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

*Paliers lisses — Techniques de contrôle de la qualité et vérifications
des caractéristiques de qualité géométriques et des matériaux*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 12301 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 12301:1992), which has been technically revised. (It also incorporates the Technical corrigendum ISO 12301:1992/Cor. 1:1995.)

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Plain bearings — Quality control techniques and inspection of geometrical and material quality characteristics

1 Scope

This International Standard specifies quality control techniques and inspection of the geometrical and material quality characteristics of the following types of plain bearings:

- thin-walled half-bearings with or without flange, as specified in ISO 3548;
- metallic thick-walled half-bearings (with and without flange) that are manufactured as halves but that are necessarily interchangeable and have the ratio $s_3 : D_o > 0,11$;
- wrapped bushes, as specified in ISO 3547;
- unsplit metallic bushes (with and without flange) made from solid and multilayer materials and with outside diameters up to 230 mm;
- solid polymer bushes (with and without flange) with inside diameters up to 200 mm;
- ring-type thrust washers and pressed bimetallic half-thrust washers, as specified in ISO 6525 and ISO 6526, respectively;
- bushes made from sintered material, as specified in ISO 2795.

2 Normative references

The following referenced documents are indispensable for the application 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 2795, *Plain bearings — Sintered bushes — Dimensions and tolerances*

ISO 3274 *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 3547-1, *Plain bearings — Wrapped bushes — Part 1: Dimensions*

ISO 3547-2, *Plain bearings — Wrapped bushes — Part 2: Test data for outside and inside diameters*

ISO 3547-3, *Plain bearings — Wrapped bushes — Part 3: Lubrication holes, grooves and indentations*

ISO 3547-4, *Plain bearings — Wrapped bushes — Part 4: Materials*

ISO 3547-5, *Plain bearings — Wrapped bushes — Part 5: Checking the outside diameter*

ISO 3547-6, *Plain bearings — Wrapped bushes — Part 6: Checking the inside diameter*

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ISO 3547-7, *Plain Bearings — Wrapped bushes — Part 7: Measurement of wall thickness of thin-walled bushes*

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

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 4378-1, *Plain bearings — Terms, definitions and classification — Part 1: Design, bearing materials and their properties*

ISO 4384-1, *Plain bearings — Hardness testing of bearing metals — Part 1: Compound materials*

ISO 4384-2, *Plain bearings — Hardness testing of bearing metals — Part 2: Solid materials*

ISO 4386-1, *Plain bearings — Metallic multilayer plain bearings — Part 1: Non-destructive ultrasonic testing of bond*

ISO 4386-2, *Plain bearings — Metallic multilayer plain bearings — Part 2: Destructive testing of bond for bearing metal layer thicknesses ≥ 2 mm*

ISO 4386-3, *Plain bearings — Metallic multilayer plain bearings — Part 3: Non-destructive penetrant testing*

ISO 6524:1992, *Plain bearings — Thin-walled half bearings — Checking of peripheral length*

ISO 6525, *Plain bearings — Ring type thrust washers made from strip — Dimensions and tolerances*

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

ISO 6691, *Thermoplastic polymers for plain bearings — Classification and designation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4378-1 and the following apply.

3.1

quality of plain bearing

condition which renders a plain bearing fit to fulfil given requirements

NOTE The given requirements are generally dependent upon the intended use.

3.2

quality control techniques

method, equipment and procedure by means of which the quality of a plain bearing is assessed

3.3

quality characteristic

characteristic by means of which the quality of a plain bearing is judged

3.4

inspection

checking of one or more quality characteristics of a plain bearing with applicable requirements

3.5**uncertainty of measurement**

parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

[Guide 99]

NOTE The uncertainty, u , should be evaluated using statistical methods, e.g. repeatability and reproducibility studies, or as shown below:

$$u = \pm t \cdot \sigma$$

where

t is the stochastic variable according to Student's t distribution; $t = 2$ and corresponds to a statistical probability in measurement $P = 95\%$, for which the probability of exceeding the value $(1 - P) = 0,05$ or 5% ;

σ is the standard deviation of the whole lot.

NOTE 1 The uncertainty of measurement is normally $\pm 10\%$ of the tolerance.

3.6**measuring points**

agreed points established to facilitate agreement on checking

NOTE The establishment of measuring points does not preclude the need to comply with dimensional specifications in other areas.

3.7**measuring lines**

agreed lines established to facilitate agreement on checking

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NOTE The establishment of measuring lines does not preclude the need to comply with dimensional specifications in other areas.

3.8**tolerance**

range between the upper specified limit and the lower specified limit

4 Symbols and units

For the purposes of this document, the symbols and units given in Table 1 apply.

Table 1

Symbol	Parameter	SI unit
a	Crush height	millimetres
Δa	Measured change in a	millimetres
a_{ch}	Distance to measuring position	millimetres
a_E	Distance between gauge faces	millimetres
a_{fl}	Distance between flanges	millimetres
A_{eff}	Effective cross-section	square millimetres
B	Width	millimetres
B_{Δ}	Joint displacement	millimetres
d_{ch}	Diameter of the checking block bore	millimetres
D_H	Housing diameter	millimetres
D_{fl}	Flange diameter	millimetres
D_{fs}	Diameter measured across the joint in the free state; free spread diameter	millimetres
D_i	Inside diameter	millimetres
D_o	Outside diameter	millimetres
ν	Elastic reduction	millimetres
F_{ch}	Checking load	newtons
F_{pin}	Measuring pin load	newtons
F_{tan}	Tangential load of bearing as fitted	newtons
h_{ch}	Radius for flange thickness measurement	millimetres
h_{Δ}	Joint face taper	millimetres
H	Height	millimetres
M	Number of measuring lines	—
s_1	Thickness of the backing layer	millimetres
s_2	Thickness of the bearing material layer	millimetres
$s_{2, red}$	Thickness of the bearing material layer, reduced	millimetres
s_{fl}	Flange thickness	millimetres
s_3	Wall thickness	millimetres
T	Tolerance	millimetres
t	Stochastic variable	—
u	Uncertainty of measurement	millimetres
x_1, x_2, \dots, x_i	Individual measured values	millimetres
y	Flatness gauge gap	millimetres
ϵ_{max}	Maximum diametral deformation in compression	millimetres
ϵ_{min}	Minimum diametral deformation in compression	millimetres
σ	Standard deviation	—
σ_{tan}	Tangential strength	newtons per square millimetre
Φ	Stress	newtons per square millimetre

5 Summary of defined quality characteristics

A summary of defined quality characteristics is given in Table 2 for the convenience of users of this International Standard, as guidance indicating which defined quality characteristics are relevant to each type of bearing.

The sequence of the characteristics listed in Table 2 does not determine their importance. The manufacturer and user shall agree on priorities for the quality characteristics that, from their points of view, are required to assure reliability and lifetime of the product.

Table 2

Relevant clause/ subclause number	Quality characteristics	Type of plain bearing						
		Thin-walled half-bearing	Thick-walled half-bearing	Wrapped bush	Unsplit metallic bush	Solid polymer bush	Sintered bush	Thrust washer (ring and half)
6 Geometrical quality characteristics^a								
6.1	Wall thickness, s_3							
6.1.1	Line measurement	+	+	+	+	+	-	-
6.1.2	Point measurement	+	+	+	+	+	+	+
6.2	Outside diameter, D_o	-	+	+	+	+	+	+
6.3	Inside diameter, D_i	+	+	+	+	+	+	+
6.4	Width, B	+	+	+	+	+	+	-
6.5	Locating features	+	+	+	+	+	-	+
6.6	Lubricant feed and distribution features	+	+	+	+	+	-	+
6.7	Surface conditions	+	+	+	+	+	-	+
6.8	Crush height, a	+	-	-	-	-	-	-
6.9	Free spread	+	+	-	-	-	-	-
6.10	Straightness of sliding surface	+	-	-	-	-	-	-
6.11	Joint face taper, h_Δ	+	-	-	-	-	-	-
6.12	Back contact	+	-	-	-	-	-	-
6.13	Joint displacement, B_Δ	-	-	+	-	-	-	-
6.14	Height of thrust half-washer, H	-	-	-	-	-	(+)	+
6.15	Flatness	-	-	-	-	-	(+)	+
6.16	Flange diameter, D_{fl}	+	+	+	+	+	+	-
6.17	Distance between flanges, a_{fl}	+	+	+	+	+	-	-
6.18	Flange thickness, s_{fl}	+	+	+	+	+	+	-
6.19	Perpendicularity (squareness) of flange	+	+	+	+	+	(+)	-
6.20	Geometric deviations							
6.20.1	Cylindricity	-	(+)	-	+	-	(+)	-
6.20.2	Run-out of thrust face	-	(+)	-	+	+	(+)	-
6.20.3	Coaxiality and concentricity	-	+	-	+	+	+	-

Table 2 (continued)

Relevant clause/ subclause number	Quality characteristics	Type of plain bearing						
		Thin-walled half-bearing	Thick-walled half-bearing	Wrapped bush	Unsplit metallic bush	Solid polymer bush	Sintered bush	Thrust washer (ring and half)
7 Material quality characteristics ^a								
7.1	Metallic solid material							
7.1.1	Hardness	-	+	+	+	-	-	+
7.1.2	Material composition	-	+	+	+	-	-	+
7.1.3	Material structure	-	+	+	+	-	-	+
7.2	Metallic multilayer material							
7.2.1	Overlay properties	+	+	+	-	-	-	+
7.2.2	Lining properties	+	+	+	-	-	-	+
7.2.3	Backing properties	+	+	+	-	-	-	+
7.2.4	Adhesion (bond) of adjacent layers	+	+	+	-	-	-	+
7.3	Polymer layer material							
7.3.1	Overlay properties	+	+	+	-	-	-	(+)
7.3.2	Lining properties	+	+	+	-	-	-	(+)
7.3.3	Backing properties	-	-	+	-	-	-	(+)
7.3.4	Adhesion (bond) of adjacent layers	-	-	+	-	-	-	(+)
7.4	Solid polymer material							
7.4.1	Material composition	-	-	-	-	+	-	-
7.4.2	Material structure	-	-	-	-	+	-	-
7.5	Sintered material							
7.5.1	Material composition	-	-	-	-	-	+	-
7.5.2	Material structure	-	-	-	-	-	+	-
^a Significance of symbols: Plus sign indicates that the characteristic is generally applicable to the corresponding type of bearing. Plus sign in parentheses indicates that this characteristic is not always applicable. Minus sign indicates that the characteristic is not relevant for the corresponding type of bearing.								

6 Geometrical quality characteristics

In order to assess plain bearing quality, important dimensional quality characteristics are specified in Clause 6.

Unless otherwise stated, the dimensions in the tables and figures are given in millimetres.

6.1 Wall thickness, s_3

See Table 3.

Table 3

Dimensions in millimetres, unless otherwise stated

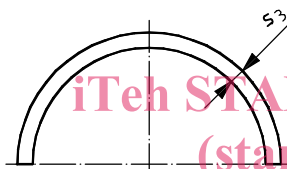
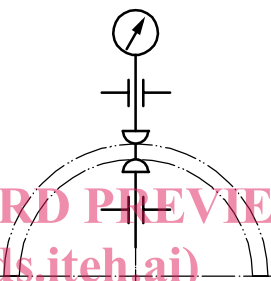
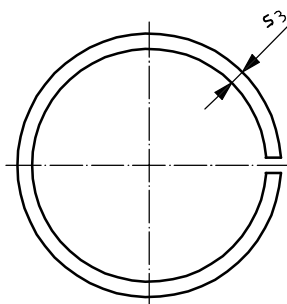
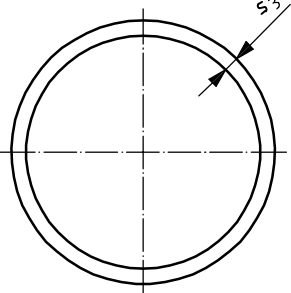
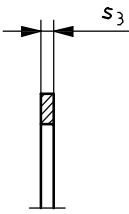
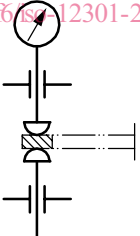
Applicability	Definition of measured geometrical characteristic	Test method/measuring principle	Test equipment
Metallic thin-walled half-bearing	See Figure 1.  Figure 1	NOTE This test method is also applicable when measuring joint face bore relief.  Figure 2	
Metallic thick-walled half-bearing	See Figure 1.	Measured normal to the back surface in the radial direction using the spherical faces of the measuring pins	Device for measuring wall thickness
Wrapped bush	See Figure 3 and ISO 3547-7.  Figure 3	Measure in accordance with ISO 3547-7. Depending on the manufacturing process, the back of the wrapped bush can show slight hollows. The wall thickness shall, therefore, be measured outside these hollows, i.e. on the "bearing areas" (see ISO 3547-7). In the cases $D_i < 8$ or $D_i > 150$, the test method shall be subject to agreement between the manufacturer and user.	Device for measuring wall thickness (see ISO 3547-7)

Table 3 (continued)

Dimensions in millimetres, unless otherwise stated

Applicability	Definition of measured geometrical characteristic	Test method/measuring principle	Test equipment
Unsplit metallic bush	See Figure 4.  <p style="text-align: center;">Figure 4</p>	Similar to Figure 2	Device for measuring wall thickness
Solid polymer bush	See Figure 4	Similar to Figure 2 Measure normal to the back surface in the radial direction using the spherical faces of the measuring pins.	Device for measuring wall thickness
Sintered bush	See Figure 4.	Similar to Figure 2	Device for measuring wall thickness
Thrust washer	Axial distance between the two faces of the washer (see Figure 5)  <p style="text-align: center;">Figure 5</p>	Measure parallel to the axial direction using the spherical faces of the measuring pins (see Figure 6).  <p style="text-align: center;">Figure 6</p>	Device for measuring wall thickness

6.1.1 Line measurement (wall thickness)

See Table 4.

Table 4

Dimensions in millimetres, unless otherwise stated

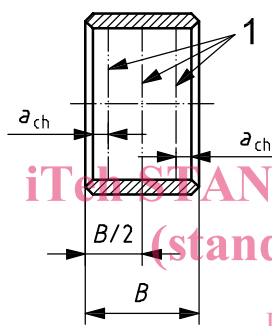
Applicability	Definition of measured geometrical characteristic	Test method/ measuring principle	Test equipment															
Metallic thin-walled half-bearing																		
Wrapped bush; unsplit metallic bush	<p>See Figure 7 and ISO 3547-7.</p> <p>Each measuring line distance, a_{ch}, is specified from the beginning of the sliding surface or from the end face by adding the nominal value of the chamfer. This measurement may also be used for an unsplit bush.</p>  <p style="text-align: center;">ISO 12301:2007</p> <p>Key https://standards.iteh.ai/catalog/standards/sist/3e589023-3077-4ef6-9a3c-600a9c4838f6/iso-12301-2007</p> <p>1 measuring lines</p> <p>$a_{ch} = 1,5$</p> <table border="1" data-bbox="391 1288 778 1590"> <thead> <tr> <th>Width</th> <th>Distance to measuring position</th> <th>Number of measuring lines</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>a_{ch}</td> <td>M</td> </tr> <tr> <td>≤ 15</td> <td>$B/2$</td> <td>1</td> </tr> <tr> <td>$> 15 \leq 50$</td> <td>4</td> <td>2</td> </tr> <tr> <td>> 50</td> <td>6</td> <td>2</td> </tr> </tbody> </table> <p style="text-align: center;">Figure 7</p>	Width	Distance to measuring position	Number of measuring lines	B	a_{ch}	M	≤ 15	$B/2$	1	$> 15 \leq 50$	4	2	> 50	6	2	<p>The thickness of the half-bearing or bush is measured continuously on one, two or three predetermined or agreed measuring lines (see Figure 7).</p> <p>It can be necessary to modify the defined position of the measuring lines to avoid design features, such as grooves, etc.</p>	Device for measuring wall thickness
Width	Distance to measuring position	Number of measuring lines																
B	a_{ch}	M																
≤ 15	$B/2$	1																
$> 15 \leq 50$	4	2																
> 50	6	2																

Table 4 (continued)

Dimensions in millimetres, unless otherwise stated

Applicability	Definition of measured geometrical characteristic	Test method/ measuring principle	Test equipment			
Metallic thick-walled half-bearing	See Figure 7. Each measuring line distance, a_{ch} , is specified from the beginning of the sliding surface or from the end face by adding the nominal value of the chamfer.	The thickness of the half-bearing is measured continuously on two predetermined or agreed measuring lines (see Figure 7). In the case where $s_3 > 25$, the test method shall be subject to agreement between the manufacturer and user. It can be necessary to modify the defined position of the measuring lines to avoid design features, such as grooves, etc.	Device for measuring wall thickness; for details see the following table.			
			Wall thickness	Measuring pin load N	Uncertainty of measurement	Radius of measuring anvil
			$s_3 \leq 10$	$0,8 \leq F_{pin} \leq 1,5$	$\pm 0,001\ 5$	$3 \pm 0,2$
			$10 < s_3 \leq 25$	$1,5 < F_{pin} \leq 2,5$	$\pm 0,002$	
Solid polymer bush	See Figure 7. Each measuring line distance, a_{ch} , is specified from the beginning of the sliding surface or from the end face by adding the nominal value of the chamfer.	The thickness of the bush is measured continuously on one, two or three predetermined or agreed measuring lines (see Figure 7). It can be necessary to modify the defined position of the measuring lines to avoid design features such as grooves, etc.	Device for measuring wall thickness; for details see the following table.			
			Outside diameter	Measuring pin load N	Radius of measuring anvil	Uncertainty of measurement
			$D_o \leq 150$	$0,8 \leq F_{pin} \leq 1,5$	$3 \pm 0,2$	$\pm 0,005$
$150 < D_o \leq 300$	$1,5 < F_{pin} \leq 2,5$	$5 \pm 0,2$				

6.1.2 Point measurement (wall thickness)

See Table 5.

Table 5

Dimensions in millimetres, unless otherwise stated

Applicability	Definition of measured geometrical characteristic	Test method/ measuring principle	Test equipment															
Metallic thin-walled half-bearing		See Figure 2.																
Wrapped bush; unsplit metallic bush	Wall thickness measured at determined measuring points; see ISO 3547-7	According to ISO 3547-7 It can be necessary to modify the defined position of the measuring points to avoid design features such as grooves, etc. This measurement can also be used for an unsplit bush.	Device for measuring wall thickness															
Metallic thick-walled half-bearing	Wall thickness measured at determined measuring points which are subject to agreement between the manufacturer and user.	It can be necessary to modify the defined position of the measuring points to avoid design features such as grooves, etc.	External micrometer with dial indicator															
Solid polymer bush; sintered bush	<p>Wall thickness measured at determined measuring points (see Figure 8)</p> <p>The figure consists of three parts. The top part is a circular cross-section of a bush with a diameter ϕ. Two measuring points are indicated: P1/6 at an angle of 60° from the vertical centerline, and P2/5 at a distance a_{ch} from the bottom edge. The bottom part shows two rectangular diagrams representing the bush's width B. The first diagram is for $B \leq 15$ and shows three measuring lines numbered 1, 2, and 3. The second diagram is for $B \geq 15$ and shows six measuring lines numbered 1 through 6, arranged in two rows of three.</p>	It can be necessary to modify the defined position of the measuring points to avoid design features such as grooves, etc.	Device for measuring wall thickness External micrometer with dial indicator															
	<table border="1"> <thead> <tr> <th>Width</th> <th>Distance to measuring position</th> <th>Number of measuring lines</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>a_{ch}</td> <td>M</td> </tr> <tr> <td>≤ 15</td> <td>$B/2$</td> <td>1</td> </tr> <tr> <td>$> 15 \leq 50$</td> <td>4</td> <td>2</td> </tr> <tr> <td>> 50</td> <td>6</td> <td>2</td> </tr> </tbody> </table>	Width	Distance to measuring position	Number of measuring lines	B	a_{ch}	M	≤ 15	$B/2$	1	$> 15 \leq 50$	4	2	> 50	6	2		
Width	Distance to measuring position	Number of measuring lines																
B	a_{ch}	M																
≤ 15	$B/2$	1																
$> 15 \leq 50$	4	2																
> 50	6	2																
	Figure 8																	