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ISO TC 123/SC 5

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Plain bearings — Thin-walled half bearings with or without flange — Part 3: Determination of the peripheral length

Paliers lisses — Demi-coussinets minces à collerette ou sans collerette — Partie 3: Mesurage de la longueur développée

Second edition

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Contents

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 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 5, *Quality analysis and assurance*.

This second edition cancels and replaces the first edition (ISO 3548-3:2012), which has been technically revised.

The main changes ~~compared to the previous edition~~ are as follows:

— the errors in the calculation form in Annex A, Figure A.1 and Figure A.~~6: errors in the calculation form~~ 4 have been corrected;

— the errors in the calculation form in Annex B, Figure B.1 and Figure B.~~5: errors in the calculation form~~ 3 have been corrected;

~~Annex E, E.3:~~ — the errors in the formulae and in the calculated example in Clause E.3 have been corrected.

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 3: Measurement of peripheral length

1 Scope

This document specifies, according to ISO 12301, the checking of the peripheral length of thin-walled half bearings with or without flange, and describes the necessary checking methods and measuring equipment.

Thin-walled half bearings are flexible and, in the free condition, do not conform to a cylindrical profile. This is one reason the peripheral length of the half bearings can only be measured under a constraining load by use of specialized measuring equipment.

In addition, measuring equipment different from that illustrated in this document can be used, provided the measuring accuracy of the equipment is consistent with the specifications given in Clause 17.

This document does not include the measurement of the parting line taper.

This document applies to thin-walled half bearings, the specifications of which are given in ISO 3548-1.

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 3548-1, *Plain bearings — Thin-walled half bearings with or without flange — Part 1: Tolerances, design features and methods of test*

ISO 12301, *Plain bearings — Quality control techniques and inspection of geometrical and material quality characteristics*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1
peripheral length
circumferential length which runs from one parting line face to the other

3.2
crush height
a
value by which a half bearing, fitted in a checking block of bore diameter, d_{cb}, under a pre-determined checking load, *F*, exceeds the defined *peripheral length* (3.1) of the checking block bore

Note 1 to entry: In practice, the datum serves as a basis for measuring *a* (see Figure 1).

Note 2 to entry: The symbol for crush height "(*nip*)" is no longer used and has been replaced with "*a*".

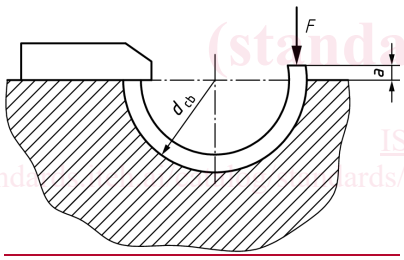


Figure 1 — Crush height, *a*

3.3
repeatability
closeness of agreement between successive results obtained with the same method on the same test piece, under the same conditions ~~as described in Table 14~~

Note 1 to entry: Repeatability is assessed from the standard deviation of repeatability σ_Δ (see Annex E).

3.4
reproducibility
closeness of agreement between individual results obtained with the same method on the same test piece but under different conditions (same or different operator, same, identical or different measurement equipment, same or different checking place and different times)

Note 1 to entry: For the purposes of this document, reproducibility is the difference between the two averages obtained from two sets of measuring equipment (see Annex E).

3.5
comparability
accuracy in the case of operators working in different checking places at different periods and each of them achieving individual results, one using method A and the other using method B, on the same plain bearing test piece in different checking blocks

Note 1 to entry: Comparability is assessed from the difference between the two averages obtained from the two methods (see Annex E).

4 Symbols

For the purposes of this document, the following symbols of Table 1 apply.

Table 1 — Symbols and units

Symbol	Parameter	Unit
a	Crush height	µm
B	Width of the half bearing without flange	mm
B_1	Checking block width of the construction for flanged half bearings	mm
B_2	Checking block width (bottom width of checking lock)	mm
B_3	Checking block width of the construction for half bearings without flange	mm
d	Diameter	mm
D	Outside diameter	mm
E	Elasticity modulus	MPa
f	Friction coefficient in calculation of deflection under load	—
F	Checking load (Method A)	N
F_1	Checking load, side 1 (Method B)	N
F_2	Checking load, side 2 (Method B)	N
F_{cor}	Correction factor	mm
h	Fillet radius between back and flange on flanged half bearing	mm
H_{cb}	Distance from the bottom of the checking block bore to the datum face	mm
ΔH_{cb}	Elastic deformation of the height of the checking block under load	mm
K_1	Checking block chamfer of the construction for half bearings without flange	mm
K_2	Checking block chamfer of the construction for flanged half bearings	mm
l	Peripheral length	mm
Δl	Deviation of the actual peripheral length of the checking block	mm
p_E	Elastic depression of the metering bar	mm

Ra	Surface roughness	µm
s	Wall thickness	mm
t_i	Tolerance value of several features (F, i = 1 to 9)	mm
t_{bms}	Tolerance of B_{ms}	mm
t_{dcbm}	Tolerance of d_{cbm}	mm
t_{dcbs}	Tolerance of d_{cbs}	mm
t_{Hcbm}	Tolerance of H_{cbm}	mm
t_{Hcbs}	Tolerance of H_{cbs}	mm
t_{sms}	Tolerance of s_{ms}	mm
U	Uncertainty of measurement	µm
W	Width of the metering bar contact area	mm
x_{1i}	Measured value of bearing no. i out of bearing set ~~no.~~number 1	µm
x_{2i}	Measured value of bearing no. i out of bearing set ~~no.~~number 2	µm
$\bar{x}_1$	Arithmetic mean value of measured bearings out of bearing set ~~no.~~number 1	µm
$\bar{x}_2$	Arithmetic mean value of measured bearings out of bearing set ~~no.~~number 2	µm
$\bar{x}_A$	Arithmetic mean value of set of bearings measured according to method A	µm
$\bar{x}_B$	Arithmetic mean value of set of bearings measured according to method B	µm
$\bar{x}_A^*$	Arithmetic mean value $\bar{x}_A$ corrected with empirical correction factor δ	µm
$\bar{x}_B^*$	Arithmetic mean value $\bar{x}_B$ corrected with empirical correction factor δ	µm
z	Distance between flanges of the flanged half bearing	mm
δ	Empirical correction to compensate for the difference in elastic deflections under load between method A and method B	mm
δ_x	Correction, approximated by calculation	mm
σ	Standard deviation	—

The characteristic subscripts are given in Table 2.

Table 2 — Subscripts

Subscript	Description
A	measurement method A
B	measurement method B
B1	position 1 of measurement method B
B2	position 2 of measurement method B
bs	bearing to be checked
cb	checking block

cbm	master checking block
cbs	series checking block
cs	comparison shell
M	measured
max	maximum
mean	arithmetic mean
min	minimum
ms	master shell
new	origin, beginning of use
th	theoretical
tot	total
worn	wear limit, end of use
1,2	consecutive number
NOTE The following notation for multi-subscripts is used: literal subscripts are separated by a blank, however, additionally needed numbers are directly connected to the subscript.	

5 Purpose of checking

In order to ensure the required mounting compression (interference fit) for the half bearings in the housing bore, the crush height tolerances shall be kept as specified in ISO 3548-1 and ISO 12301.

6 Measurement methods

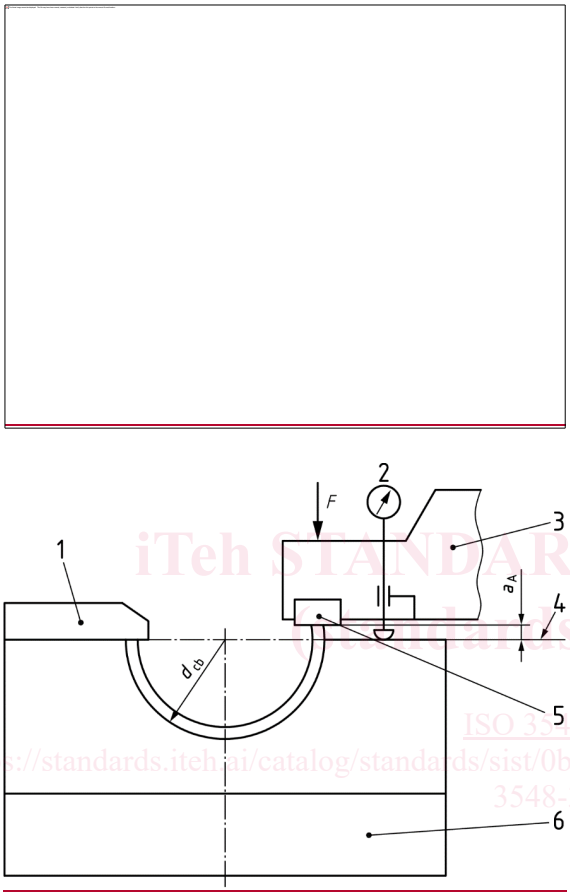
6.1 Method A

The checking load, *F*, is directly applied via the measuring head with a pivoting metering bar to one parting line face of the half bearing while the other parting line face is in contact with a fixed stop (see Figure 2).

The measured crush height according to method A~~:~~

~~(1)~~

~~NOTE nip~~ is ~~the former used (deprecated) term for crush height~~indicated a_A.



Key

1 fixed stop
2 dial gauge
3 movable measuring head
4 datum
5 metering bar
6 checking block

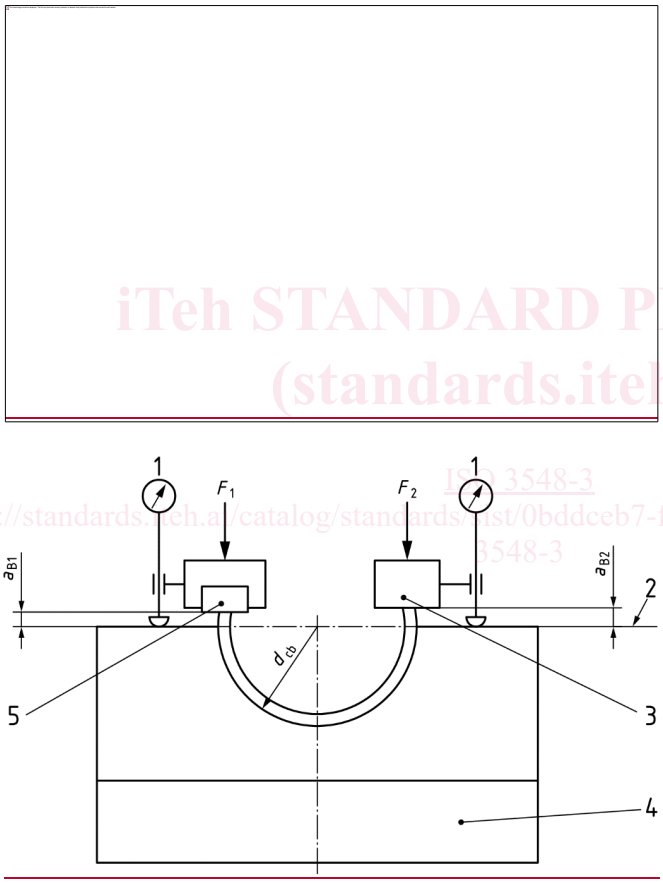
Figure 2 — Measuring principle of method A

6.2 Method B

The checking loads, F_1 and F_2, are applied via the measuring head and two metering bars to both parting line faces of the half bearing (see Figure 3).

The crush height of method B is the sum of the measurements on the two sides~~:~~ [as shown in Formula (2)]:

$$a_B = a_{B1} + a_{B2} \quad (2)$$



Key

1 dial gauge
2 datum
3 rigid metering ~~bar~~bar

4 checking block
5 pivoting toe piece
NOTE Bearings can also be checked using two pivoting metering bars.

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Figure 3 — Measuring principle of method B

NOTE In the case of method A, the fixed stop exerts the required counterforce, which, in the case of method B, is applied directly by the measuring equipment via two metering bars.

EXAMPLE

Method A F = 6 000 N

Method B F_1 = 6 000 N

F_2 = 6 000 N

7 Choice and designation of checking method

7.1 Choice of checking method

Recommendations for choosing either method A or method B, based on dimensions of the half bearings to be checked, are given in Table 3.

However, any size of bearing can be tested by either method by agreement between the manufacturer and user. In that case, a correction, δ, should be applied to compensate for the difference in deflections at parting line face(s) under load between method A and method B, and ~~be such that:~~should be implemented as shown in Formula (3):

$$a_A = a_{B1} + a_{B2} + \delta = a_B + \delta \quad (3)$$

The value of δ shall be determined empirically by actual measurements obtained on the two different types of equipment used. Since the detailed design of the checking feature shall be varied between different manufacturers, the value of δ established by one manufacturer cannot be transferred to another, who shall determine it separately. See example in Annex E.

For general guidance, the value of δ can be derived from the formula (Euler-Eytelwein) used in the mathematical analysis of belt friction, which gives~~:~~ Formula (4):

$$\delta = \frac{d_{\mathrm{cbM}} \cdot F}{s_{\mathrm{ms}} \cdot B_{\mathrm{ms}}} \cdot \frac{1}{2Ef}\left(1 + e^{-f\pi} - 2e^{-f\pi/2}\right) \quad (4)$$

With a value of the friction coefficient f = 0,15, Formula (4) becomes~~:~~

Formula (5~~)~~):

$$\delta_{f=0,15} = 7 \cdot 10^{-7} \cdot \frac{d_{\mathrm{cbM}} \cdot F}{s_{\mathrm{ms}} \cdot B_{\mathrm{ms}}} \quad (5)$$

Table 3 — Selection of checking method

D_{bs} mm	Recommended checking method
$D_{bs} \leq 200$	A, B
$200 < D_{bs} \leq 500$	B

7.2 Designation of checking method

An example of the designation of method B for checking thin-walled half bearings with an outside diameter, D_{bs} of 340 mm is as follows:

Method ISO 3548-3-B-340

8 Measuring equipment

Figures 4 and 5 show typical measuring equipment for the measurement of the crush height by method A and by method B, respectively.