SLOVENSKI STANDARD
oSIST prEN ISO 1660:2014

01-januar-2014

Specifikacija geometrijskih veličin izdelka (GPS) - Toleriranje geometrijskih veličin - Toleriranje profilov (ISO/DIS 1660:2013)

Geometrical product specifications (GPS) - Geometrical tolerancing - Profile tolerancing (ISO/DIS 1660:2013)

Geometrische Produktspezifikation (GPS) - Geometrische Tolerierung - Profiltolerierung (ISO/DIS 1660:2013)

Spécification géométrique des produits (GPS) - Tolérancement géométrique - Tolérancement des profils (ISO/DIS 1660:2013)

Ta slovenski standard je istoveten z: **prEN ISO 1660 rev**

ICS:

01.100.01	Tehnično risanje na splošno	Technical drawings in general
17.040.30	Merila	Measuring instruments

oSIST prEN ISO 1660:2014 **en,fr,de**

DRAFT INTERNATIONAL STANDARD

ISO/DIS 1660

ISO/TC **213** Secretariat: **DS**

Voting begins on: **2013-09-12**

Voting terminates on: **2014-02-12**

Geometrical product specifications (GPS) — Geometrical tolerancing — Profile tolerancing

Spécification géométrique des produits (GPS) — Tolérancement géométrique — Tolérancement des profils

[Revision of second edition (ISO 1660:1987)]

ICS: 01.100.20

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Reference number
ISO/DIS 1660:2013(E)

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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 1660 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This second edition cancels and replaces the first edition (ISO 1660:1987).

Introduction

ISO 1660 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, 2 and 3 of the chains of standards on form of lines and surfaces independent of datums and dependent 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 B.

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

This edition of ISO 1660 provides rules for profile tolerancing.

Contrary to other kinds of geometrical tolerancing, profile tolerancing allows geometrical tolerancing of non-straight lines and non-flat surfaces. This makes profile tolerancing more complex than other geometrical tolerancing with respect to the definition of the nominal geometry and the extent of the toleranced feature. This International Standard expands on and provides tools and rules for these two complexities.

This edition of ISO 1660 is a pilot project for writing rule based standards for geometrical tolerancing rather than example based standards. In the long term it is envisioned that the content of this standard will be integrated into a future rule based ISO 1101.

This International Standard references other standards for rules for GPS tolerancing in general and geometrical tolerancing in particular, rather than repeating those rules. These GPS principles and rules include, but are not limited to:

— The feature principle (See ISO 8015 Clause 5.4)

— The independency principle (see ISO 8015 Clause 4.5)

— The rules for implicit TEDs (See ISO 5458 Clause 4.3)

— The width of the tolerance zone applies normal to the toleranced feature (See ISO 1101 Clause 8).

— The rules for identifying the toleranced feature(s) (see ISO 1101 Clause 7 and clause 10.1)

— Form tolerances, i.e. tolerances without reference to a datum, a datum system or a pattern, constrain neither orientation nor location (see ISO 1101 Clause 15).

— The tolerance zone can be constrained by reference to datums (see ISO 5459).

Geometrical product specifications (GPS) — Geometrical tolerancing — Profile tolerancing

IMPORTANT — The illustrations included in this International Standard are intended to illustrate the text and/or to provide examples of the related technical drawing specification; these illustrations are not fully dimensioned and toleranced, showing only the relevant general principles.

As a consequence, the illustrations are not a representation of a complete workpiece, and are not of a quality that is required for use in industry (in terms of full conformity with the standards prepared by ISO/TC 10 and ISO/TC 213), and as such are not suitable for projection for teaching purposes.

1 Scope

This International Standard gives the rules for geometrical tolerancing of integral and derived features (lines and surfaces).

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 1101:2012, *Geometrical Product Specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*

ISO 1101:2012 AMD 1: —[1)], *Geometrical Product Specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out — Indication of special specification operators for form, orientation, location and run-out*

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

ISO 5458:1998, *Geometrical product specifications (GPS) — Geometrical tolerancing — Positional tolerancing*

ISO 5459:2011, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems*

ISO 8015:2011, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

ISO 10579:2010, *Geometrical product specifications (GPS) — Dimensioning and tolerancing — Non-rigid parts*

ISO 14660-2:1999, *Geometrical product specifications (GPS) — Geometrical features — Part 2: Extracted median line of a cylinder and a cone, extracted median surface, local size of an extracted feature*

ISO 16792, *Technical product documentation — Digital product definition data practices*

1) Under preparation

ISO 17450-1:2011, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 22432:2011, *Geometrical product specifications (GPS) — Features utilized in specification and verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1101, ISO 5459, ISO 8015, ISO 14660-2, ISO 17450-1and ISO 22432 and the following apply.

3.1
profile
simple or complex, integral or derived feature

3.1.1
line profile
profile where the feature is a line

3.1.2
surface profile
profile where the feature is a surface

3.2
redundant degree of freedom
degree of freedom for which the tolerance zone is invariant

3.3
non-redundant degree of freedom
degree of freedom for which the tolerance zone is not invariant

4 Symbols

Table 1 — Tolerance symbols

⌒	Line profile tolerance symbol
⌓	Surface profile tolerance symbol

NOTE 1 The line profile tolerance symbol is called "profile any line" in ISO 1101

NOTE 2 The surface profile tolerance symbol is called "profile any surface" in ISO 1101

These symbols shall be used in the first compartment of the tolerance indicator, see ISO 1101 clause 6.1.

The nominal features, for which each symbol can be used, are given in table 2.

Table 2 — Valid tolerance symbol and nominal toleranced feature combinations

Toleranced feature	⌒	⌓
Integral straight line	√	
Derived straight line	√	
Integral non-straight line	√	
Derived non-straight line	√	
Integral flat surface		√
Derived flat surface		√
Integral non-flat surface		√
Derived non-flat surface		√

For straight lines and planes there are other tolerance symbols that directly gives the information about the shape of the toleranced feature, e.g. flatness for planes and straightness for straight line(s). When profile tolerance symbols are used for straight lines and planes, it is necessary to analyse the drawing or the CAD model for absence of information that the feature is nominally non-flat or non-straight, to determine the nominal shape of the toleranced feature.

5 Rules for profile tolerancing

5.1 General

According to the feature principle (See ISO 8015 Clause 5.4), by default a profile tolerance applies to one entire single feature as defined in ISO 22432. It is the designer's responsibility to select the feature(s) or part(s) of feature(s) for which a tolerance applies and either indicate that on a paper drawing using appropriate symbology or define it on the CAD model.

According to the independency principle (see ISO 8015 Clause 4.5), by default a profile tolerance that applies to more than one single feature as defined in ISO 22432, applies to those features independently. If it is desired that the profile tolerance apply to the features as if they were one or with some constraint amongst the tolerance zones for the single features, it is the designer's responsibility to either indicate this on a paper drawing using appropriate symbology or define it on the CAD model.

Nevertheless, the "all around" indication and the "between" indication shall always be combined with UF, CZ or SZ to make it explicit whether the tolerance applies to a united feature, defines a combined zone or defines a set of separate zones.

NOTE 1 In former times "all around" was used without any other indication. That made it ambiguous whether the tolerance applied to the features independently or the tolerance defined a combined zone. The requirement to always use UF, CZ or SZ is a failsafe indication.

NOTE 2 In its resolution 196, ISO TC 213/WG 18 explicitly asks the member bodies to comment on this rule and provide reasons, if they do not think this rule is appropriate (This note will be deleted at the next stage.)

5.2 Default rules for profile tolerancing

Rule A: Definition of nominal geometry

The nominal geometry of the toleranced feature shall be defined with theoretically exact dimensions (TEDs) or be embedded in the CAD model.

These TEDs may include:

— Explicit TEDs

— Implicit TEDs:

  — Plane (single surface with no intrinsic characteristic)

  — Straight line (single line with no intrinsic characteristic)

  — Circle (single line with one intrinsic characteristic)

  — Cylinder (single surface with one intrinsic characteristic)

  — Sphere (single surface with one intrinsic characteristic)

  — Cone (single surface with one intrinsic characteristic)

  — Torus (single surface with two intrinsic characteristics)

— Tables of values and interpolation algorithms

— Mathematical functions including splines and other formulas

— Reference to CAD model queries

A feature that appears to be a nominally straight line or a nominal plane in the drawing with no indications that the nominal shape is anything else, shall be considered a nominally straight line or a nominal plane, respectively, defined by implicit TEDs.

The shape of a feature that is nominally a circle, a cylinder, a sphere or a cone shall be considered defined by implicit TEDs. The size of the feature shall be considered undefined, unless it is defined by an explicit TED.

The shape of a feature that is nominally a torus shall be considered defined by implicit TEDs when the directrix size is defined by an explicit TED. The size of the generatrix shall be considered undefined, unless it is defined by an explicit TED.

If the nominal geometry of a feature is defined by a table with sets of coordinates, the interpolation algorithm for defining points between the given coordinates shall also be indicated.

EXAMPLE The points are connected by straight lines.

When the nominal geometry is embedded in the CAD model, it shall be accessible via queries, see ISO 16792.

Rule B: Type of toleranced feature

When the tolerance symbol is the surface profile tolerance symbol, the toleranced feature is an integral or derived surface.

When the tolerance symbol is the line profile tolerance symbol, the toleranced feature is either one identified integral or derived line or all lines in the identified integral or derived surface in a particular direction.

If the toleranced feature is one identified line in a surface, the location of this line shall be identified by TEDs.

If the toleranced feature is all lines in the identified surface in a particular direction, that direction shall be identified using an intersection plane indicator, see ISO 1101 clause 16.

The rules for indicating whether the toleranced feature is an integral feature or a derived feature are given in ISO 1101 clause 7.

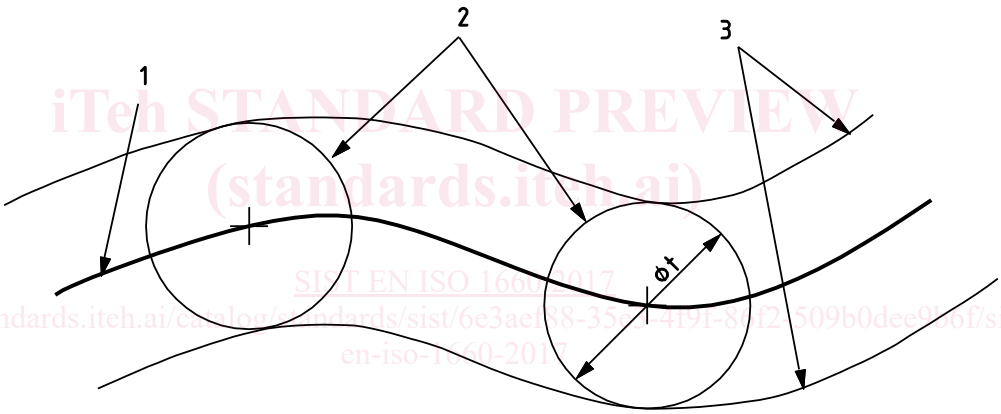
Rule C: Definition of the tolerance zone

For surface tolerances, the tolerance zone is limited by two equidistant surfaces enveloping spheres with a diameter equal to the tolerance value, the centres of which are situated on the nominal geometry, unless otherwise specified, see rules E and F.

For line tolerances, when the tolerance value is not preceded by ø, the tolerance zone is limited by two equidistant coplanar lines enveloping circles with a diameter equal to the tolerance value, the centres of which are situated on the nominal geometry, unless otherwise specified, see rules E and F.

For line tolerances, when the tolerance value is preceded by ø, the tolerance zone is limited by a tube enveloping spheres with a diameter equal to the tolerance value, the centres of which are situated on the nominal geometry, unless otherwise specified, see rules E and F.

NOTE See also ISO 1101 Clause 10.2.



Key

1 nominal geometry

2 two of the infinite number of spheres or circles defining the tolerance zone along the nominal geometry

3 limits of the tolerance zone

t tolerance value

Figure 1 — Definition of tolerance zone

5.3 Modifier rules for profile tolerancing

Rule D: Toleranced feature modifiers

If the toleranced feature is not one entire single feature, this shall be indicated by using the tools given in ISO 1101 and ISO 1101 AMD 1, e.g. the CZ, UF, "between" and SIM modifiers.

Rule E: Unequally disposed tolerance zone