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Sixth edition
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Rolling bearings — Radial bearings — Geometrical product specifications (GPS) and tolerance values

Roulements — Roulements radiaux — Spécification géométrique des produits (GPS) et valeurs de tolérance

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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 document 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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 4, *Rolling bearings*, Subcommittee SC 4, *Rolling bearings - Vocabulary, boundary dimensions and geometrical product specifications*.

This sixth edition cancels and replaces the fifth edition (ISO 492:2014), which has been technically revised.

The main changes are as follows:

— symbols have been revised and the symbol list amended;

— some revisions have been made to the geometrical product specifications (GPS) system, such as the indication of K_{ia} and K_{ea};

— revisions have been made to the symbol for width of asymmetric rings and assembled bearing;

— an extension of deviation limits and tolerance values towards larger bore diameter and outside bearing diameters in Tables 4 to 26 has been made;

— the tables for the radial bearings and the tapered roller bearings, such as the headings, notes of tables and some other values, have been aligned;

— Annexes A, B, C and D (in ISO 492:2014) have been deleted;

— the stiffness series of tapered roller bearings and background information regarding affected tolerance values have been added in new Annexes A and B.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a machine element geometry standard as defined in the geometrical product specifications (GPS) system presented in matrix model of ISO 14638[7].

The fundamental rules of ISO GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1[5] apply to specifications made in accordance with this document, unless otherwise indicated.

The connection between functional requirements, measuring technique, and measuring uncertainty should always be considered. For measurement uncertainty, ISO 14253-2[6] should be considered.

This document uses most of the existing symbols associated with rolling bearings because they are well established in the market. In some cases, new terms are derived from the full GPS definition. The definitions of the established terms and symbols are necessarily changed according to the GPS rules. These changes of terms, definitions and symbols for geometrical product specifications (GPS) to define characteristics and tolerances of rolling bearing components and assemblies are given in ISO 22872 and incorporated in this document.

The representation of symbols, tolerance values, limits of size, deviation limits and limit values derived from GPS indications according to, for example, ISO 1101 and ISO 14405-1, including indications in tables and graphical descriptions, have been revised and implemented in accordance with the principles of ISO 22872.

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Rolling bearings — Radial bearings — Geometrical product specifications (GPS) and tolerance values

1 Scope

This document specifies dimensional and geometrical characteristics, deviation limits from nominal sizes, and tolerance values to define the interface (except chamfers) of radial rolling bearings. Nominal boundary dimensions are defined in ISO 15, ISO 355[2] and ISO 8443[4].

This document does not apply to certain radial bearings of particular types (e.g. needle roller bearings) or for particular fields of application (e.g. airframe bearings). Tolerances for such bearings are given in the relevant International Standards.

Chamfer dimension limits are given in ISO 582[3].

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirement 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 15:2017, *Rolling bearings — Radial bearings — Boundary dimensions, general plan*

ISO 1101:2017, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 5593, *Rolling bearings — Vocabulary*

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

ISO 14405-1:2016, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO/TS 17863:2013, *Geometrical product specification (GPS) — Tolerancing of moveable assemblies*

ISO 22872, *Rolling bearings — Geometrical product specifications (GPS) — Vocabulary and representation of symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15, ISO 1101, ISO 5593, ISO 14405-1, ISO/TS 17863 and ISO 22872 apply.

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

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

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

4 Symbols

4.1 Symbols for physical quantities

Symbols in Table 1 represent physical quantities in the GPS environment and may sometimes be applied to more than one physical quantity.

In this document, the symbols for tolerance values, deviation limits and limit values are preceded by letter "t" in figures and tables.

EXAMPLE 1 $t_{\Delta Bs}$, t_{Vdmp}.

In this document, the symbols for nominal dimensions and values of upper/lower limit of size are not preceded by the letter "t" because those values are usually interpreted as nominal dimensions.

EXAMPLE 2 C, D.

Table 1 — Symbols for dimensions and tolerance values

Symbol	Description	Figure
a	Distance from face to define the restricted area for S_D or S_{D1}	3, 8, 13
B	Nominal inner ring width	1, 2, 7, 12
C	Nominal outer ring width	1, 2, 7, 12
C_1	Nominal outer ring flange width	12
D	Nominal outside diameter	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
D_1	Nominal outside diameter of outer ring flange	12
d	Nominal bore diameter <cylindrical bore>	1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 16
d	Nominal bore diameter <tapered bore>	7
d_1	Nominal bore diameter at the theoretical large end of a tapered bore	7
S_L	Nominal tapered slope	7
T	Nominal assembled bearing width <tapered roller bearing>	17
T_1	Nominal effective width of inner subunit assembled with a master outer ring <tapered roller bearing>	17
T_2	Nominal effective width of outer ring assembled with a master inner subunit	17
T_F	Nominal width of an assembled flanged bearing	17
T_{F2}	Nominal effective width between an outer ring flange with a master inner subunit	17
t_{Kea}	Tolerance value for range of section height at outer ring of assembled bearing	4, 5, 6, 9, 10, 11, 14, 15, 16
t_{Kia}	Tolerance value for range of section height at inner ring of assembled bearing	4, 5, 6, 9, 10, 11, 14, 15, 16
t_{SD}	Tolerance value for perpendicularity of outer ring outside surface to the face	3, 8
t_{SD1}	Tolerance value for perpendicularity of outer ring outside surface to the flange back face	13
t_{Sd}	Tolerance value for run-out of inner ring face to the bore	3, 8, 13
t_{Sea}	Tolerance value for axial run-out of outer ring of assembled bearing	5, 6, 10, 11
t_{Sea1}	Tolerance value for axial run-out of outer ring flange back face of assembled bearing	15, 16
t_{Sia}	Tolerance value for axial run-out of inner ring of assembled bearing	5, 6, 10, 11, 15, 16

Table 1 *(continued)*

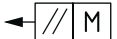| Symbol	Description	Figure
t_{VBgp}	Tolerance value for range of inner ring width with faces offset or narrow	2, 7
t_{VBs}	Tolerance value for range of inner ring width with faces directly opposite	1, 12
t_{VCgp}	Tolerance value for range of outer ring width with faces offset or narrow	2, 12
t_{VCs}	Tolerance value for range outer ring width with faces directly opposite	1, 7
t_{VC1s}	Tolerance value for range of outer ring flange width	12
t_{VDmp}	Tolerance value for range of mid-range outside diameter	1, 2, 7, 12
t_{VDsp}	Tolerance value for range of outside diameter	1, 2, 7, 12
t_{Vdmp}	Tolerance value for range of mid-range bore diameter	1, 2, 12
t_{Vdsp}	Tolerance value for range of bore diameter	1, 2, 7, 12
$t_{\Delta Bgp}$	Upper deviation limit of inner ring width with faces offset or narrow	2, 7
$t_{\Delta Bs}$	Upper and lower deviation limits of inner ring width with faces directly opposite	1, 12
$t_{\Delta Bs}$	Lower deviation limit of inner ring width with faces offset or narrow	2, 7
$t_{\Delta Cgp}$	Upper deviation limit of outer ring width with faces offset or narrow	2, 12
$t_{\Delta Cs}$	Upper and lower deviation limits of outer ring width with faces directly opposite	1, 7
$t_{\Delta Cs}$	Lower deviation limit of outer ring width with faces offset or narrow	2, 12
$t_{\Delta C1s}$	Upper and lower deviation limits of outer ring flange width	12
$t_{\Delta Dmp}$	Upper and lower deviation limits of mid-range outside diameter	1, 2, 7, 12
$t_{\Delta Ds}$	Upper and lower deviation limits of outside diameter	1, 2, 7, 12
$t_{\Delta D1s}$	Upper and lower deviation limits of outside diameter of outer ring flange	12
$t_{\Delta dmp}$	Upper and lower deviation limits of mid-range bore diameter <cylindrical bore>	1, 2, 12
$t_{\Delta dmp}$	Upper and lower deviation limits of mid-range bore diameter <tapered bore>	7
$t_{\Delta d1mp}$	Upper and lower deviation limits of a mid-range bore diameter at the theoretical large end of an inner ring <tapered bore>	7
$t_{\Delta ds}$	Upper and lower deviation limits of bore diameter	1, 2, 12
$t_{\Delta SL}$	Upper and lower deviation limits of tapered slope	7
$t_{\Delta Tg}$	Upper and lower deviation limits of the actual bearing width <tapered roller bearing>	17
$t_{\Delta T1g}$	Upper and lower deviation limits of the actual effective width of inner subunit <tapered roller bearing>	17
$t_{\Delta T2g}$	Upper and lower deviation limits of the actual effective width of outer ring	17
$t_{\Delta TFg}$	Upper and lower deviation limits of the actual bearing width of flanged bearing	17
$t_{\Delta TF2g}$	Upper and lower deviation limits of the actual effective width of flanged outer ring	17
α	Angel of tapered inner ring bore	7, 8, 9, 10, 11

4.2 Additional symbols

Symbols defined in standards other than ISO 22872 and used in this document are presented in Table 2 for information.

These includes symbols for specification modifiers, complementary specification modifiers and geometrical characteristics.

Table 2 — Additional symbols defined in other standards

| Symbol	Description	Figure	Reference
ACS	Any cross-section	1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16	ISO 14405-1:2016, 7.4
ALS	Any longitudinal section	2, 7, 12	ISO 14405-1:2016, 7.4
Ⓖ🄽	Minimum circumscribed size	2, 7, 12, 17	ISO 14405-1:2016, 3.7.1.3
Ⓛ🄿	Two-point size	2, 7, 12	ISO 14405-1:2016, 3.6.1
Ⓢ🄳	Mid-range size	1, 2, 7, 12	ISO 14405-1:2016, 3.7.2.2.5
Ⓢ🅁	Range of sizes	1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16	ISO 14405-1:2016, 3.7.2.2.6
//	Parallelism	2, 7, 12	ISO 1101:2017, 17.10
⊥	Perpendicularity	3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16	ISO 1101:2017, 17.11
⩵	Symmetry	2, 7, 12	ISO 1101:2017, 17.15
↗	Circular run-out	3, 5, 6, 8, 10, 11, 13, 15, 16	ISO 1101:2017, 17.16
◁═│M│ a	Intersection plane indicator	2, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16,	ISO 1101:2017, 13
◄─│//│M│ a	Direction feature indicator	2, 7, 12	ISO 1101:2017, 15
FP	Fixed part	4, 5, 6, 9, 10, 11, 14, 15, 16	ISO/TS 17863:2013, 6.10.1.1
MP	Moveable part	4, 5, 6, 9, 10, 11, 14, 15, 16	ISO/TS 17863:2013, 6.10.1.1
⬇G	Gravity	4, 5, 6, 9, 10, 11, 14, 15, 16, 17	ISO/TS 17863:2013, 6.3
⬡1 a	Flag	4, 5, 6, 9, 10, 11, 14, 15, 16, 17	ISO/TS 17863:2013, 6.8 and 6.9
a Letters and characteristic symbols are examples.			

5 Graphical description

To express that the ISO GPS system in ISO 8015 is applied, the dimensional and geometrical characteristics shall be included in the technical product documentation (e.g. on the drawing). The dimensional and geometrical specifications associated to these characteristics are described in Figures 1 to 17.

According to ISO 8015, specifications shall be completed with specification operators, e.g. filtration. These may be agreed between manufacturer and customer case by case.

The indications in Figures 1 to 17 illustrate the correlation of interface dimensions and corresponding dimensional and geometrical tolerance symbols. The specifications for single components are illustrated in Figures 1, 2, 3, 7, 8, 12 and 13. The specifications for assembled bearings are illustrated in Figures 4, 5, 6, 9, 10, 11, 14, 15, 16 and 17. The examples are not intended to cover all possible assemblies.

NOTE   Figures 1 to 17 are drawn schematically and do not necessarily show all design details.
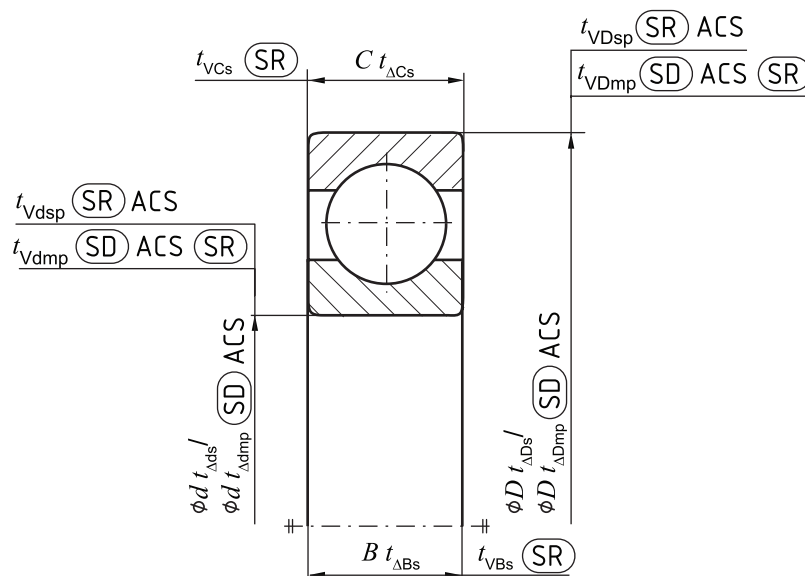
NOTE   The symbol "/" (forward slash) shows alternative specification indications depending on tolerance class and diameter series.

Figure 1 — Size specification for single components of bearing with cylindrical bore and symmetrical rings
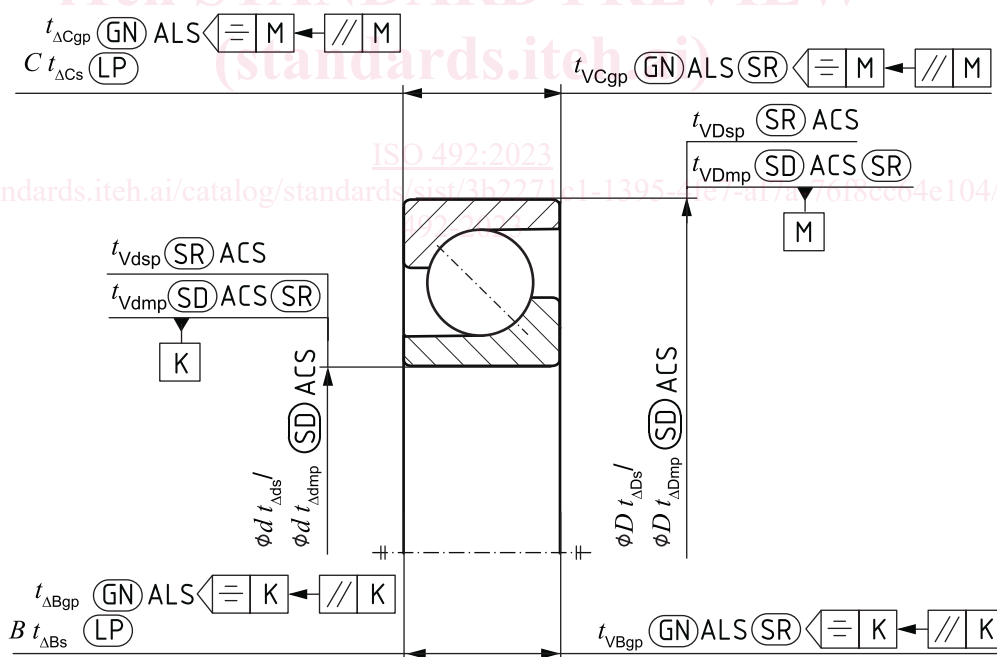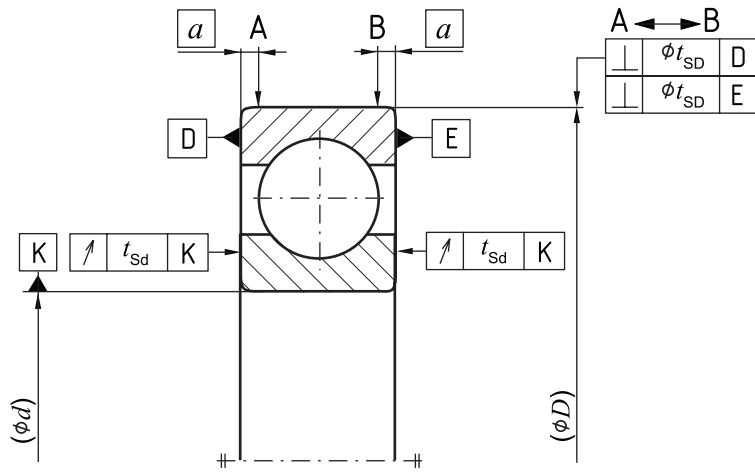

NOTE   The symbol "/" (forward slash) shows alternative specification indications depending on tolerance class and diameter series.

Figure 2 — Size specification for single components of bearing with cylindrical bore and asymmetrical rings
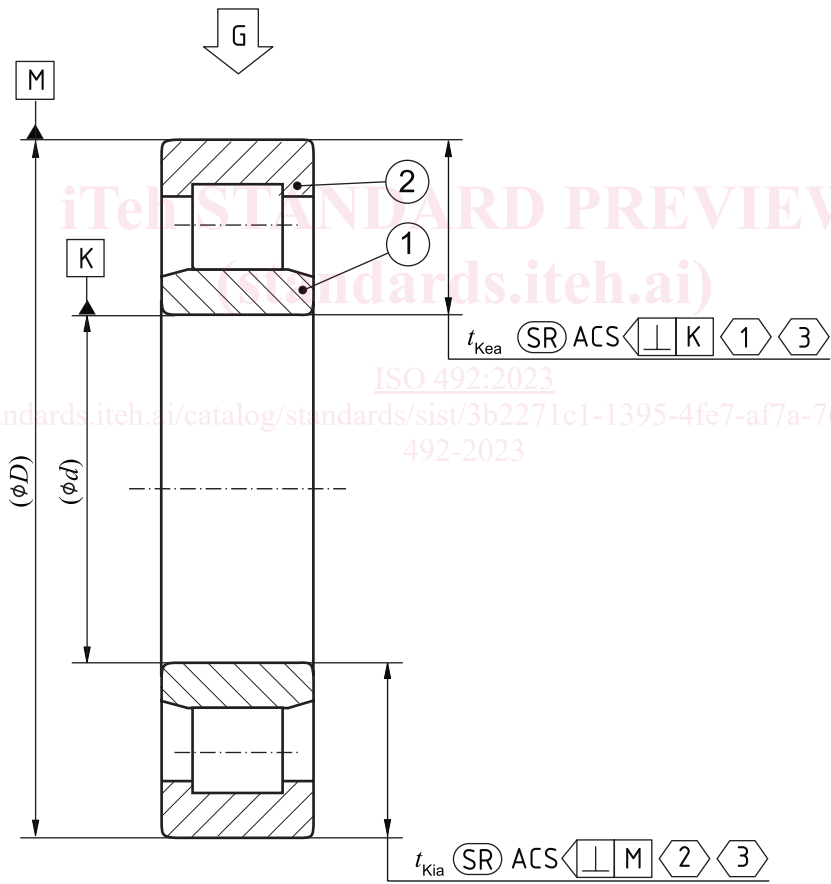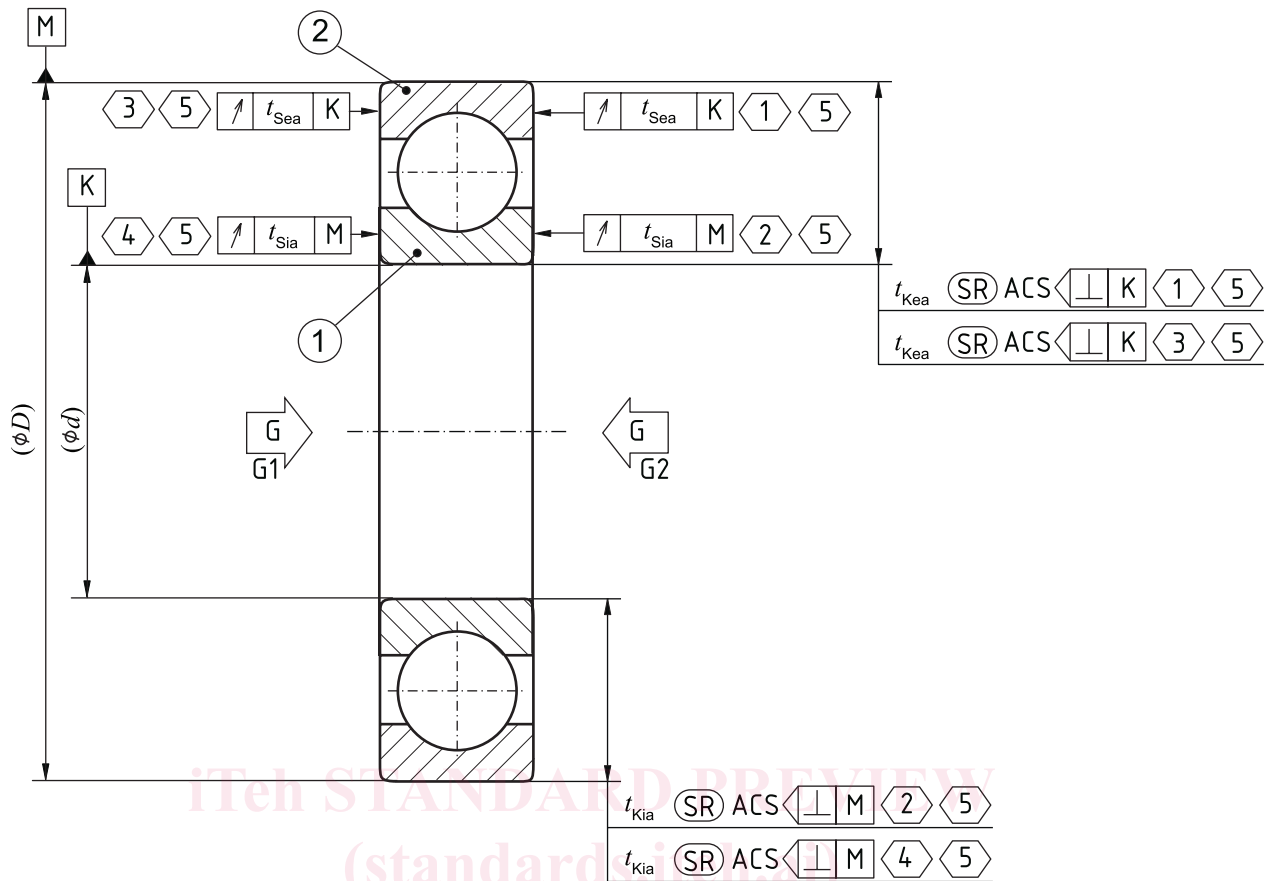
Figure 3 — Geometrical tolerances for single components of bearing with cylindrical bore

Key

⟨1⟩ = FP ① - MP ② , G

⟨2⟩ = FP ② - MP ① , G

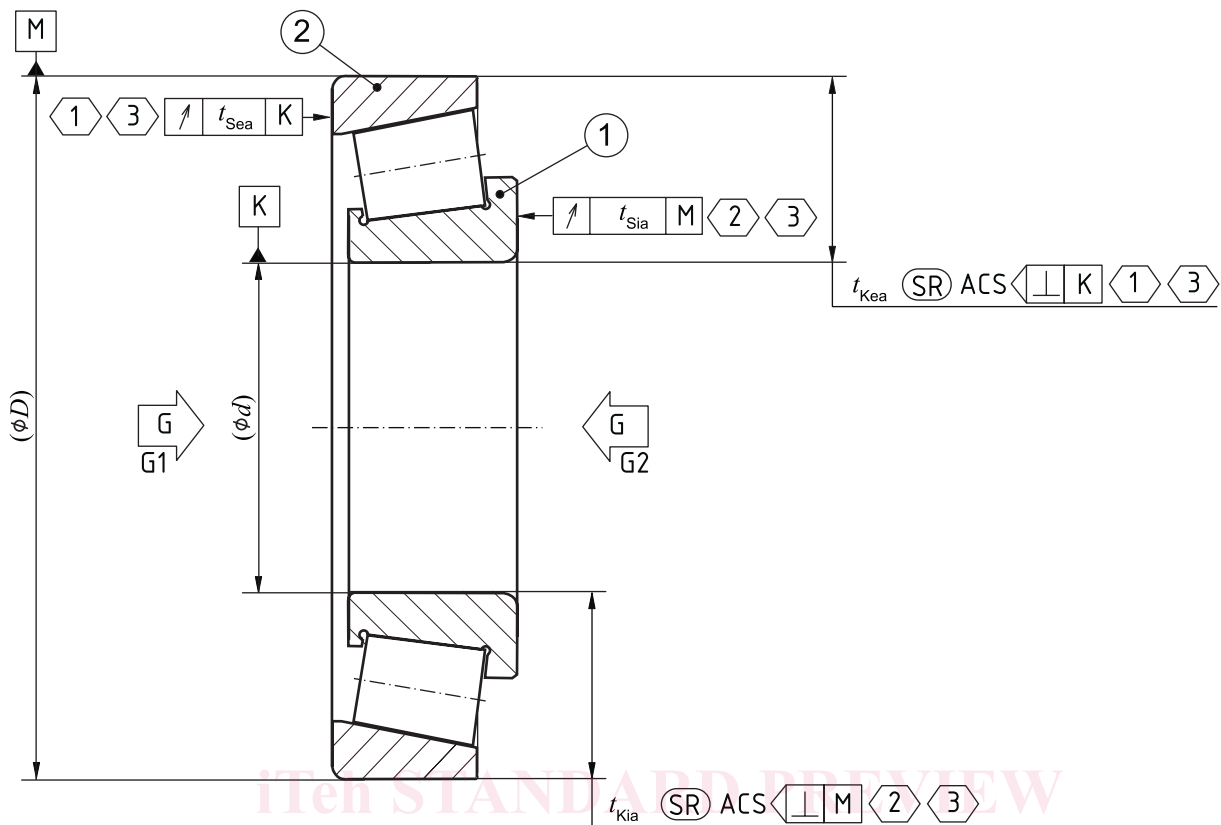⟨3⟩ = the rolling elements shall be in correct functional contact with both the inner and outer rings

Figure 4 — Geometrical tolerances for assembled bearing with cylindrical bore — Cylindrical roller bearing, spherical roller bearing, toroidal roller bearing and self-aligning ball bearing

Key

$\langle 1 \rangle$ = FP ① - MP ②, G2

$\langle 2 \rangle$ = FP ② - MP ①, G2

$\langle 3 \rangle$ = FP ① - MP ②, G1

$\langle 4 \rangle$ = FP ② - MP ①, G1

$\langle 5 \rangle$ = the rolling elements shall be in correct functional contact with both the inner and outer rings

Figure 5 — Geometrical tolerances for assembled bearing with cylindrical bore — Deep groove ball bearing, double-row deep groove ball bearing, double-row angular contact ball bearing and four-point-contact ball bearing

Key

⟨1⟩	= FP ① - MP ② , G1
⟨2⟩	= FP ② - MP ① , G2
⟨3⟩	= the rolling elements shall be in correct functional contact with both the inner and outer rings

Figure 6 — Geometrical tolerances for assembled bearing with cylindrical bore — Single-row angular contact ball bearing and tapered roller bearing
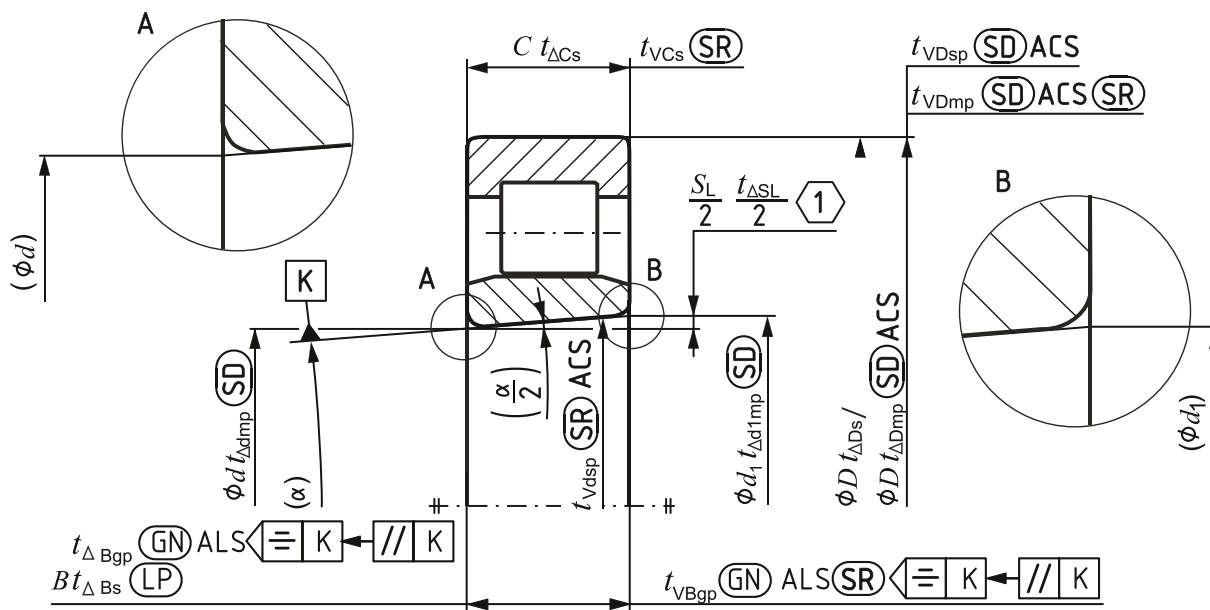
Key

⟨1⟩ =
S_L is a calculated nominal size according to Formula (1)
$t_{\Delta SL}$ is a calculated characteristic according to Formula (2)

$$S_L = (d_1 - d) = 2B \tan(\alpha/2) \tag{1}$$

$$t_{\Delta SL} = t_{\Delta d1mp} - t_{\Delta dmp} \tag{2}$$

NOTE 1 See Figure 2 for indications on asymmetrical outer ring.

NOTE 2 The symbol "/" (forward slash) shows alternative specification indications depending on tolerance class and diameter series.

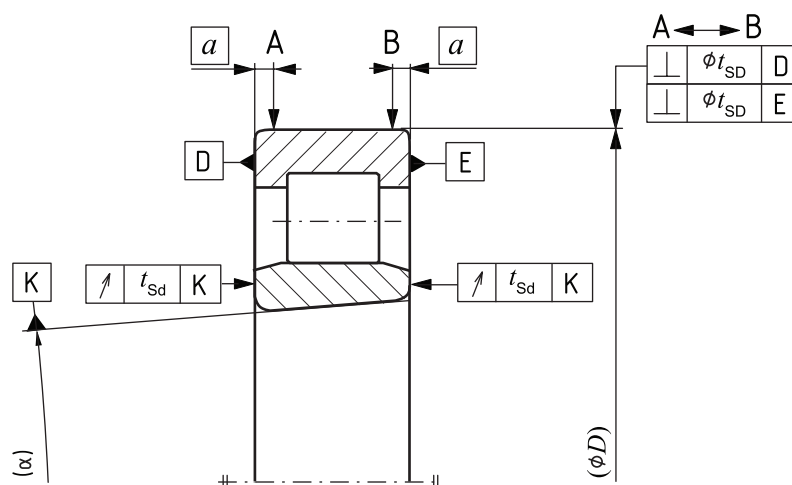**Figure 7 — Size specification for single components of bearing with tapered bore**

Figure 8 — Geometrical tolerances for single components of bearing with tapered bore