INTERNATIONAL STANDARD

ISO 12306

First edition
1994-02-15

Plain bearings — Measurement of wall thickness of thin-walled half-bearings and thin-walled bushes

Paliers lisses — Mesurage de l'épaisseur de paroi des demi-coussinets minces et des bagues minces

Reference number
ISO 12306:1994(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12306 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 5, *Quality analysis and assurance.*

Annex A forms an integral part of this International Standard. Annex B is for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Plain bearings — Measurement of wall thickness of thin-walled half-bearings and thin-walled bushes

1 Scope

This International Standard describes in accordance with ISO 12301 the checking methods and measuring equipment used for measuring the total wall thickness of thin-walled half-bearings and thin-walled bushes in the finished state.

It is not applicable to thermoplastic bushes.

NOTE 1 All dimensions in this International Standard are given in millimetres.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3547:1976, *Plain bearings — Wrapped bushes — Dimensions, tolerances and methods of checking.*

ISO 3548:1978, *Plain bearings — Thin-walled half bearings — Dimensions, tolerances and methods of checking.*

ISO 4379:1993, *Plain bearings — Copper alloy bushes.*

ISO 6864:1984, *Plain bearings — Thin-walled flanged half bearings — Dimensions, tolerances and methods of checking.*

ISO 12301:1992, *Plain bearings — Quality control techniques and inspection of geometrical and material quality characteristics.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 total wall thickness, s_{tot}**:** Radial distance between the opposing measuring points at the inside and the outside surface diameter. (See figure 1.)

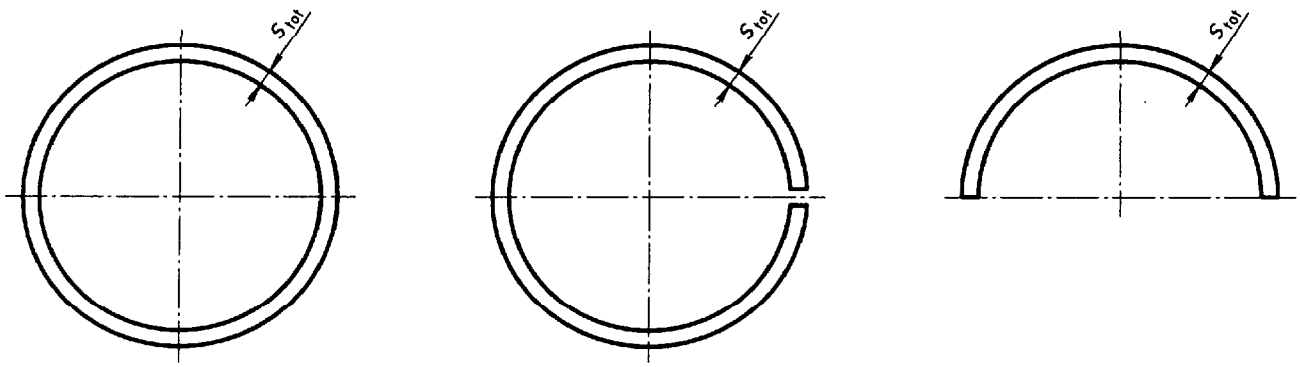

Figure 1 — Total wall thickness, s_{tot}

4 Symbols and units

For the purposes of this International Standard, the symbols and units are as given in table 1.

Table 1 — Symbols and units

Symbol	Parameter	SI unit
a_c	Measuring distance	mm
B	Width	mm
D_o	Outside diameter	mm
F_{pin}	Checking load (measuring pin)	N
n	Number of test pieces	
s_{tot}	Total wall thickness	mm
u	Uncertainty of measurement (confidence level of 95 %)	mm
u_E	Uncertainty of measurement of measuring equipment	mm
Δx	Difference in measured values between first and second readings	mm
$\overline{\Delta x}$	Arithmetic mean of Δx	mm
σ	Standard deviation	mm
$\sigma_{\Delta x}$	Standard deviation of Δx	mm

5 Purpose of checking

In order to guarantee the required bearing clearance and consequently the operational efficiency of the plain bearing unit, it is necessary to keep to the wall thickness tolerances specified in ISO 3547, ISO 3548, ISO 4379 and ISO 6864.

6 Checking methods (see annex A)

6.1 Measuring principle

The gauging axis of the measuring pins shall be in the radial direction and at a right angle to the outside surface of the test piece in order to find the minimum value of the wall thickness. The measured values may be recorded by a single measurement or by sum measurement, which are symbolically represented in figure 2.

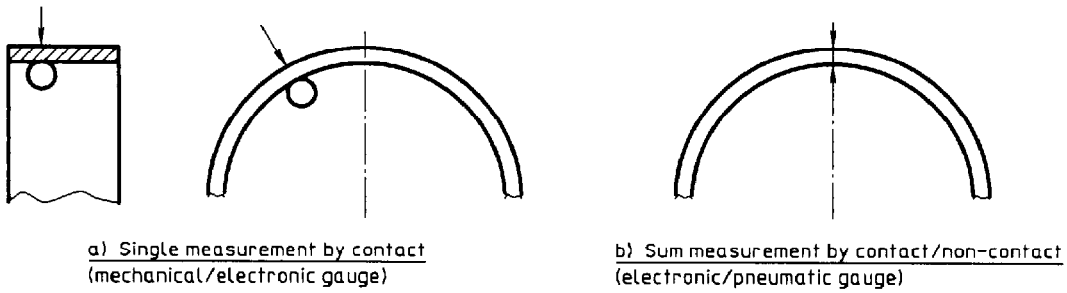

Figure 2 — Measuring principle of wall thickness measurement

The presence of lubricating holes, oil pockets, oil grooves, markings or special chamfers may require deviation from the measuring lines and measuring points specified in the following and shall be agreed upon separately.

Any wall thickness not conforming to the specified values on account of the manufacturing process, because of deformation of the bearing backing in the area of marking or at non-load bearing places of wrapped bushes, shall be defined separately.

6.2 Line measurement around the circumference

Continuous measurement of the wall thickness around the circumference shall be carried out at the measuring lines specified in figure 3 and table 2.

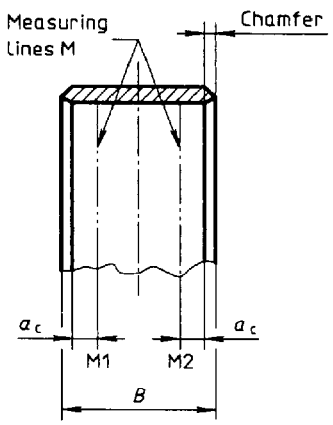

Figure 3 — Position of measuring lines

Table 2 — Measuring line distances a_c

Width B	Measuring distance[1] a_c	Number of measuring lines M
$B \leqslant 15$	$B/2$	1
$15 < B \leqslant 50$	4	2
$50 < B \leqslant 90$	6 and $B/2$	3
$B > 90$	8 and $B/2$	3

1) Each measuring line distance a_c is specified from the beginning of the sliding surface.

6.3 Line measurement in the axial direction

Continuous measurement of the wall thickness shall be carried out in the axial direction at the measuring lines specified in figures 4 and 5 for widths of $B \leqslant 50$ mm and outside diameter $D_o \leqslant 150$ mm.

In the case where $B > 50$ mm and $D_o > 150$ mm, the measurement method shall be subject to agreement between the manufacturer and customer.

6.3.1 Half-bearings

See figure 4

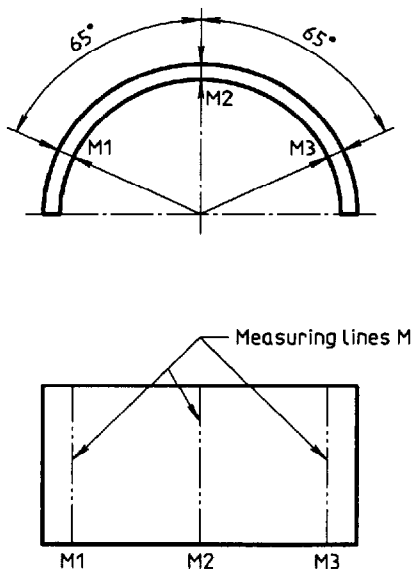

Figure 4 — Three-line measuring scheme for half-bearings with $D_o \leqslant 150$ mm

6.3.2 Bushes

See figure 5.

This method of measurement may be used for unsplit as well as for wrapped bushes, of ground or calibrated design.

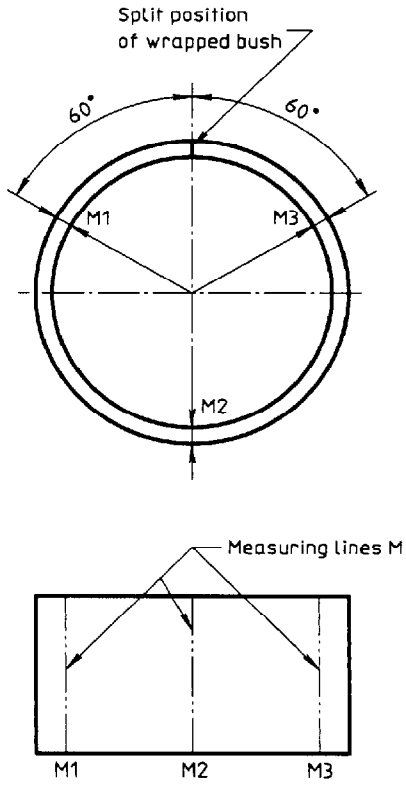

Figure 5 — Three-line measuring scheme for unsplit or wrapped bushes with $D_o \leqslant 150$ mm

6.4 Point measurement

Point-by-point measurement of wall thickness shall be carried out at the measuring points specified in figures 6 to 8 for widths of $B \leqslant 90$ mm and outside diameter $D_o \leqslant 150$ mm. In the case where $B > 90$ mm and $D_o > 150$ mm, the measurement method shall be subject to agreement between the manufacturer and customer. The measuring line distance, a_c, shall be taken from table 2.

6.4.1 Half-bearings

See figures 6 to 8.

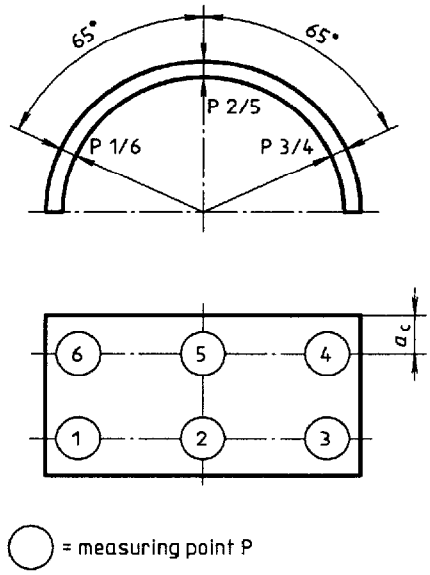

Figure 6 — Six-point measuring scheme for half-bearings with $B \leqslant 50$ mm and $D_o \leqslant 80$ mm

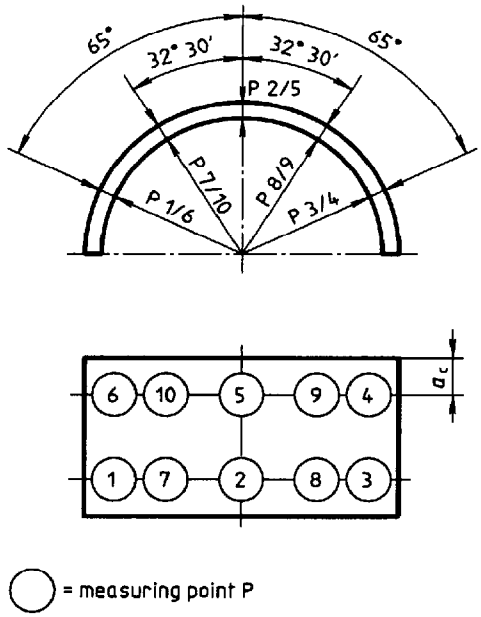

Figure 7 — Ten-point measuring scheme for half-bearings with $B \leqslant 50$ mm and $D_o \leqslant 150$ mm

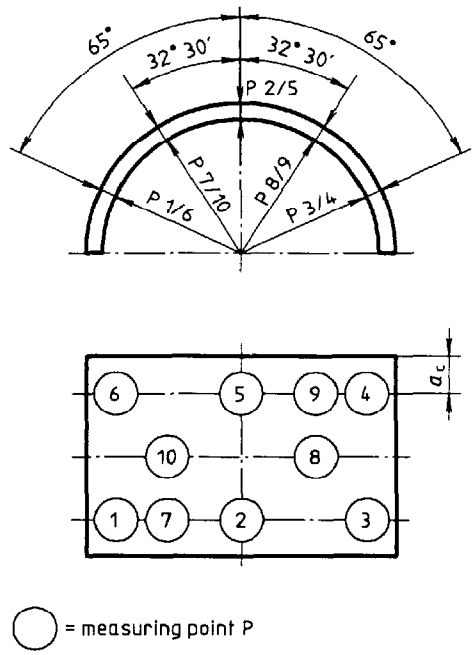

Figure 8 — Ten-point measuring scheme for half-bearings with $B \leqslant 90$ mm and $D_o \leqslant 150$ mm

6.4.2 Bushes

See figure 9.

This method of checking may be used for unsplit as well as for wrapped bushes, ground or calibrated design.

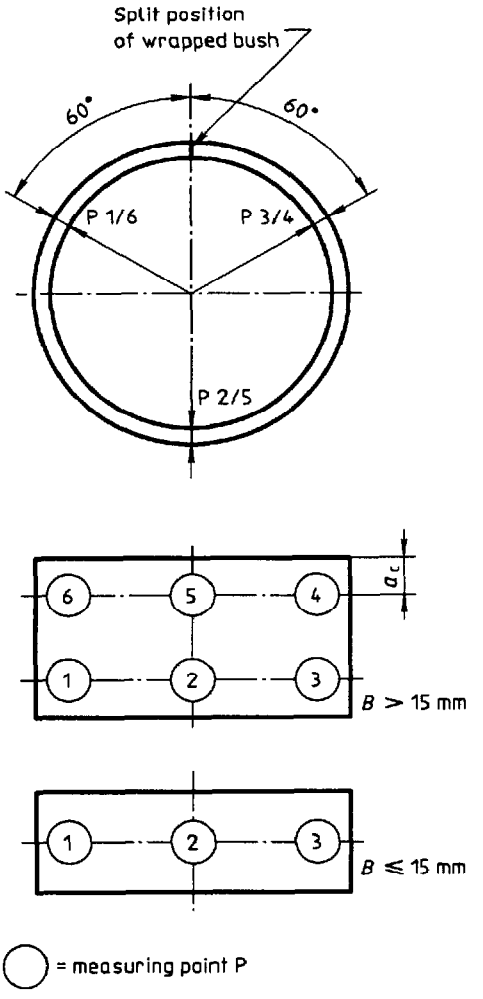

Figure 9 — Three- or six-point measuring scheme for unsplit or wrapped bushes with $D_o \leqslant 150$ mm

7 Requirements for measuring equipment for the contact method

7.1 Radius for measuring the outside surface

The radius at the gauge sides of the measuring pins which are positioned on the outside shall be 1,5 mm ± 0,2 mm.

7.2 Radius for measuring the inside surface and checking load

The radius at the gauge sides of the opposite fixture or measuring pin on the inside and the checking load are given in table 3 as a function of the plain bearing outside diameter D_o and the bearing material.

Table 3 — Radius for measuring the inside surface and checking load

Outside diameter D_o	Radius for measuring inside surface		Checking load of measuring pin[1] F_{pin} N
	metallic	plastic	
$D_o \leqslant 10$	1,5 ± 0,2	1,5 ± 0,2	0,6 to 2
$10 < D_o \leqslant 25$	3 ± 0,2	3 ± 0,2	
$25 < D_o \leqslant 150$	3 ± 0,2	5 ± 0,2	
$D_o > 150$	5 ± 0,2	5 ± 0,2	

1) For metallic or plastic inside surface.

7.3 Accuracy data

The selection of the measuring equipment and measuring pins is dependent on the measuring method and the wall thickness tolerance to be tested. The limiting values of measurement of the uncertainty of measurement of the measuring equipment are given in table 4.

The determination of the uncertainty of measurement is given in 8.1.

Table 4 — Limiting values for the measuring equipment

Outside diameter D_o	Uncertainty of measurement of measuring equipment u_E
$D_o \leqslant 80$	0,002
$80 < D_o \leqslant 150$	0,003
$150 < D_o \leqslant 500$	0,004

8 Checking of measuring equipment

The measuring equipment should be checked for uncertainty of measurement at a frequency specified by the user, based on the type of equipment and on experience from previous checks.

8.1 Determination of the uncertainty of measurement, u (see annex B)

Twenty-four bushes or half-bearings shall be measured twice each (after each reinsertion of the piece) within a short period of time by means of the same measuring equipment including the measuring instrument to be checked, and by the same person at the same checking place.

The difference, Δx, between the two measurements determined with correct signs gives the standard deviation, σ (calculated by computer) from the equation:

$$\sigma_{\Delta x} = \sqrt{\left(\frac{1}{24-1}\right)\sum_{i=1}^{24}(\Delta x_i - \overline{\Delta x})^2}$$

Provided that the values derive from a normal distribution and that σ is considered to be a sufficiently exact assessed value for the standard deviation of the lot, a random component of the measurement uncertainty u for a single result measured by means of this measuring instrument is (for a confidence level of 95 %):

$$u \approx \frac{4\sigma_{\Delta x}}{\sqrt{2}}$$

The value u is compared to the limiting value u_E.

Annex A
(normative)

Indication of the checking method on drawings

A.1 Half-bearings

The drawing shall include the measuring scheme and whether it was "point measurement" or "line measurement".

A.2 Bushes

The drawing shall include the measuring scheme and whether it was "point measurement" or "line measurement".

Either the inside diameter or the wall thickness shall be indicated as the dimension to be checked, but not both.

The following instruction shall be respected for the dimensioning:

> "The drawing shall indicate the external diameter and wall thickness, or the external diameter and internal diameter. In no case shall both the wall thickness and the internal diameter be given as dimensions to be checked."

A.3 Unequal wall thickness

Where the bearing design requires unequal wall thicknesses, this shall be indicated as in figure A.1, together with the corresponding checking method in accordance with A.1 and A.2.

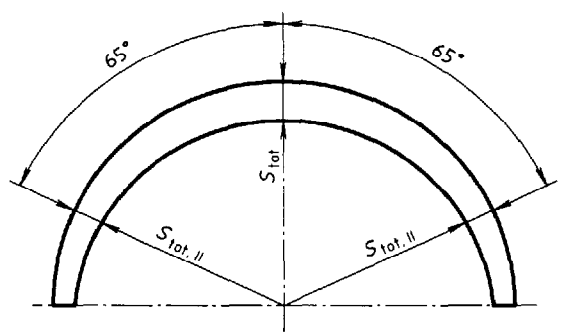

Figure A.1 — Dimensioning for unequal wall thickness

Annex B
(informative)

Determination of uncertainty of measurement

Tabulation of test results for checking the thickness of bushes or half-bearings to determine the uncertainty of measurement, u, according to 8.1 should be as shown in table B.1.

Table B.1 — Test results

Values in micrometres

Test piece No.	1st reading	2nd reading	Difference Δx between 1st and 2nd readings
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
—	—	—	$\sigma_{\Delta x} =$
$u = \frac{4\sigma_{\Delta x}}{\sqrt{2}} =$			

ICS 21.100.10

Descriptors: bearings, plain bearings, bearing bushes, wrapped bushes, unsplit bushes, dimensional measurements, thickness measurement, measuring instruments, gauges.

Price based on 12 pages