INTERNATIONAL STANDARD

ISO 5458

Second edition
1998-12-15

Geometrical Product Specifications (GPS) — Geometrical tolerancing — Positional tolerancing

Spécification géométrique des produits (GPS) — Tolérancement géométrique — Tolérancement de localisation

Reference number
ISO 5458:1998(E)

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.

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.

International Standard ISO 5458 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 5458:1987), which has been technically revised.

Annexes A, B, C and D of this International Standard are for information only.

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Introduction

This International Standard is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain links 1 and 2 of the chain of standards on location.

For more detailed information of the relation of this standard to the GPS matrix model, see annex C.

This International Standard is intended to promote the relationship between the designer and the manufacturer.

The concept of positional tolerancing, as described in ISO 1101, is further elaborated in this International Standard.

The figures in this International Standard serve to illustrate the subject matter only and are not necessarily complete.

Other relevant International Standards, such as those dealing with the maximum material requirement (ISO 2692), datums and datum systems (ISO 5459), should be taken into consideration when using this International Standard.

For the purposes of this International Standard, all dimensions and tolerances on the drawings have been shown in vertical lettering. It should be understood that these indications could just as well be written in free-hand or inclined (italic) lettering without altering the meaning of the indications.

For the presentation of lettering (proportions and dimensions), see ISO 3098-1.

Geometrical Product Specifications (GPS) — Geometrical tolerancing — Positional tolerancing

1 Scope

This International Standard describes positional tolerancing. This tolerancing method is applied to the location of a point, of a line nominally straight and of a surface nominally plane, e.g. the centre of a sphere, the axis of a hole or shaft and the median surface of a slot.

NOTE Profile tolerancing is used when lines are not intended to be straight or surfaces are not intended to lie in a plane; see ISO 1660.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1101:—[1], *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Generalities, definitions, symbols, indication on drawings.*

3 Definitions

Definitions related to features are under development and will be issued as ISO 14660-1. This work will result in new terms that are different from those used in this International Standard. These new terms are defined in annex A and appear in the main body of this International Standard in parentheses next to the currently used term .

4 Establishment of positional tolerances

4.1 General

The primary constituents are theoretically exact dimensions, tolerance zones and datums.

4.2 Fundamental requirement

Positional tolerances are associated with theoretically exact dimensions and define the limits for the location of actual (extracted) features, such as points, axes, median surfaces, nominally straight lines and nominally plane surfaces relative to each other or in relation to one or more datums. The tolerance zone is symmetrically disposed about the theoretically exact location.

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

NOTE Positional tolerances do not accumulate when theoretically exact dimensions are arranged in a chain (see figure 4). (This contrasts with dimensional tolerances that are arranged in a chain.) Positional tolerancing allows clear reference to be made to one or more datums.

4.3 Theoretically exact dimensions

Theoretically exact dimensions, both angular and linear, are indicated by being enclosed in a rectangular frame in accordance with ISO 1101. This is illustrated in figures 2 a), 2 b), 3 a), 4 a), 5 a) and 7 a).

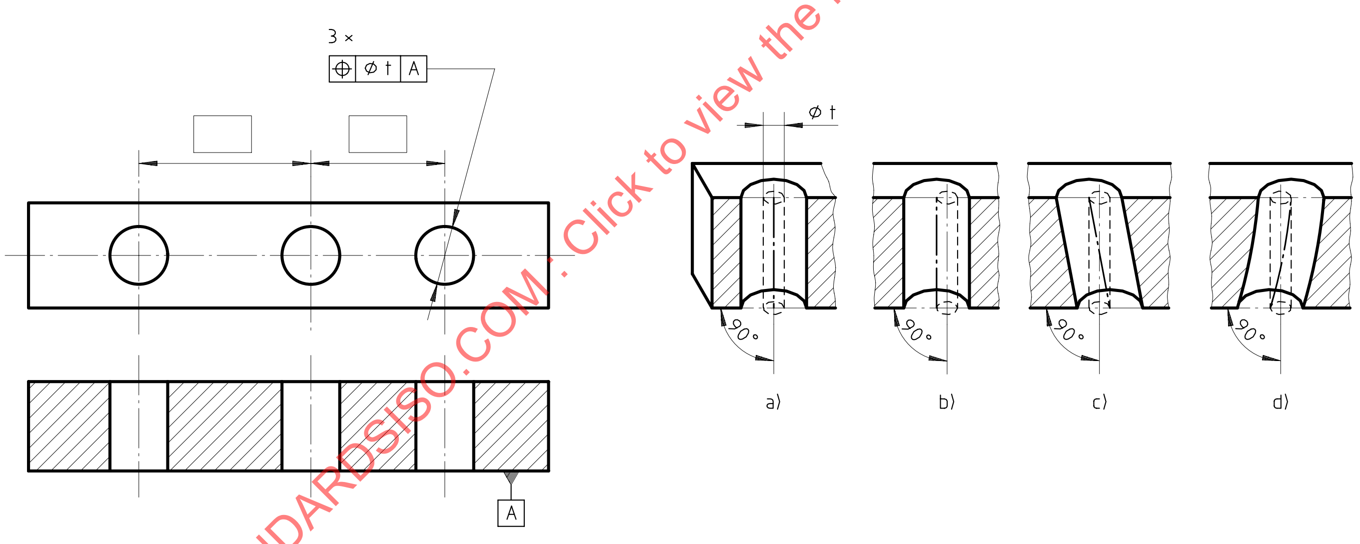
The theoretically exact dimensions 0° and 90°, 180° or distance 0 between

- positionally toleranced features not related to a datum [see figure 4 a) and figure 5 a)],
- positionally toleranced features related to the same datum(s) [see figure 2 a)],
- positionally toleranced features and their related datums (see figure 1),

are implied without specific indication.

When the positional tolerance features share the same centreline or axis they are regarded as theoretically exactly related features, unless otherwise specified, e.g. in relation to different datums or other reason indicated by an appropriate note on the drawing as shown in figure 2 b).

Indication on the drawing **Explanation**



Cases a), b), c) or d) may apply at each individual hole:

a) axis of hole coincident with theoretically exact location (zero deviation);

b) axis of hole at maximum position deviation with zero perpendicularity deviation;

c) axis of hole at maximum position deviation with maximum perpendicularity deviation;

d) axis of hole at maximum position deviation; in this case a combination of geometrical deviations.

Figure 1

4.4 Positional tolerances on a complete circle

When positionally toleranced features are arranged in a complete circle it is understood that the features are equally spaced, unless otherwise stated, and that their locations are theoretically exact.

If two or more groups of features are shown on the same axis, they shall be considered to be a single pattern when

— they are not related to a datum;

— they are related to the same datum or datum system (datums in the same order of precedence or under the same material conditions) [see figure 2 a)];

unless otherwise stated [see figure 2 b)].

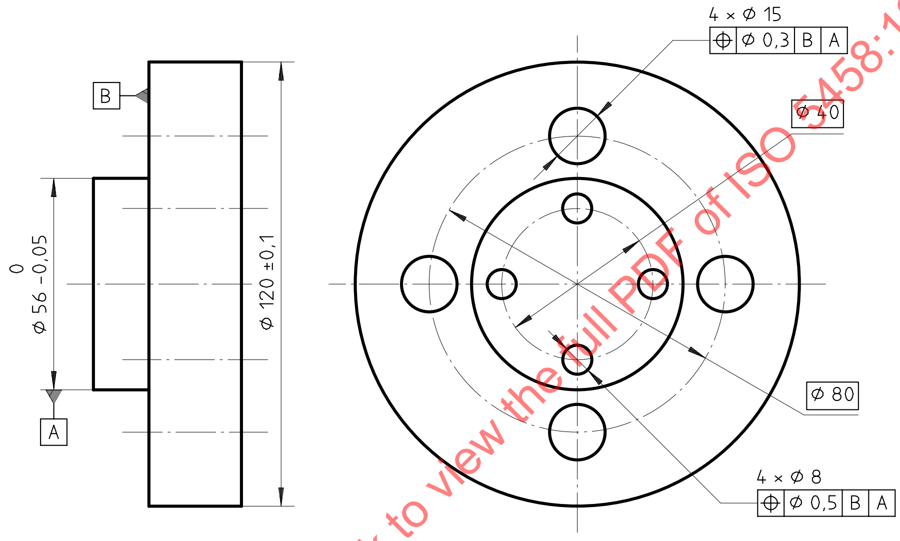


Figure 2 a)

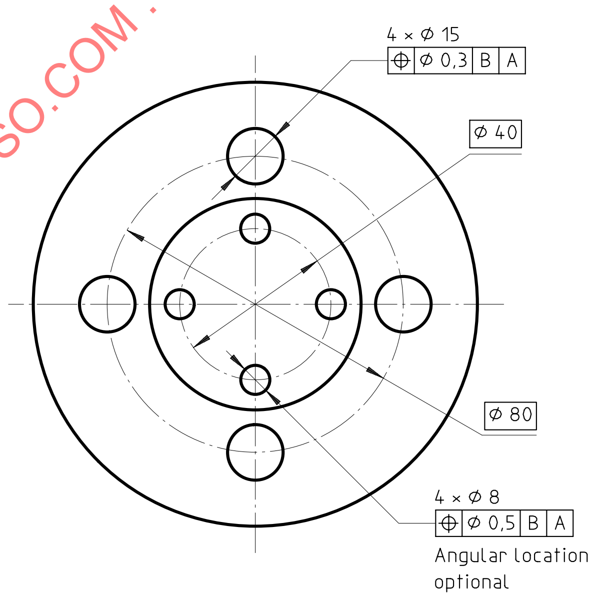


Figure 2 b)

4.5 Directions of positional tolerances

4.5.1 Positional tolerances in one direction only

The tolerance value can be specified in one direction. The orientation of the width of the tolerance zone is based on the pattern of the theoretically exact dimensions and is at 0° or 90° as indicated by the direction of the arrow line [see figures 3 a) and 3 b)] unless otherwise indicated.

Indication on the drawing

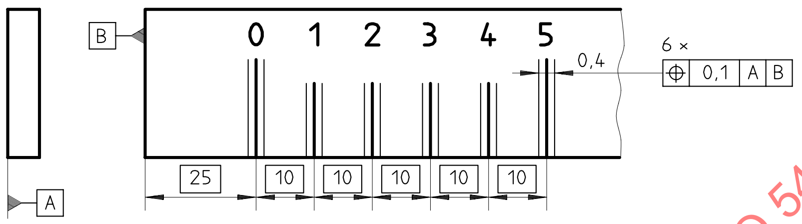
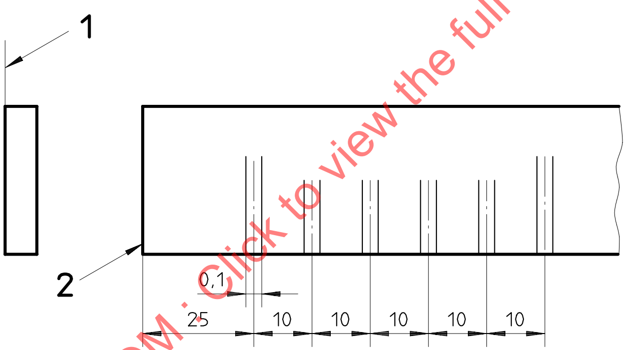


Figure 3 a)

Explanation



Key

1 Simulated datum A
2 Simulated datum B

Each of the scale lines shall be contained within a tolerance zone defined by two parallel straight lines 0,1 apart which are symmetrically disposed about the theoretically exact position of each scale line relative to each other.

Figure 3 b)

4.5.2 Positional tolerances in two directions

The tolerance value can be specified in two directions perpendicular to each other, reference being made to unequal values [see figures 4 a) and 4 b)] or equal values.

Indication on the drawing

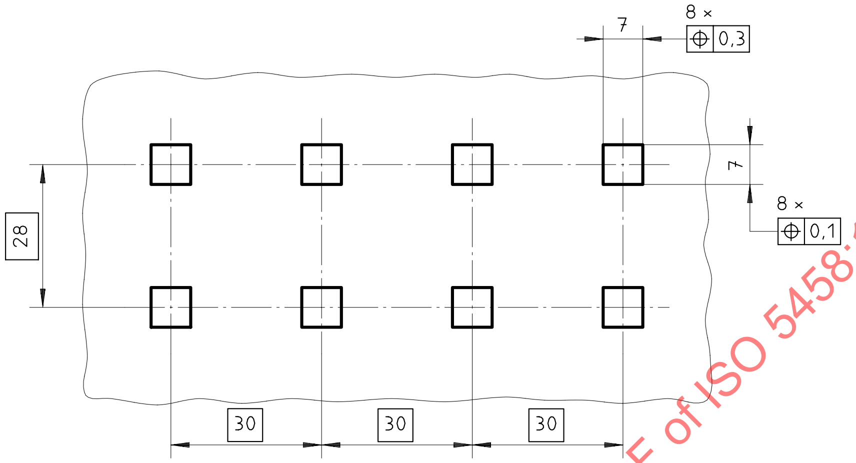


Figure 4 a)

Explanation

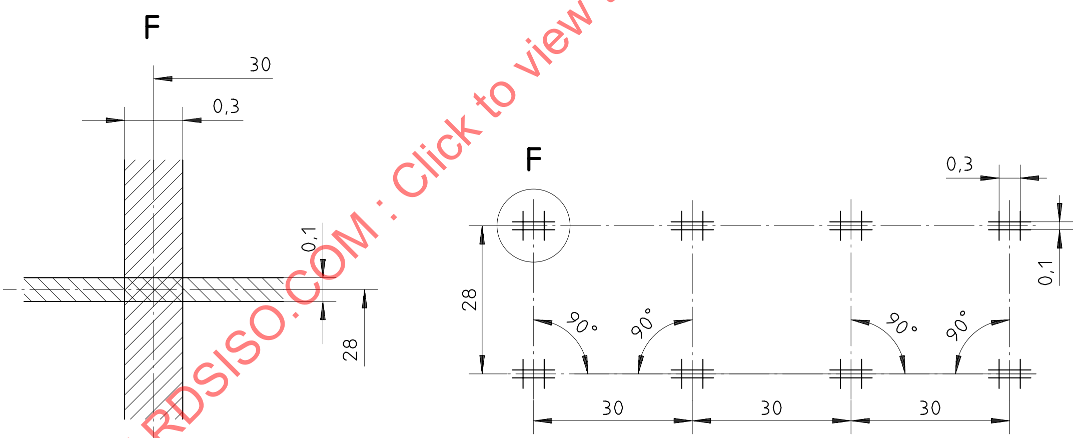


Figure 4 b)

The rectangular pattern consisting of the eight tolerance zones, placed 30 mm apart from each other, is a floating one, the location and orientation of which depends on the considered actual (extracted) features of the workpiece.

Each of the holes shall be:

— measured in the direction of the theoretically exact dimension 30; its actual (extracted) median surface lies within a tolerance zone with a rectangular cross section 0,3 × actual length of the feature;

— measured in the direction of the theoretically exact dimension 28; its actual (extracted) median surface lies within a tolerance zone with a rectangular cross section 0,1 × actual length of the feature;

— the median planes of the tolerance zones are fixed by theoretically exact dimensions.

4.5.3 Multi-directional positional tolerances

The tolerance is specified as a cylindrical zone [see figures 5 a) and 5 b)]. The "rigid rectangular pattern" consisting of the eight tolerance zones, placed 30 mm apart from each other, may be implied by a best fit (rotations and translations) to the centre point/line data from the actual (extracted) features of the workpiece.

Indication on the drawing

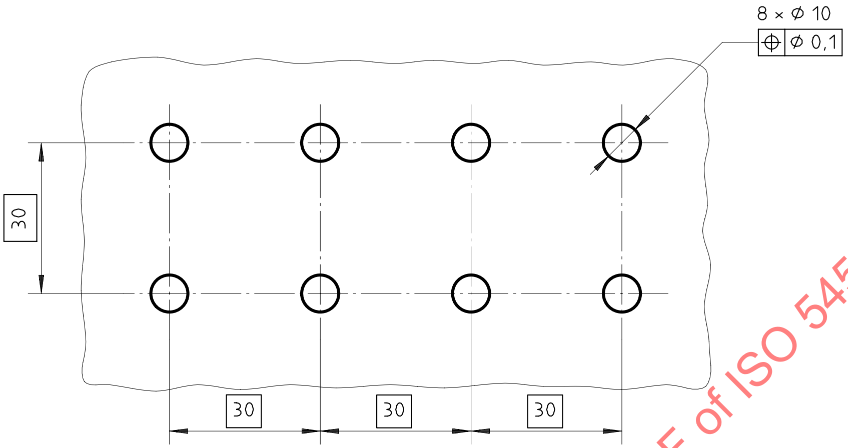
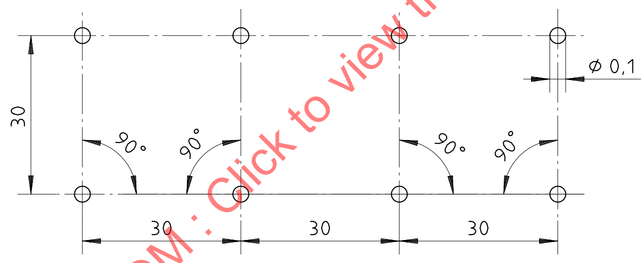


Figure 5 a)

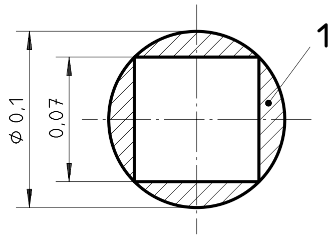
Explanation



The actual (extracted) axis of each hole shall lie within a cylindrical tolerance zone of diameter 0,1 mm; the axes of the cylindrical tolerance zones are fixed by theoretically exact dimensions.

Figure 5 b)

NOTE For cylindrical features of mating parts, the tolerance zone is usually cylindrical, as the positional tolerance is multi-directional from the theoretically exact location. In these cases the positional tolerancing method achieves a larger tolerance zone than in the two directions method which can only generate a square (or rectangular) two dimensional tolerance zone; see figure 6. The choice between "multi-directional" and "in two directions" tolerance zone should be made according to the function of the toleranced feature.



Key

1 57 % larger zone

Figure 6

5 Tolerance combinations

5.1 If a group of features is individually located by positional tolerancing and their pattern location is also located by positional tolerancing, each requirement shall be met independently [see figure 7 a)].

5.2 The actual (extracted) axis of each of the four holes shall lie within the cylindrical tolerance zone of diameter 0,01; the positional tolerance zones are located in their theoretically exact positions to each other and perpendicular to datum A [see figure 7 b)].

5.3 The actual (extracted) axis of each holes shall lie within the cylindrical tolerance zone of diameter 0,2; the positional tolerance zones are perpendicular to datum A and located in their exact theoretical positions in relation to each other and to the datums B and C [see figure 7 c)].

Indication on the drawing

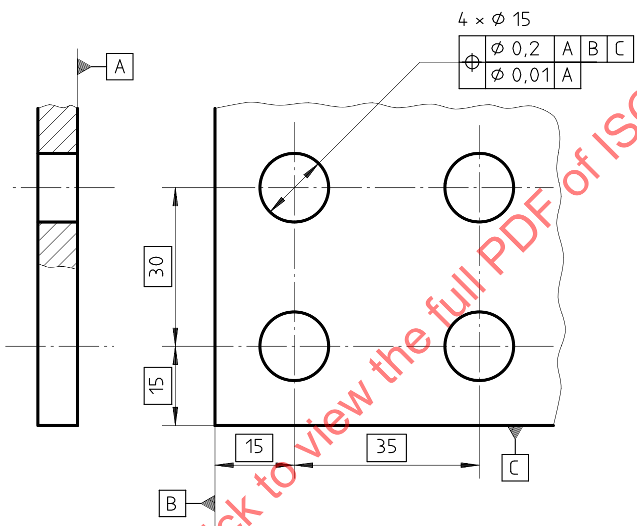
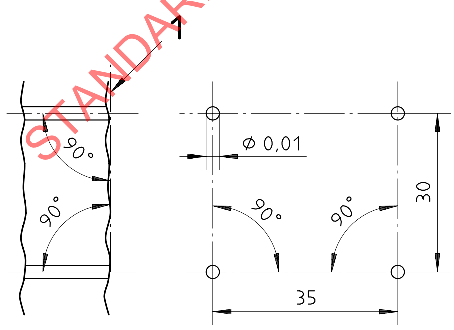


Figure 7 a)

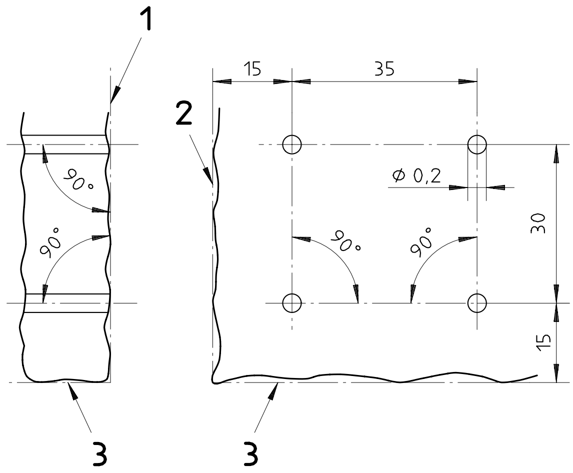
Explanation



Key

1 Simulated datum A

Figure 7 b)



Key

1 Simulated datum A
2 Simulated datum B
3 Simulated datum C

Figure 7 c)

Annex A
(informative)

Definitions

For full details, see ISO 14660-1.

feature
point, line or surface

integral feature
surface or line on a surface

derived feature
centre point, median line or median surface derived from one or more integral features

feature of size
geometric shape defined by a linear dimension which is a size

nominal integral feature
theoretically exact integral feature as defined by a technical drawing or by other means

nominal derived feature
centre point, median straight line or median plane derived from one or more nominal integral features

real surface of a workpiece
set of features which physically exist and separate the entire workpiece from the surrounding medium

real (integral) feature
integral feature part of a real surface of a workpiece limited by the adjacent real (integral) features

extracted integral feature
approximated representation of the real (integral) feature, obtained by extracting a finite number of points from the real (integral) feature

NOTE This extraction is performed in accordance with specified conventions.

extracted derived feature
centre point, median line or median surface derived from one or more extracted integral features

associated integral feature
integral feature of perfect form associated to the extracted integral feature in accordance with specified conventions

associated derived feature
centre point, median straight line or median plane derived from one or more associated integral features