INTERNATIONAL STANDARD

**ISO 13012-2**

Second edition
2018-12

# Rolling bearings — Accessories for sleeve type linear ball bearings —

## Part 2: Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 5

*Roulements — Accessoires pour douilles à billes linéaires —*

*Partie 2: Dimensions d'encombrement, spécification géométrique des produits (GPS) et tolérances pour la série 5*



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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 11, *Linear motion rolling bearings*.

This second edition cancels and replaces the first edition (ISO 13012-2:2009), which has been technically revised. The main changes compared to the previous edition are as follows:

— Change of title;

— Change of scope;

— Update of normative references;

— Revision of terms, definitions, symbols and dimensional tolerance indications in figures and tables according to rules of geometrical product specification (GPS) system;

— Inclusion of Tables 2, 4, 6, 8;

— Inclusion of a bibliography.

A list of all the parts in the ISO 13012 series can be found on the ISO website.

This document was developed to be used in conjunction with ISO 10285.

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 specification system (GPS system) as presented in matrix model of ISO 14638[5].

The fundamental rules of ISO/GPS given in ISO 8015[2] apply to this document and the default decision rules given in ISO 14253-1[3] apply to specifications made in accordance with this document, unless otherwise indicated.

The connection between functional requirements, measuring technique and measuring uncertainty is always intended to be considered. For measurement uncertainty, it is intended that ISO 14253-2[4] be considered.

The use of sleeve type linear ball bearings can be facilitated by the selection of bearing housings, shafts, shaft support blocks and shaft support rails. These items, referred to as accessories, can aid in the application of the sleeve type linear ball bearings to achieve the desired criteria of smooth, accurate and low friction linear motion free from chatter or stick-slip.

The appropriate selection of bearing housing type, shaft and shaft support should be established between the manufacturer and the user.

# Rolling bearings — Accessories for sleeve type linear ball bearings —

# Part 2: Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 5



## 1 Scope

This document specifies the boundary dimensions, other relevant dimensions and the corresponding tolerances of accessories for sleeve type linear ball bearings which are specified in ISO 10285.

This document applies to:

— the following housings:

  — closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings,

  — open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings;

— standard height shaft support rails for series 5 sleeve type linear ball bearings;

— flanged shaft support blocks for series 5 sleeve type linear ball bearings;

— solid and tubular shafts for series 5 sleeve type linear ball bearings.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1132-1, *Rolling bearings — Tolerances — Part 1: Terms and definitions*

ISO 5593, *Rolling bearings — Vocabulary*

ISO 10285, *Rolling bearings — Sleeve type linear ball bearings — Boundary dimensions and tolerances*

ISO 15241, *Rolling bearings — Symbols for physical quantities*

ISO 18203, *Steel — Determination of the thickness of surface-hardened layers*

ISO 24393, *Rolling bearings — Linear motion rolling bearings — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1132-1, ISO 5593, ISO 10285,

ISO 24393 and the following apply.

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

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

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

**3.1**
**flangeless housing**
<sleeve type linear ball bearing> bearing housing which has a face with bolt holes or threaded holes for attachment to a support surface nominally parallel to the bearing axis

**3.2**
**closed housing**
<sleeve type linear ball bearing> bearing housing in which the bearing seating is circumferentially continuous

**3.3**
**adjustable housing**
<sleeve type linear ball bearing> bearing housing with a longitudinal slit across its bearing seating which facilitates the mechanical adjustment of the bearing seating diameter

**3.4**
**open housing**
<sleeve type linear ball bearing> bearing housing with a longitudinal section removed to provide clearance over a *shaft* (3.8) and support rail unit

**3.5**
**open adjustable housing**
<sleeve type linear ball bearing> bearing housing which has the features of both *open* (3.4) and *adjustable* (3.3) sleeve type linear ball bearing housings

**3.6**
**shaft support rail**
longitudinal pedestal which provides continuous support to a *shaft* (3.8)

Note 1 to entry: Shaft support rails may be used with open sleeve type linear ball bearings.

**3.7**
**shaft support block**
block which provides support to a *shaft* (3.8)

Note 1 to entry: Shaft support blocks are normally used to support the shaft at its ends and can be used with closed sleeve type, adjustable sleeve type or open sleeve type linear ball bearings.

**3.8**
**shaft**
basically cylindrical rod along which a linear ball bearing traverses

## 4 Symbols

### 4.1 General

For the purposes of this document, the symbols given in ISO 15241 and the following apply.

The symbols (except those for tolerances) shown in Figures 1 to 5 and the values given in Tables 1 to 10 denote nominal dimensions, unless specified otherwise.

NOTE Figures 1 to 5 are drawn schematically and do not necessarily show all design details.

Tolerance values associated to a characteristic are symbolized by $t$ followed by the symbol of characteristic, for example, $t_{p1}$.

In this document, the ISO default specification operator for size is according to ISO 14405-1, i.e. the two-point size is valid.



### 4.2 Closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings

See Tables 1 and 2, and Figure 1.

$A$ (overall) width

$D_a$ seating diameter

$F_w$ bore diameter of ball complement of sleeve type linear ball bearing (reference)

$G$ designation of screw thread of attachment hole

$H$ distance from mounting face to centreline of seating diameter

$H_1$ (overall) height

$J$ centre distance between bolt holes (length)

$J_1$ centre distance between bolt holes (width)

$L$ length of housing

$N$ diameter of bolt hole

$t_{p1}$ position tolerance of bore in correlation to mounting surface

$t_{p2}$ position tolerance of threaded holes in correlation to mounting surface and mounting reference surface

$t_{p3}$ position tolerance of bore in correlation to mounting surface

### 4.3 Open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings

See Tables 3 and 4, and Figure 2.

$A$ (overall) width

$D_a$ seating diameter

$E$ width of sector opening (at diameter $D_a$)

$F_w$ bore diameter of ball complement of sleeve type linear ball bearing (reference)

$G$ designation of screw thread of attachment hole

$H$ distance from mounting face to centreline of seating diameter

$H_1$ (overall) height

$J$ centre distance between bolt holes (length)

$J_1$ centre distance between bolt holes (width)

$L$ length of housing

$t_{p1}$ position tolerance of bore in correlation to mounting surface

$t_{p2}$ position tolerance of threaded holes in correlation to mounting surface and mounting reference surfaces

$t_{p3}$ position tolerance of bore in correlation to mounting surface

$\alpha$ angle of sector opening

## 4.4 Standard height shaft support rails for series 5 sleeve type linear ball bearings

See Tables 5 and 6, and Figure 3.

$A$ (overall) width

$D$ outside diameter of shaft (reference)

$F_w$ bore diameter of ball complement of sleeve type linear ball bearing (reference)

$H$ distance from mounting face to centreline of shaft

$H_1$ height of flange

$J$ centre distance between bolt holes (length)

$J_1$ centre distance between bolt holes (width)

$M$ width of shaft support

$N$ diameter of bolt hole

$N_1$ diameter of bolt hole (shaft attachment)

$t_{p1}$ position tolerance of centreline of shaft in correlation to mounting surface

$t_{p2}$ position tolerance of centreline of shaft in correlation to mounting reference surface

$t_{p3}$ position tolerance of mounting holes in correlation to mounting surface and mounting reference surface

$\beta$ angle of shaft support

## 4.5 Flanged shaft support blocks for series 5 sleeve type linear ball bearings

See Tables 7 and 8, and Figure 4.

$A$ (overall) width

$D_a$ seating diameter

$F_w$ bore diameter of ball complement of sleeve type linear ball bearing (reference)

$H$ distance from mounting face to centreline of seating diameter

$H_1$ height of flange

$H_2$ (overall) height

$J$ centre distance between bolt holes (length)

$L$ length of base

$N$ diameter of bolt hole

$t_{p1}$ position tolerance of bore in correlation to mounting surface

$t_{p2}$ position tolerance of bore in correlation to mounting reference surface

$t_{p3}$ position tolerance of mounting holes in correlation to mounting surface and mounting reference surface

### 4.6 Solid and tubular shafts for series 5 sleeve type linear ball bearings

See Tables 9 and 10, and Figure 5.

$d$ outside diameter of shaft

$d_s$ single outside diameter of shaft

$k$ run-out

$k_{adj}$ adjusted run-out derived from discrete shaft length

$k_1$ total indicator reading (TIR) at shaft position 1

$k_2$ total indicator reading (TIR) at shaft position 2

$k_3$ total indicator reading (TIR) at shaft position 3

$L$ length of shaft

$L_s$ actual length of shaft

$l_{ch}$ length of chamfer in axial direction

$V_{dmp}$ variation of mean outside diameter of shaft

$V_{dsp}$ variation of outside diameter of shaft in a single plane

$\Delta_{ds}$ deviation of a single outside diameter of shaft

$\Delta_{Ls}$ deviation of the actual length of shaft

## 5 Housings

### 5.1 General

To facilitate the design and assembly of sleeve type linear ball bearings, specifically designed housings are available. Included in this document are the boundary dimensions and other related dimensions of sleeve type linear ball bearings series 5 as specified in ISO 10285.

The housings specified in Tables 1 and 3 and the corresponding sleeve type linear ball bearings should be supplied by the same producer. The reason for this is that the fixation of the bearings in the housings is specified by the producer and is not covered by this document.

### 5.2 Housings for series 5 sleeve type linear ball bearings

This document includes the following housing designs for series 5 sleeve type linear ball bearings:

— closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings (Table 1);

— open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings (Table 3).

# 6 Shaft support rails

This document includes the following shaft support rails for sleeve type linear ball bearings:

— standard height shaft support rails for series 5 sleeve type linear ball bearings (Table 5).

# 7 Shaft support blocks

This document includes the following shaft support blocks for sleeve type linear ball bearings:

— flanged shaft support blocks for series 5 sleeve type linear ball bearings (Table 7).

# 8 Shafts

## 8.1 Material

Shafts covered by this document are precision hardened and ground steel shafts in both solid and tubular section. They are manufactured from high quality carbon steel or high quality carbon chrome steel and are either surface hardened or through hardened.

## 8.2 Heat treatment

### 8.2.1 Surface hardened shafts

The cylindrical surface of the shafts is heat treated to provide a basically uniform effective depth of hardening and a surface hardness of not less than 653 HV (58 HRC) over the entire operating length. The effective depth of hardening shall be determined in accordance with ISO 18203. This effective depth of hardening is the distance from the outside surface of the shaft to a material layer at which the hardness is approximately 80 % of the specified minimum surface hardness. End faces of shafts may remain unhardened.

### 8.2.2 Through hardened shafts

The shafts shall be heat treated to give a surface hardness of no less than 653 HV (58 HRC) over the entire operating length.

## 8.3 Geometrical tolerances

### 8.3.1 Tolerance class

The precision hardened and ground solid and tubular shafts are specified in one diameter tolerance class to match the sleeve type linear ball bearing and housing series 5.

### 8.3.2 Geometric form

The geometric form of the tolerance class is controlled by the following features:

a) circularity (roundness): variation of shaft outside diameter in a single plane;

b) cylindricity (taper, concavity, convexity): variation of mean shaft outside diameter;

c) run-out (per metre).

These tolerances for the class are shown in Table 9. A method for measuring run-out is illustrated in Figure 5 and defined in Table 9.



#### 8.3.3 Shaft length tolerances

These tolerances are given in Table 10.

#### 8.3.4 Chamfers

The shaft ends are provided with chamfers to facilitate the entry of the shaft into the sleeve type linear ball bearing. The ends of shafts with machined end faces are usually provided with chamfers that are shallow in the radial direction and long in the axial direction. The length of the chamfer is shown in Table 9. Shafts for use with sealed sleeve type linear ball bearings shall have a chamfer angle less than 30°.

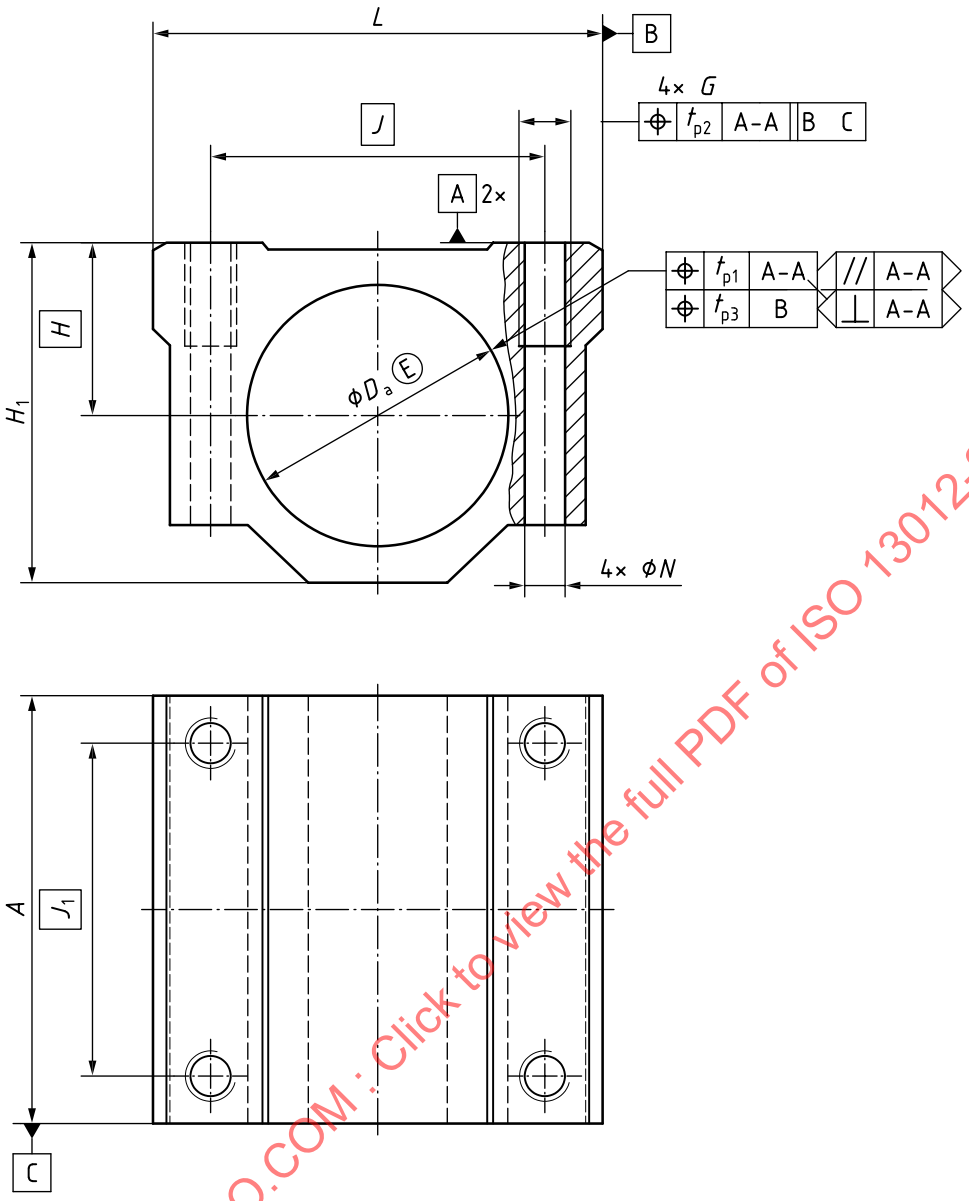
#### 8.3.5 Surface roughness

The roughness of the cylindrical surface of the steel shaft is given in Table 9 in accordance with ISO 1302.

## 9 Boundary dimensions and tolerances

### 9.1 Housings

Boundary dimensions and tolerances for housings are given in Tables 1, 2, 3 and 4.




NOTE 1 Alternatively, there can be two attachment holes.

NOTE 2 This figure shows a closed type housing.

NOTE 3 Identification of reference side face is at the discretion of the manufacturer.

NOTE 4 $D_a$ (E) needs to be measured before the housing is split.

**Figure 1 — Closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings**

**Table 1 — Closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings**

Dimensions in millimetres

| $F_w$ Ref. | $D_a$ H7[a] | $H$[b] | $H_1$ max. | $L$ max. | $J$ | Type 1 $A$ max. | Type 1 $J_1$ | Type 2 $A$ max. | Type 2 $J_1$ | $N$ | $G$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 12 | 9 | 18,5 | 30 | 20 | 25 | 15 | 48 | 36 | 3,4 | M4 |
| 8 | 15 | 11 | 22,5 | 34 | 24 | 30 | 18 | 58 | 42 | 3,4 | M4 |
| 10 | 19 | 13 | 26,5 | 40 | 28 | 35 | 21 | 68 | 46 | 4,3 | M5 |
| 12 | 21 | 15 | 29 | 42 | 30,5 | 36 | 26 | 70 | 50 | 4,3 | M5 |
| 13 | 23 | 15 | 30,5 | 44 | 33 | 39 | 26 | 75 | 50 | 4,3 | M5 |
| 16 | 28 | 19 | 39 | 50 | 36 | 44 | 34 | 85 | 60 | 4,3 | M5 |
| 20 | 32 | 21 | 42 | 54 | 40 | 50 | 40 | 96 | 70 | 5,2 | M6 |
| 25 | 40 | 26 | 52 | 76 | 54 | 67 | 50 | 130 | 100 | 7 | M8 |
| 30 | 45 | 30 | 60 | 78 | 58 | 72 | 58 | 140 | 110 | 7 | M8 |
| 35 | 52 | 34 | 68,5 | 90 | 70 | 80 | 60 | 155 | 120 | 7 | M8 |
| 40 | 60 | 40 | 78,5 | 102 | 80 | 90 | 60 | 175 | 140 | 8,7 | M10 |
| 50 | 80 | 52 | 102,5 | 122 | 100 | 110 | 80 | 215 | 160 | 8,7 | M10 |
| 60 | 90 | 58 | 114,5 | 132 | 108 | 122 | 90 | 240 | 180 | 10,7 | M12 |

NOTE Type 1 housings are designed to be combined with one linear bearing and Type 2 housings are designed to be combined with two linear bearings.

[a] Seating diameter tolerance (see ISO 286-2).

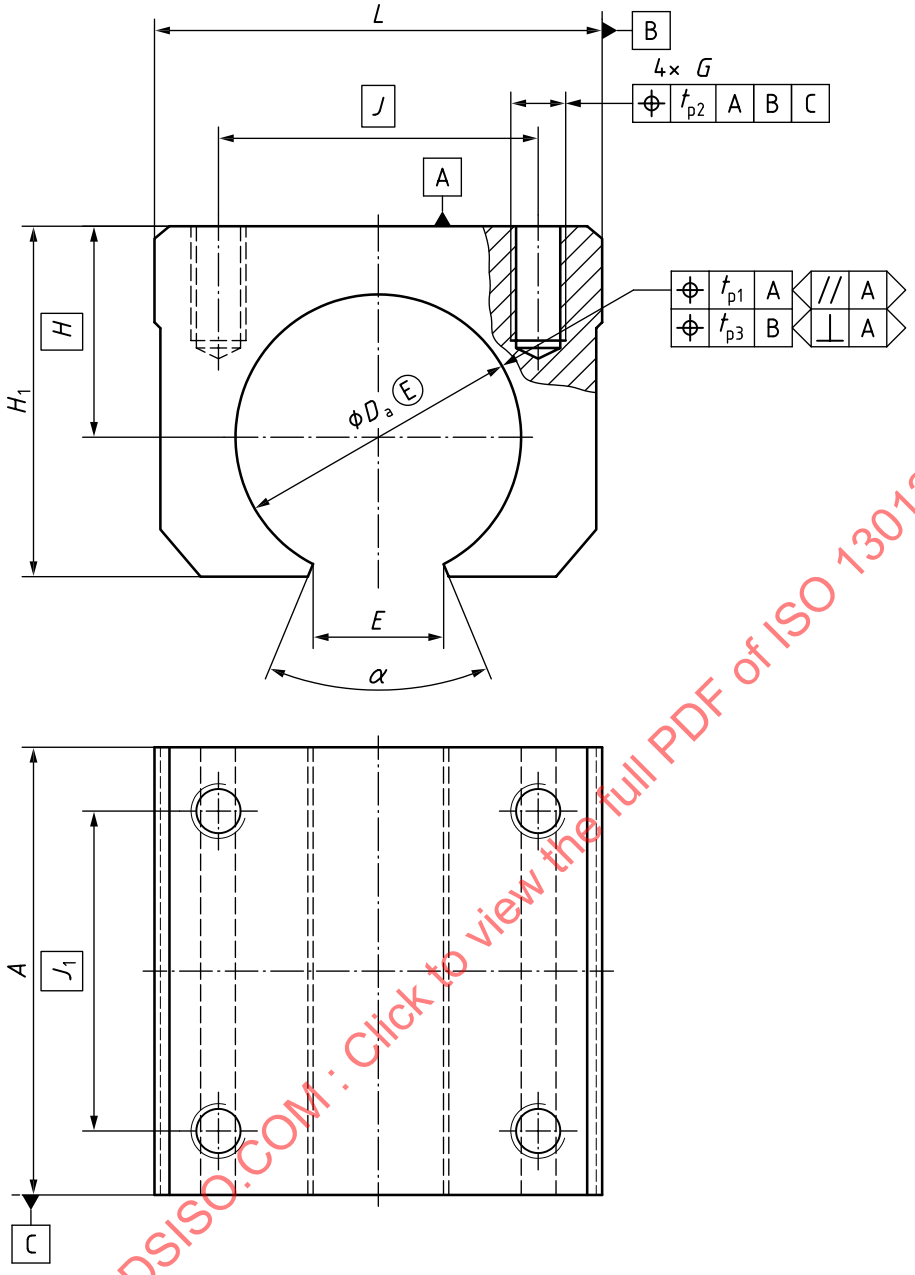
[b] $H$ shall be measured with the nominal seating bore diameter. For adjustable type housings, the tolerance for $D_a$ shall apply before the housing is split.

**Table 2 — Tolerances for closed and adjustable flangeless housings for series 5 sleeve type linear ball bearings**

Dimensions in millimetres

| $F_w$ | $t_{p1}$ | $t_{p2}$[a] | $t_{p3}$[a] |
|---|---|---|---|
| All sizes | 0,04 | (0,04) | (0,04) |

[a] The given values can be used as a guideline for specific agreement between supplier and manufacturer to define $t_{p2}$ and $t_{p3}$.




NOTE 1 Alternatively, there can be two attachment holes.

NOTE 2 This figure shows an open type housing.

NOTE 3 Identification of reference side face is at the discretion of the manufacturer.

NOTE 4 $D_a$ (E) needs to be measured before the housing is split.

**Figure 2 — Open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings**

**Table 3 — Open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings**

Dimensions in millimetres and angles in degrees

| $F_w$ Ref. | $D_a$[a] JS7[b] | $H$[c] | $H_1$ max. | $L$ max. | $A$ max. | $J$ | $J_1$ | $G$ | $\alpha$ min. | $E$ min. |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 23 | 17 | 28 | 40 | 39 | 28 | 26 | M5 | 80 | 14,8 |
| 16 | 28 | 20 | 34 | 45 | 45 | 32 | 30 | M5 | 80 | 17,7 |
| 20 | 32 | 23 | 39 | 48 | 50 | 35 | 35 | M6 | 60 | 16 |
| 25 | 40 | 28 | 48 | 60 | 65 | 40 | 40 | M6 | 50 | 16,9 |
| 30 | 45 | 33 | 56 | 70 | 70 | 50 | 50 | M8 | 50 | 19 |
| 35 | 52 | 37 | 63 | 80 | 80 | 55 | 55 | M8 | 50 | 22 |
| 40 | 60 | 42 | 72 | 90 | 90 | 65 | 65 | M10 | 50 | 25,4 |
| 50 | 80 | 53 | 92 | 120 | 110 | 94 | 80 | M10 | 50 | 33,8 |

a $D_a$ can only be measured when the housing is fastened to a plane surface.

b Seating diameter tolerance (see ISO 286-2).

c $H$ shall be measured with the nominal seating bore diameter.

**Table 4 — Tolerances for open and open adjustable flangeless housings for series 5 sleeve type linear ball bearings**

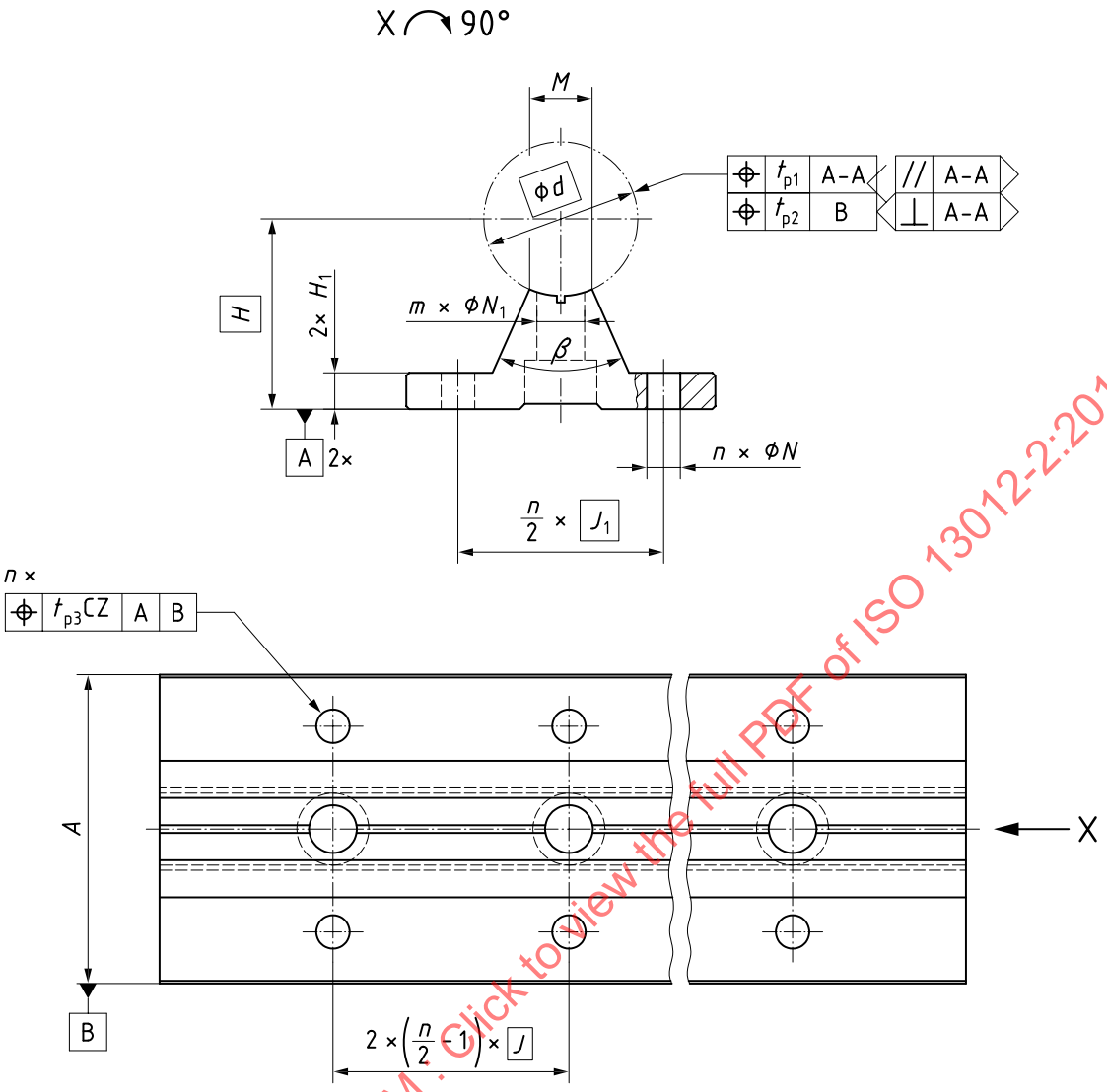
Dimensions in millimetres

| $F_w$ | $t_{p1}$ | $t_{p2}$[a] | $t_{p3}$[a] |
|---|---|---|---|
| All sizes | 0,04 | (0,04) | (0,04) |

a The given values can be used as a guideline for specific agreement between supplier and manufacturer to define $t_{p2}$ and $t_{p3}$.

## 9.2 Shaft support rails

Boundary dimensions are given in Tables 5 and 6.




**Key**

*m* number of mounting holes for shaft (half of *n*)

*n* total number of holes for mounting shaft support rail

NOTE Identification of reference side face is at the discretion of the manufacturer.

**Figure 3 — Standard height shaft support rails for series 5 sleeve type linear ball bearings**

**Table 5 — Standard height shaft support rails for series 5 sleeve type linear ball bearings**

Dimensions in millimetres and angles in degrees

| $d$<br>Ref. | $H$[a]<br> | $A$<br>max. | $H_1$<br>±0,5 | $J_1$<br> | $J$<br> | $M$<br>max. | $N$<br> | $N_1$<br> | $\beta$<br>max. |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 18 | 32 | 4 | 22 | 100 | 4,7 | 4,5 | 4,5 | 80 |
| 13 | 21 | 34 | 4,5 | 25 | 100 | 6,5 | 4,5 | 4,5 | 80 |
| 16 | 25 | 40 | 5 | 30 | 100 | 8 | 5,5 | 5,5 | 80 |
| 20 | 27 | 45 | 5 | 30 | 100 | 8,5 | 5,5 | 6,6 | 50 |
| 25 | 32 | 55 | 6 | 35 | 120 | 10,6 | 6,6 | 6,6 | 50 |
| 30 | 37 | 60 | 7 | 40 | 150 | 12,7 | 6,6 | 9 | 50 |
| 35 | 43 | 65 | 8 | 45 | 200 | 14,8 | 9 | 9 | 50 |
| 40 | 48 | 75 | 9 | 55 | 300 | 16,9 | 9 | 9 | 50 |
| 50 | 62 | 95 | 11 | 70 | 300 | 20 | 11 | 11 | 50 |

a $H$ shall be measured with the nominal shaft diameter under mounting condition.

**Table 6 — Tolerances for standard height shaft support rails for series 5 sleeve type linear ball bearings**

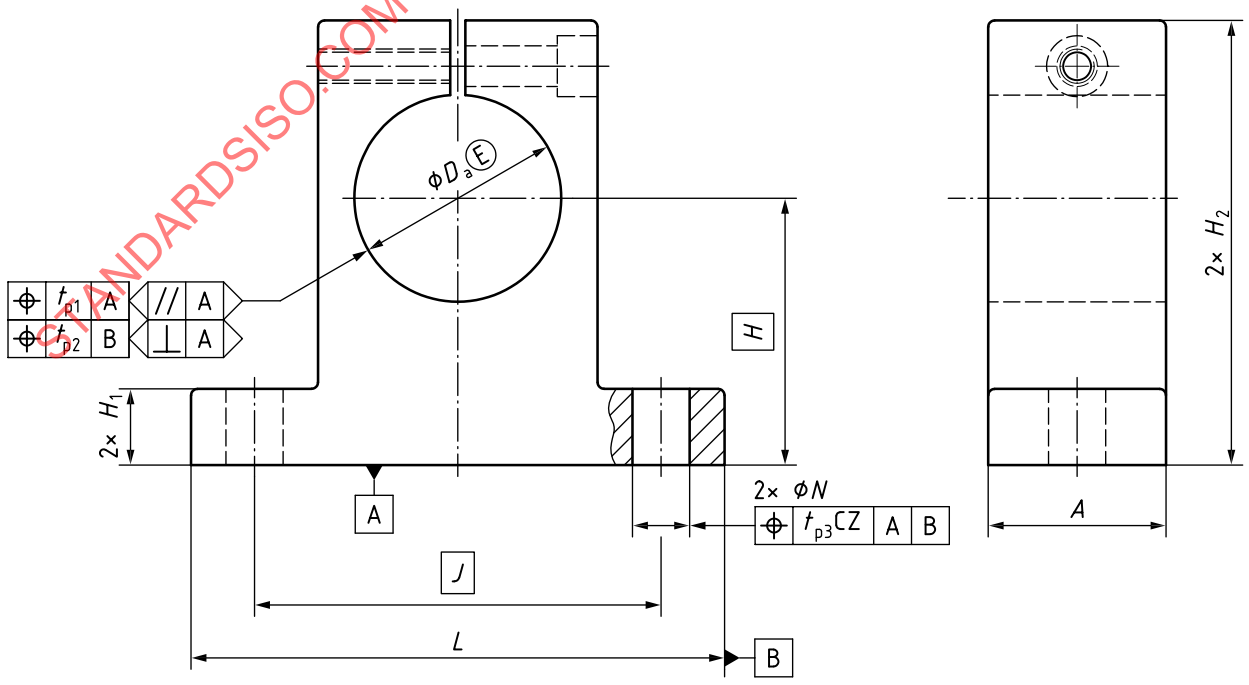
Dimensions in millimetres

| $F_w$ | $t_{p1}$ | $t_{p2}$[a] | $t_{p3}$[a] |
|---|---|---|---|
| All sizes | 0,04 | (0,04) | (0,04) |

a The given values can be used as a guideline for specific agreement between supplier and manufacturer to define $t_{p2}$ and $t_{p3}$.

## 9.3 Shaft support blocks

Boundary dimensions are given in Tables 7 and 8.




NOTE 1 $D_a$ Ⓔ needs to be measured before the splitting of the support block.