined in 8.2.

3.22
contacting feature
ideal feature, with theoretical exact geometry (shape and dimension), different from the nominal geometry of the integral geometrical feature with which it is in contact

Note 1 to entry: A contacting feature can be used to define a set of one or more datum features, and/or to establish a datum.

Note 2 to entry: See rule a in 7.5.2.

Note 3 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

3.23
datum coordinate system
cartesian coordinate system established from a datum system

Note 1 to entry: The datum coordinate system can describe some degrees of freedoms, which are locked through the datum system.

Note 2 to entry: Using a datum coordinate system is optional.

EXAMPLE A datum system defined by only a primary datum, which is a plane, can allow establishing a non-unique datum coordinate system, one translation and two rotations being locked by the primary datum.

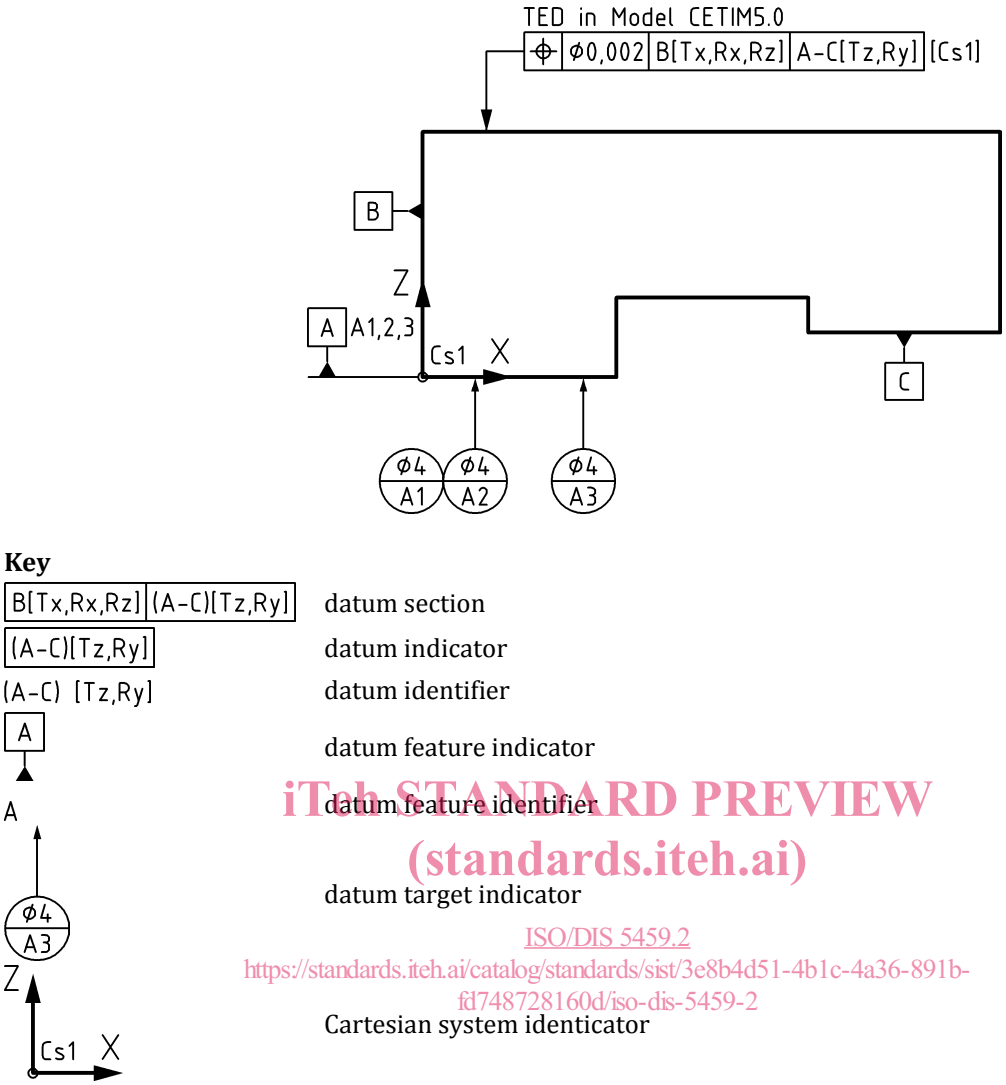


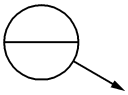
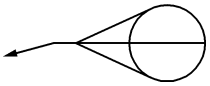
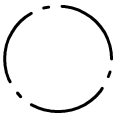
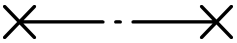
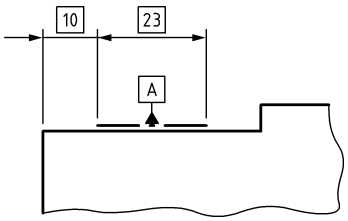
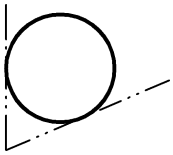
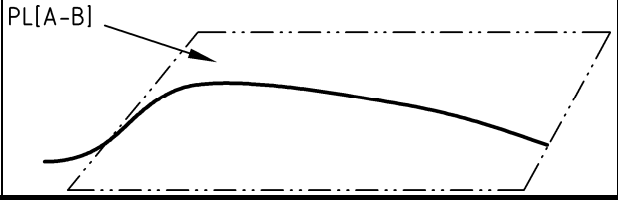
Figure 2 — Identification of specification elements attached to the descriptioin of a datum system

4 Symbols

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

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

Table 1 — Datum features and datum target symbols and indications

Description	Indication /Symbol	Subclause
Datum feature indicator		6.1
Datum feature identifier	Capital letter (A, B, C, AA, etc.)	6.2
Single datum target indicator		6.4.3.2.2
Moveable datum target indicator		6.4.3.2.3
Datum target point		6.4.3.2.4
Closed datum target line		6.4.3.2.4
Open datum target line		6.4.3.2.4
Datum target area		6.4.3.2.4
Datum coordinate system	 3D representation 2D representation	7.9
Restricted datum feature	Between symbol ↔ 	6.4.4
Contacting feature		7.5.2
Indication of a situation feature of a datum, which is a plane		7.6, 7.7, 7.8

