INTERNATIONAL STANDARD

**ISO 3548-1**

Second edition
2022-08

# Plain bearings — Thin-walled half bearings with or without flange —

## Part 1: Tolerances, design features and methods of test

*Paliers lisses — Demi-coussinets minces à ou sans collerette —*

*Partie 1: Tolérances, caractéristiques de conception et méthodes d'essai*



Reference number
ISO 3548-1:2022(E)



ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

# Contents

Page

# 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 123, *Plain Bearings*, Subcommittee SC 3, *Dimensions, tolerances and constructions details*.



This second edition cancels and replaces the first edition (ISO 3548:2014), which has been technically revised.

The main changes are as follows:

— normative references have been revised in Clause 2;

— symbols and terms with units have been added to Table 1;

— symbols in Figure 2 have been modified;

— symbols and measures in Figure 7 have been modified;

— Figures 3, 10 and 11 have been modified;

— symbols in 7.2 and 7.3 have been modified.

A list of all parts in the ISO 3548 series can be found on the ISO website.

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.

# Plain bearings — Thin-walled half bearings with or without flange —

# Part 1: Tolerances, design features and methods of test

## 1 Scope

This document specifies tolerances, design features and test methods for thin-walled half bearings with integral flange up to an outside diameter of $D_0$ = 250 mm and without flange up to an outside diameter of $D_0$ = 500 mm. Due to the variety of design, it is, however, not possible to standardize the dimensions of the half bearings.

Half bearings according to this document are predominantly used in reciprocating machinery and consist of a steel backing and one or more bearing metal layers on the inside.

In reciprocating machinery, flanged half bearings can be used in connection with half bearings without flange.

Alternatively, to serve as a flanged half bearing, it is possible to use a half bearing without flange together with two separate half thrust washers according to ISO 6526, or a half bearing with assembled flanges.



NOTE All dimensions and tolerances are given in millimetres.



## 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 3548-3, *Plain bearings — Thin-walled half bearings with or without flange — Part 3: Measurement of peripheral length*

ISO 6526, *Plain bearings — Pressed bimetallic half thrust washers — Features and tolerances*

ISO 21920-3, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators*

## 3 Terms and definitions

No terms and definitions are listed in this document.

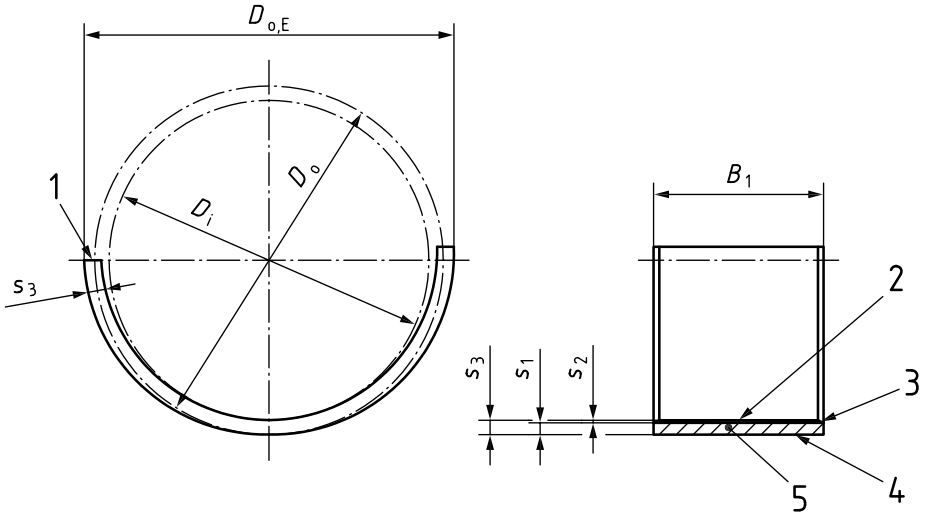
ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

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

## 4 Symbols

Symbols and units are shown in Figures 1 and 2 and Table 1.




**Key**

1 joint face
2 sliding surface
3 bearing metal
4 bearing back
5 steel bearing backing



**Figure 1 — Half bearing without flange with positive free spread**



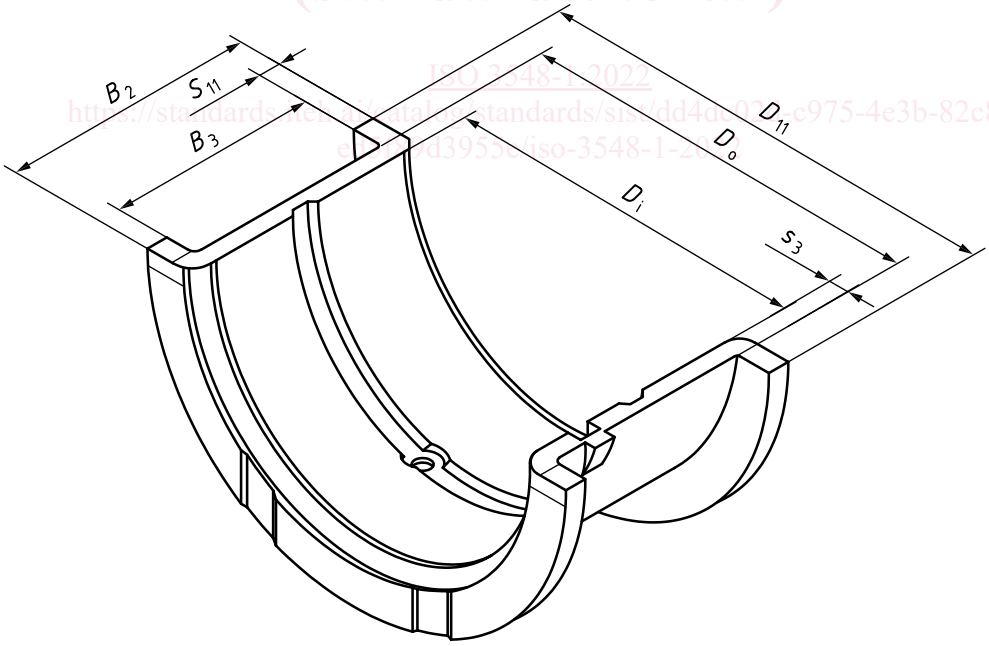



**Figure 2 — Flange half bearing, integral or assembled, excluding free spread**

**Table 1 — Symbols and units**

| Symbol | Description | Unit |
|---|---|---|
| $a$ | Crush height | mm |
| $a_A$ | Crush height in checking method A | mm |
| $a_B$ | Crush height in checking method B | mm |
| $a_{B1}$ | Crush height on first joint face side in checking method B | mm |
| $a_{B2}$ | Crush height on second joint face side in checking method B | mm |
| $a_1$ | Measuring point perpendicular to plane of joint face | mm |
| $a_2$ | Circumferential length of locating nick | mm |
| $a_4$ | Locating nick protrusion | mm |
| $a_5$ | Locating recess depth | mm |
| $a_6$ | Bearing bore relief length | mm |
| $a_7$ | Sliding relief length | mm |
| $a_8$ | Sliding relief length under 10° inclination | mm |
| $a_9$ | Bending transition length | mm |
| $a_{10}$ | Undercut length | mm |
| $a_{11}$ | Groove centre distance | mm |
| $A_{cal}$ | Reduced area of cross section (calculated value) of half bearing | $mm^2$ |
| $A_f$ | Face area of flange | $mm^2$ |
| $b_1$ | Distance to locating nick | mm |
| $b_2$ | Locating nick width | mm |
| $b_3$ | Distance recess centre to locating nick | mm |
| $b_4$ | Distance locating nick groove to lubrication hole | mm |
| $b_5$ | Locating recess width | mm |
| $b_6$ | Clearance | mm |
| $b_G$ | Oil groove width | mm |
| $b_H$ | Housing width | mm |
| $B_1$ | Half bearing width (without flange) | mm |
| $B_2$ | Flange half bearing width | mm |
| $B_3$ | Distance between flanges | mm |
| $c_i$ | Inside chamfer | mm |
| $c_o$ | Outside chamfer | mm |
| $d_{cb}$ | Diameter of the checking block bore | mm |
| $d_H$ | Housing diameter | mm |
| $D_{11}$ | Outside diameter of flange | mm |
| $D_i$ | Nominal inside diameter of the half bearing (bearing bore) | mm |
| $D_o$ | Nominal outside diameter of the half bearing | mm |
| $D_{o,E}$ | Outside diameter of the half bearing in the free state (with free spread) | mm |
| $e_B$ | Amount of eccentricity | mm |
| $F$ | Test force | N |
| $F_{ax}$ | Axial test force for assembled flange bearings | N |
| $i_1$ | Bearing bore relief height | mm |
| $i_2$ | Flange bearing, sliding relief length | mm |
| $i_3$ | Flange bearing, sliding relief length under 10° inclination | mm |
| $L_{Bu}$ | Bottom limit of $u$ | — |
| $L_{Uu}$ | Upper limit of $u$ | — |

**Table 1** *(continued)*

| Symbol | Description | Unit |
|---|---|---|
| $P$ | Amount of free spread | mm |
| $Ra$ | Arithmetic average surface roughness | µm |
| $s$ | Wall thickness (general) | mm |
| $s_1$ | Steel backing thickness | mm |
| $s_2$ | Bearing metal thickness | mm |
| $s_3$ | Half bearing wall thickness | mm |
| $s_{3,\,act}$ | Actual value of $s_3$ | — |
| $s_4$ | Wall thickness at the base of the groove | mm |
| $s_5$ | Contact width assembled flange with half bearing | mm |
| $s_6$ | Assembled flange joint thickness | mm |
| $s_{11}$ | Flange thickness | mm |
| $s_\alpha$ | Wall thickness at different angle | mm |
| $s_{\alpha,\,BL}$ | Bottom value of $s_\alpha$ | — |
| $s_{\alpha,\,UL}$ | Upper value of $s_\alpha$ | — |
| $u$ | Amount of wall thickness reduction for eccentric bearing | mm |
| $x$ | Tolerance, position limit of oil groove and oil hole | mm |
| $x_1$ | Centre of the bearing outside surface | — |
| $x_2$ | Centre of the bearing bore | — |
| $\alpha$ | Angle | ° |
| $\alpha_2$ | Angle at eccentricity measuring point | ° |
| $\beta$ | Chamfer angle of oil groove | ° |



# 5 Dimensions and tolerances

## 5.1 Housing diameter, half bearing outside diameter and crush height

The housing diameter should be manufactured to limit deviations H6 as defined in ISO 286-2. The half bearing outside diameter shall be selected with such an oversize that an adequate interference fit is ensured in the housing diameter.

In the case of housings made from materials having a high coefficient of expansion or where other factors such as housing dimensional stability are involved, the housing size may depart from tolerance class H6 but shall always be produced in accordance with standard tolerance grade 6 values.

The half bearing in a free state is flexible so that its outside diameter cannot be measured directly. Instead of this, its peripheral length is determined by means of special checking fixtures. The peripheral length results from the periphery of the checking block bore and the crush height taking into account the reduction under a given checking load per joint face (see Clause 6). The calculation of the effective interference fit of the half bearings in the housing is provided in Reference [7].

The tolerances given in Table 2 for the crush height apply to half bearings with machined joint faces. Different materials and housing design require different interference fits, therefore only tolerances are given in Table 2.

## 5.2 Half bearing wall thickness and bearing bore

Nominal dimensions to be preferred for the wall thickness of the bearing are given in Table 2 (the particulars of the wall thickness for each application cannot be specified in general). Therefore, only tolerances can be given for the wall thickness. These tolerances and the surface roughnesses of the

bearing back and the sliding surface of half bearings with or without electroplated antifriction layers are given in Table 2.

The tolerance for the half bearing wall thickness depends on the fact whether the bearing bore is subject to a final machining operation (i.e. "as machined") or whether the bearing bore is electroplated without further machining (i.e. "as-plated").

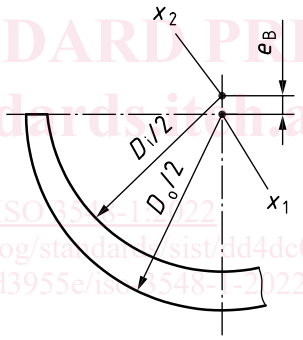
Slight surface deformations are acceptable on the outside diameter of the bearing provided that they are not numerous. However, the measurement of the wall thickness shall not be carried out in these areas.

The bearing bore in the fitted state results from the housing bore which is elastically enlarged by the press fit, reduced by twice the value of the half bearing wall thickness[7].

NOTE In certain applications, it can be necessary to use plain or flange half bearings with eccentric bores, i.e. the wall thickness of the half bearing decreases uniformly from the crown to the joint faces (see Figures 3 and 4).

The eccentricity $e_B$ is characterized in a radial plane by the distance between the centre $x_1$ of the bearing outside surface and the centre $x_2$ of the bearing bore. $e_B$ is not dimensioned specifically. The eccentricity is controlled by the specified reduction $u$ which is measured at a vertical distance $a_1$ from the plane of the joint face. For guidance of draughtsmen, $a_1$ is generally specified so that the angle $\alpha_2$ is approximately 25° from the joint face. The measuring point is subject to agreement between the user and manufacturer.



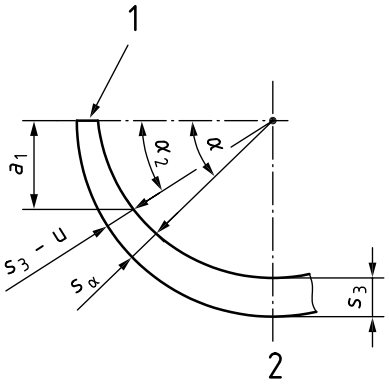



**Key**

$x_1$ centre of the bearing outside surface

$x_2$ centre of the bearing bore

**Figure 3 — Eccentric bearing bore of half bearing**




**Key**

1 joint face

2 crown

**Figure 4 — Example of the wall thickness at different angles**

The tolerance limit for the behaviour of wall thickness can be calculated using Formulae 1 and 2:

$$s_{\alpha,\mathrm{BL}} = s_{3,\mathrm{act}} - L_{\mathrm{B}u} \cdot \frac{1-\sin\alpha}{1-\sin\alpha_2} \tag{1}$$

$$s_{\alpha,\mathrm{UL}} = s_{3,\mathrm{act}} - L_{\mathrm{U}u} \cdot \frac{1-\sin\alpha}{1-\sin\alpha_2} \tag{2}$$



where



$L_{\mathrm{B}u}$ is the bottom limit of $u$;

$L_{\mathrm{U}u}$ is the upper limit of $u$;

$s_{3,\,\mathrm{act}}$ is the actual value of $s_3$;

$s_{\alpha,\,\mathrm{BL}}$ is the bottom value of $s_\alpha$;

$s_{\alpha,\,\mathrm{UL}}$ is the upper value of $s_\alpha$.

## 5.3 Width of half bearing, distance between flanges, outside diameter of flange and flange thickness

The nominal dimension for the half bearing width and the distance between flanges depends upon the type of application, the common ratio being $B_1(B_2)/D_\mathrm{i} \leq 0{,}5$. The tolerances for the half bearing width are given in Table 2. The flange outside diameter should be smaller than the diameter of the shoulder of the shaft and smaller than the diameter of the housing block.

In most cases, the flange thickness is fixed in conformity with the half bearing wall thickness and, in general, a tolerance is fixed only for the flange thickness of the pressure loaded side in order to ensure that these flanges of the upper and lower half bearing have approximately the same thickness. In this case, the position of these flanges with respect to the locating lips is fixed.

If the upper and lower half bearings are of the same design, then generally the two flanges of one half bearing shall have the same thickness within the tolerance range fixed in Table 2. In that case, the flange thicknesses result from the bearing width and the distance between flanges. Nevertheless, another tolerance can be accepted after agreement between the user and the manufacturer (see Clause 7).

### 5.4 Free spread

Free spread is influenced by factors such as the lining material, its thickness and its physical properties, by the bearing backing material and its properties, and by the operating temperature of the assembly. Since these features are not specified in this document, it is not possible to specify free spread. Free spread shall in all circumstances be positive. After operation in the combustion engine at normal conditions, a sufficient amount of free spread remains in the bearing to enable it to be refitted. The actual amount of free spread shall be the subject of agreement between the manufacturer and user.

Half bearings for reciprocating machinery normally have a free spread of 0,2 mm up to 3 mm. For very large, thin-walled half bearings, the free spread may be greater but it shall not be such that the half bearing cannot be fitted into the housing.