TECHNICAL REPORT

ISO/TR 16570

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Geometrical Product Specifications (GPS) — Linear and angular dimensioning and tolerancing: +/- limit specifications — Step dimensions, distances, angular sizes and radii

Spécification géométrique des produits (GPS) — Cotation et tolérancement linéaires et angulaires: Spécifications de limites en +/- — Ressauts, distances, tailles angulaires et rayons

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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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR 16570 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

Introduction

This Technical Report is a geometrical product specification (GPS) technical report and is to be regarded as a general GPS technical report (see ISO/TR 14638). It influences links 1 and 2 of the chains of standards on size, distance, radius and angle.

For more detailed information on the relation of this Technical Report to other standards and the GPS matrix model, see Annex B.

The application of ± limit specifications usually causes large specification uncertainty (see ISO/TS 17450-2). It must be emphasized that any ± limit specification in this Technical Report, generally speaking, can be completely substituted by geometrical dimensioning and tolerancing as per ISO 1101 and its related standards. Even the application of this Technical Report might cause large specification uncertainty. Consequently, ISO/TC 213 recommends that the use of ± limit specifications be restricted to features of size only (see ISO 14660-1 and ISO 14405).

Other geometrical specifications are indicated and toleranced according to the principles given in ISO 1101 and related standards (e.g. by positional tolerancing).

This Technical Report consists of several groups of examples and it needs to be recognized that several different interpretation concepts are applied in the various groups.

ISO 129 contains general rules for dimensioning and dimensional tolerancing with ± limit specifications in technical drawings. These rules are not always sufficient for an unambiguous description of the workpiece geometry.

EXAMPLE 1 Distances between axes of holes on a pitch cylinder cannot be toleranced by ± limit specifications suitable for the function (see Figure A.1, left).

EXAMPLE 2 Angles between planes containing axes of holes cannot be toleranced by ± limit specifications suitable for the function (see Figures A.3 and A.5).

EXAMPLE 3 Linear dimensions and ± limit specifications, even when related to the same reference (having the same origin as in superimposed running dimensioning), but dimensioned in two or three directions and nominally perpendicular to each other, are ambiguous (see Figure A.1, centre, right).

In certain cases, such as for step dimensions, the function (e.g. assembly) allows for larger tolerances for the form (e.g. flatness) than for the location of the point of the surface, which is the most outward of the material. In these cases the production process including casting, forging and sheet metal working, becomes more beneficial when ± limit deviation specifications are applied.

For these and similar cases, this Technical Report deals with ± limit specifications for

— step dimensions (see 4.2),

— distances between an integral feature and a derived feature (see 4.3.1),

— distances between two derived features (see 4.3.2),

— angular sizes (see Clause 5), and

— radii (see 6.4),

only when two features are involved.

Geometrical Product Specifications (GPS) — Linear and angular dimensioning and tolerancing: +/- limit specifications — Step dimensions, distances, angular sizes and radii

1 Scope

This Technical Report describes the ± limit specification of step dimensions, distances, angular sizes and radii when the function relates to two features only.

The interpretation of ± limit specifications in accordance with this Technical Report is only applicable to a drawing when “ISO/TR 16570” is referred to on the drawing.

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 129-1:2004, *Technical drawings — Dimensioning — General principles, definitions, methods of execution and special* indications

ISO 1101:—[1], *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out*

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

ISO/TS 17450-1:—[2], *Geometrical product specifications (GPS) — Part 1: Model for geometrical specification and verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 129, ISO 1101, ISO 14660-1 and ISO/TS 17450-1 apply.

1) To be published. (Revision of ISO 1101:1983)

2) To be published.

4 Linear dimensioning

4.1 General

Linear dimensioning may be applied for tolerancing sizes and distances between two ideal features, otherwise the requirements of ISO 1101 apply.

4.2 Distance dimensioning between two parallel planes (step dimensioning)

A step dimension is the distance between two parallel planes (integral features) having the same direction outward from the material (see Figure 1).

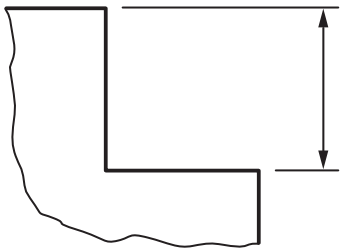
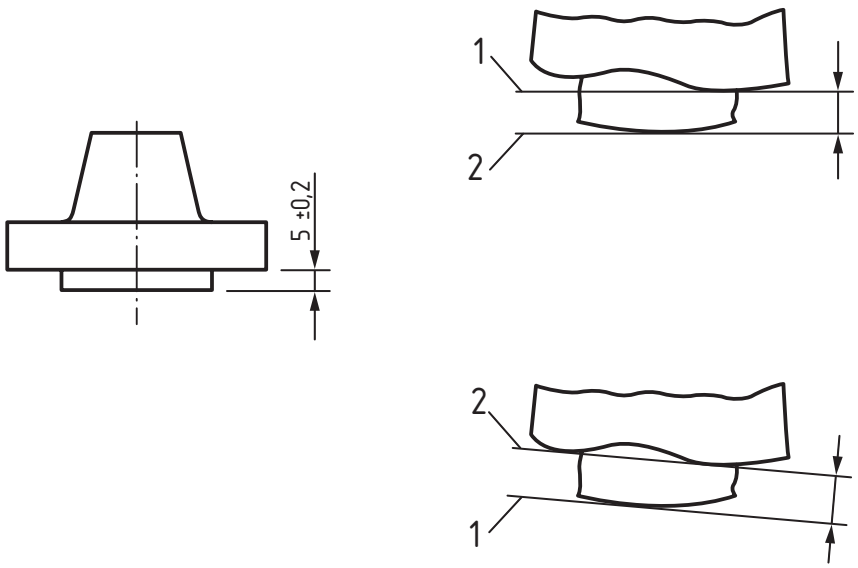


Figure 1 — Step dimension

One of the two parallel planes is to be taken as the reference.

For the purposes of this Technical Report, the step dimension corresponds to the distance between the reference and the contacting associated plane of the other surface parallel to the reference plane (see Figure 2).

The reference is a contacting plane so located and orientated that any motion is equalized.



a) Drawing indication **b) Explanation (two reference possibilities)**

Key

1 contacting associated plane
2 reference plane

Figure 2 — Step dimension without origin symbol according to ISO 129

Where the origin symbol indicates a single feature in accordance with ISO 129, this feature applies as the reference feature only (see Figure 3). When there is no reference indicated (dimension line with arrows on both sides) both reference possibilities apply.

NOTE 1 Form and orientation of the features are controlled by individually indicated geometrical tolerances or general tolerances of form (e.g. flatness) and of orientation (e.g. parallelism, perpendicularity).

NOTE 2 This definition of step dimensioning corresponds to the functional requirements of an assembly.

NOTE 3 This concept of step dimensioning is different from the other concepts of distance dimensioning given in 4.3.

a) Drawing indication **b) Explanation**

Key

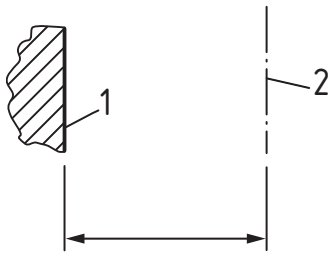
1 contacting associated plane
2 reference plane

Figure 3 — Step dimension with origin symbol according to ISO 129

4.3 Distance dimensioning between two parallel features, at least one of which is derived

4.3.1 Distance between integral feature (plane surface) and derived feature

For the distance between an integral feature (plane surface) and a derived feature, see Figure 4.



Key

1 integral feature
2 derived feature

Figure 4 — Distance between integral and derived feature

One of the features is to be taken as a reference.

For the purposes of this Technical Report, the distances correspond to the range of distances between the reference and the contacting associated feature of the other feature in any section plane perpendicular to the reference, over the length of the extracted derived feature, or over the length of the extracted plane feature.

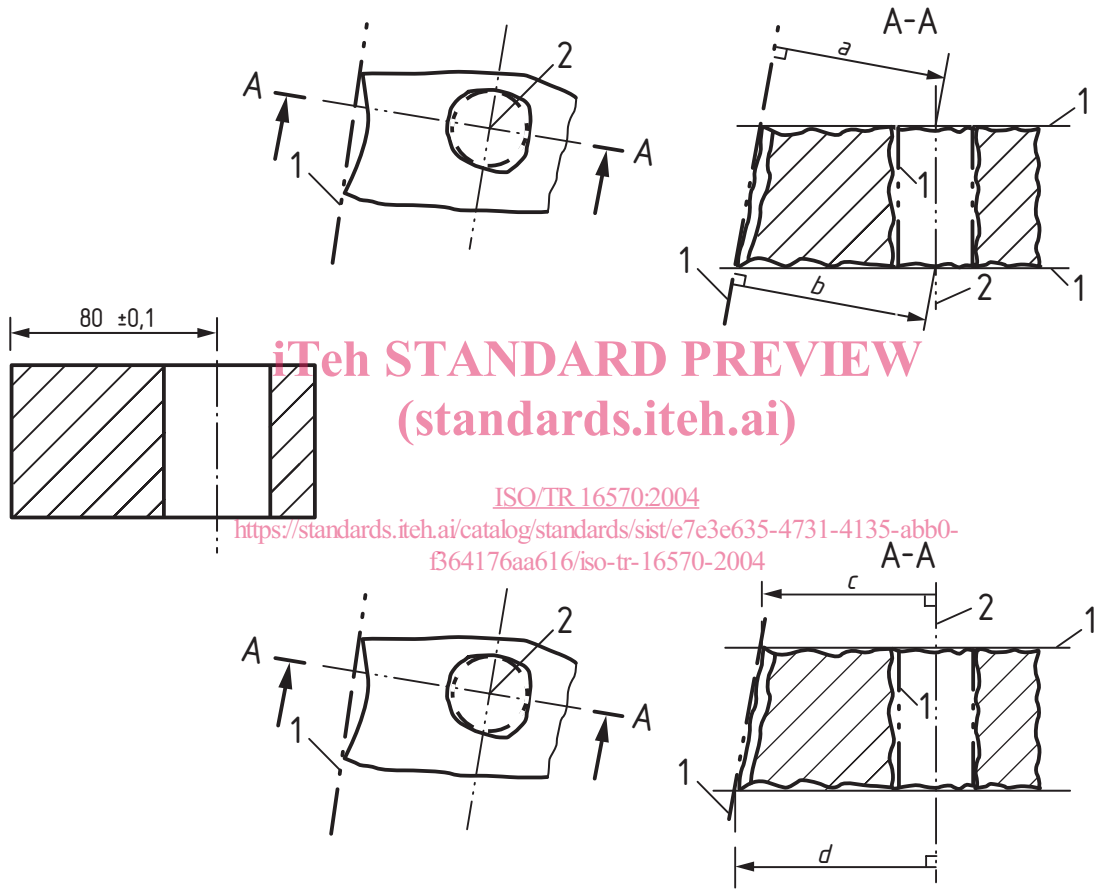
The reference is

— for a cylinder, the axis of the largest inscribed cylinder of a hole or the smallest circumscribed cylinder of a shaft, so located and orientated that any motion is equalized, or

— for a plane, a contacting plane located and orientated such that any motion is equalized.

For the feature other than the reference, the contacting associated feature has the same definition as for the reference.

The lengths of the extracted derived feature and the extracted plane feature are determined by the distance of the contacting associated features from the adjacent surfaces (see Figure 5).



a) Drawing indication **b) Explanation (two reference possibilities)**

Key

1 contacting associated feature
2 reference cylinder axis

a, b, c, d possible distances between contacting associated feature and reference cylinder axis, depending on choice of reference

Figure 5 — Distance between plane and reference cylinder — Reference possibilities

Where the origin symbol indicates a single feature in accordance with ISO 129, that feature applies as the reference feature only. When there is no reference indicated (dimension line with arrows on both sides) both reference possibilities apply.

NOTE This concept is different from the concept of step dimensioning given in 4.2.

4.3.2 Distance between the two axes of two parallel cylinders (derived features)

For the distance between the two axes of two parallel cylinders (derived features), see Figure 6.

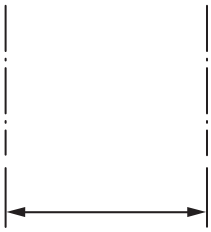


Figure 6 — Distance between two derived features

One of the features is to be taken as a reference.

For the purposes of this Technical Report, the distances correspond to the range of the distances between the reference and the derived contacting associated feature of the other feature in any section plane perpendicular to the reference, over the length of the extracted derived feature.

For the reference and contacting associated features, see 4.3.1.

The length of the extracted derived feature is determined by the distance of the contacting associated features to the adjacent surfaces (see Figure 7).

Where the origin symbol indicates a single feature in accordance with ISO 129, this feature applies as the reference feature only. When there is no reference indicated (dimension line with arrows on both sides) both possibilities apply.

NOTE 1 The form of the features is controlled by individually indicated or general form tolerances (e.g. flatness or cylindricity).

NOTE 2 In case of holes, this definition of distance corresponds to the measuring method with the aid of inspection mandrels, suiting some functional requirements.

NOTE 3 This concept is different from the concept of step dimensioning given in 4.2.