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ISO 3040

Fourth edition
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Geometrical product specifications (GPS) — Dimensioning and tolerancing — Cones

Spécification géométrique des produits (GPS) — Cotation et tolérancement — Cônes

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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 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.

The committee responsible for this document is ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This fourth edition cancels and replaces the third edition (ISO 3040:2009), which has been technically revised:

— Clause 6 on the tolerancing of cones has been revised;

— Annex A on former practice from ISO 3040:1990 has been deleted;

— a new informative Annex A with examples has been added.

Introduction

This International Standard is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638), applicable to a conical feature. It influences chain links A and B of the chain of standards on size, form, orientation, location and run-out.

For more detailed information about the relationship of ISO 3040 to other standards and to the GPS matrix model, see Annex B.

The ISO/GPS matrix model given in ISO 14638 gives an overview of the ISO/GPS system of which this international standard is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this international standard and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this international standard, unless otherwise indicated.

In this International Standard, the figures illustrate the text only and should not be considered as design examples. For this reason, the figures are simplified and are not to scale.

No indications from the previous edition (ISO 3040:2009) have been made obsolete by this edition. Therefore, there is no 'former practice'.

Geometrical product specifications (GPS) — Dimensioning and tolerancing — Cones

1 Scope

This International Standard specifies graphical indication applicable to a cone (right-angle circular cones) to define its dimensioning or to specify its tolerancing.

For the purposes of this International Standard, the term "cone" relates to right-angle circular cones only (any intersection by a plane perpendicular to the axis of the nominal cone is a circle).

NOTE 1 For simplicity, only truncated cones have been represented in this International Standard. However, this International Standard can be applied to any type of cone within its scope.

NOTE 2 This International Standard is not intended to prevent the use of other methods of dimensioning and tolerancing.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1119:2011, *Geometrical product specifications (GPS) — Series of conical tapers and taper angles*

ISO 81714-1, *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
rate of taper
C
ratio of the difference in the diameters of two sections of a cone to the distance between them

Note 1 to entry: lt is expressed by the following formula (see also Figure 1).

$$C = \frac{D - d}{L} = 2\tan\left(\frac{\alpha}{2}\right) \tag{1}$$

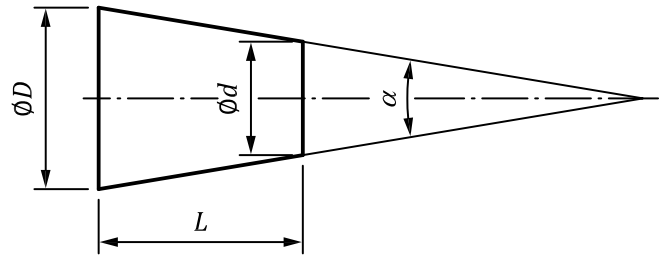


Figure 1

4 Graphical symbol for a rate of taper for a cone

A rate of taper for a cone shall be indicated using the graphical symbol illustrated in Figure 2 centred on a reference line (see Figure 7). The orientation of the graphical symbol shall coincide with that of the cone (see Figure 7 and Figure 8).

Size and line thickness of the graphical symbol are according to ISO 81714-1.

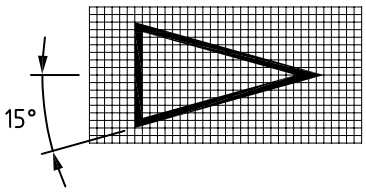


Figure 2

5 Dimensions and indication on a cone

5.1 Dimensions on a cone

Several kinds of dimensions as shown in Table 1 may be used in order to define a cone.

Table 1 — Dimensions on a cone

Type of dimensions	Letter symbol	Examples of indication	
		Preferred method	Optional method
Rate of taper value	C	1:5 1/5	0,2:1 20 %
Cone angle value	α	35°	0,6 rad
Cone diameter value			
— at the larger end	D		
— at the smaller end	d		
— at the specified cross-section	D_x		
Length value			
— Distance between two planes limiting a cone	L		
— Distance between two planes limiting a set of a cone and a cylinder	L'		
— Distance locating the cross-section where D_x is defined	L_x		

No more dimensions than necessary shall be indicated. However, additional dimensions may be given for information as auxiliary dimensions.

Some dimensions may be used to establish a tolerancing by dimensional or geometrical specification (see Clause 6). For this reason these dimensions may be defined as TEDs.

Some typical combinations of cone dimensions are shown in Figure 3, Figure 4, Figure 5 and Figure 6.

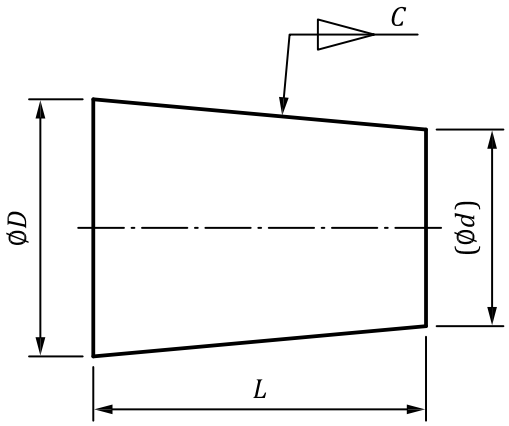


Figure 3

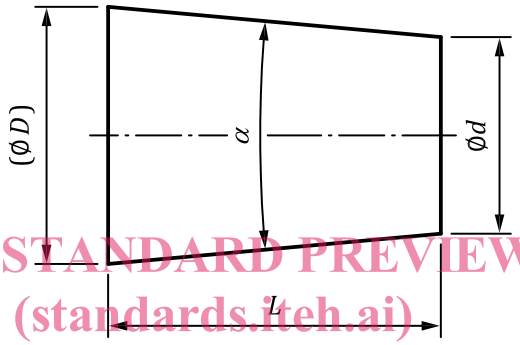


Figure 4

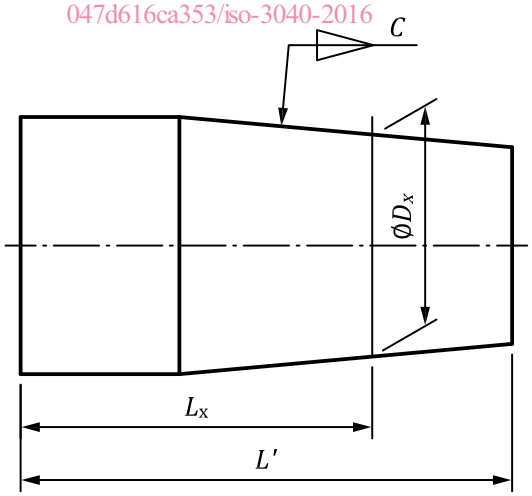


Figure 5

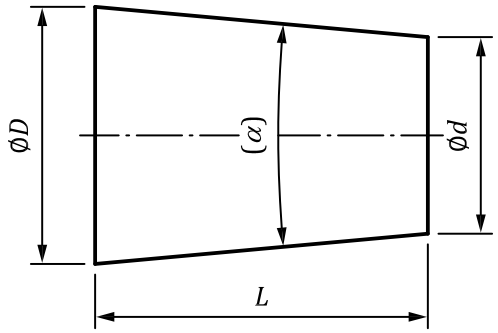


Figure 6

5.2 Indication of rate of taper value on drawings

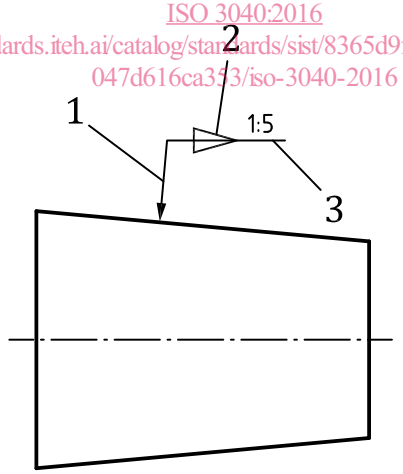
The graphical symbol with the rate of taper value of a cone shall be indicated near the feature according to the rules presented in Clause 4.

As shown in Figure 7, the reference line attached to the graphical symbol shall be:

— drawn parallel to the cone axis, and

— connected by a leader line to the outline of the cone.

When the taper belongs to a standardized series of conical taper (in particular Morse or metric taper), the rate of taper value of the cone may be replaced by the codification given by standard series according to ISO 1119 and appropriate number (see Figure 8). For example, the rate of taper value "1:20,047" may be replaced by the codification "Morse No. 1".



Key

1 leader line

2 rate of taper graphical symbol

3 reference line

NOTE 1:5 is the rate of taper value.

Figure 7

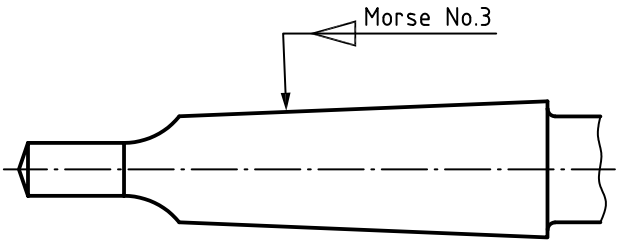


Figure 8

6 Tolerancing of a cone

A cone is intrinsically defined by its angle (see Figure 9).

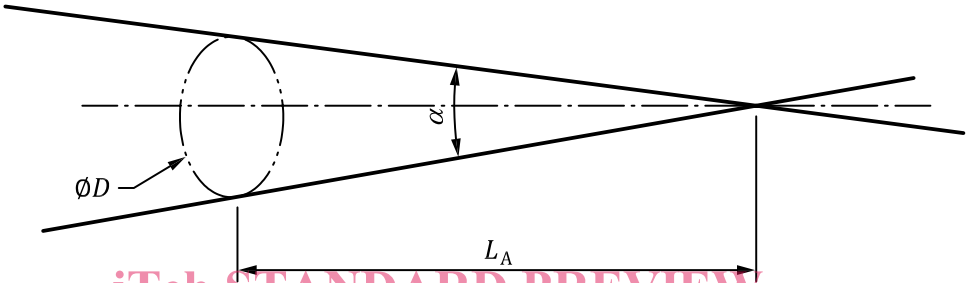
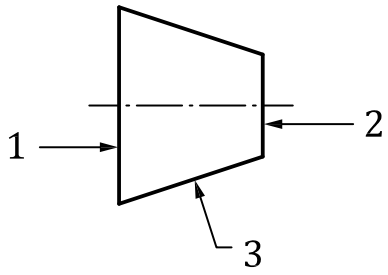


Figure 9 — Intrinsic representation of a cone

NOTE A cone is different from a frustum which is defined by three geometrical entities (one of them is a cone).

EXAMPLE A frustum defined by a cone and two end planes (not necessarily perpendicular to the axis of this cone). See Figure 10.



Key

1 Plane 1
2 Plane 2
3 cone

Figure 10 — Example

The objective of tolerancing is to define a set of one or more GPS specifications. Each GPS specification defines a particular characteristic and its permissible extent by the mean of one or two tolerances limits (see example in Figure 11).

When a gauge plane is used in a specification, the gauge plane location shall be defined by TEDs (explicit or implicit: 0 mm).

When a datum or datum system is used to locate or orientate the tolerance zone, the angular or linear dimensions constraining the tolerance zone shall be defined by TEDs (explicit or implicit:0 mm, 0°, 90 °, 180°, 270°).

When a geometrical specification is applied to a cone with the surface profile characteristic symbol without datum or datum system and the intrinsic characteristic of the cone shall be taken into account as fixed, then:

— the symbol VA shall not be indicated in the second compartment of the tolerance frame; and

— the angle of the cone shall be indicated:

  — directly with the cone angle as a TED, or

  — indirectly with the rate of taper value or by a combination of several dimensions on a cone (e.g. see Figure 6).

Each characteristic controls a set of degrees of freedom on the real workpiece.

The set of degrees of freedom, which are possible to consider individually or collectively, is:

— the angle deviation;

— the form deviation on a section line or the surface;

— the location deviation (X, Y, Z : in Cartesian system);

— the orientation deviation (β, γ : in Cartesian system).

The table in Figure 11 presents, for a specification, the type of deviations which are controlled. The indication of the specification is presented and its meaning is illustrated and explained. This presentation is used in Annex A.

Figure 11 and Annex A present various individual (independent) examples of possible dimensional or geometrical specifications in relation with a cone, in accordance with ISO 1101, ISO 14405-1 and ISO 14405-3. Each of these examples shall be considered independently from each other, but could be used in the same drawing on the same feature.

