
**Plain bearings — Wrapped bushes —
Part 5:
Checking the outside diameter**

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Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Symbols and units.....	1
5 Outside diameter, D_o.....	2
6 Purpose of checking.....	2
7 Methods of checking.....	2
7.1 General.....	2
7.2 Checking method A — Measurement of outside diameter, D_o	3
7.3 Checking method B — Gauging of outside diameter, D_o	3
7.4 Checking method D — Measurement of outside diameter, $D_o > 120$ mm.....	3
8 Selection of checking method for outside diameter.....	3
9 ISO 3547-2:2017, test A — Outside diameter, D_o.....	3
9.1 Measuring equipment.....	3
9.2 Requirements for checking the block and the setting plug.....	5
9.3 Determination of correction factor, C	10
9.4 Procedure.....	10
9.5 Measuring errors.....	11
9.5.1 General.....	11
9.5.2 Errors due to measuring equipment.....	11
9.5.3 Errors due to the bush.....	11
9.5.4 Errors due to human factors.....	11
9.6 Summary of the factors relating to the measurement of the outside diameter, D_o , of the bush.....	11
9.6.1 Checking load, F_{ch}	11
9.6.2 Diameter of the checking block, $d_{ch,1}$, and of the setting plug, $d_{ch,2}$	11
9.6.3 Upper limiting value and lower limiting value for Δz	11
9.6.4 Correction factor, C	12
9.6.5 Conversion of the indicated measured value, Δz , for outside diameter.....	12
10 ISO 3547-2:2017, test B — Outside diameter, D_o.....	12
10.1 Gauging equipment.....	12
10.2 Requirements for measuring equipment.....	12
10.3 Procedure.....	13
10.4 Measuring errors.....	13
11 ISO 3547-2, test D — Outside diameter, $D_o > 120$ mm.....	13
11.1 Gauging equipment.....	13
11.2 Measuring equipment.....	13
11.3 Procedure.....	14
11.4 Measuring errors.....	14
12 Specifications on drawings of bushes.....	14
13 Specifications for control of the checking equipment.....	14
13.1 Gauging equipment.....	14
13.2 Measuring equipment.....	14
Bibliography.....	15

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 5, *Quality analysis and assurance*.

This second edition cancels and replaces the first edition (ISO 3547-5:2007), which has been technically revised.

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

- [Clause 2](#) has been updated;
- [Clause 9](#) has been updated;
- [Figure 8](#) has been updated.

A list of all parts in the ISO 3547 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.

Introduction

Wrapped bushes in the free condition are flexible, but after insertion they adapt largely to the shape of the housing bore due to the oversize between the outside diameter of the bush and the housing bore. For this reason, checking of the outside diameter of wrapped bushes can only be carried out under a constraining load by use of specialized measuring equipment.

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Plain bearings — Wrapped bushes —

Part 5: Checking the outside diameter

1 Scope

This document specifies, following ISO 12301, the checking of the outside diameter of wrapped bushes (ISO 3547-2:2017, methods A, B and D) and describes the necessary checking methods and measuring equipment.

NOTE The dimensions and tolerances of wrapped bushes are given in ISO 3547-1. Checking the wall thickness is the subject of ISO 3547-7.

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 286-2:2010, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO 1938-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Plain limit gauges of linear size*

ISO 3547-2:2017, *Plain bearings — Wrapped bushes — Part 2: Test data for outside and inside diameters*

3 Terms and definitions

No terms and definitions are listed in this document.

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/>

4 Symbols and units

For the purposes of this document, the symbols and units given in [Table 1](#) apply.

Table 1 — Symbols and units

Symbol	Parameter	SI unit
B	Width of the bush	millimetres
$b_{ch,1}$	Width of the checking block	millimetres
$b_{ch,2}$	Width of the setting plug	millimetres
d_o	Outside diameter of the ring gauge	millimetres
D_o	Outside diameter of the bush	millimetres
$d_{ch,1}$	Diameter of the checking block bore (see ISO 3547-2)	millimetres

Table 1 (continued)

Symbol	Parameter	SI unit
$d_{ch,2}$	Diameter of the setting plug (see ISO 3547-2)	millimetres
$d_{ch,a,1}$	Actual diameter of the checking block	millimetres
$d_{ch,a,2}$	Actual diameter of the setting plug	millimetres
F_{ch}	Checking load	newtons
C	Correction factor	millimetres
Ra	Surface roughness	micrometres
$t_1 \dots t_6$	Tolerances of form and position	millimetres
x	Length of checking block	millimetres
y	Width of checking block	millimetres
z	Distance between checking block halves	millimetres
ΔD_o	Tolerance of D_o	millimetres
Δz	Indicator reading	millimetres
Δz_D	Circumference indicator reading	millimetres

5 Outside diameter, D_o

For the outside diameter of a wrapped bush, see [Figure 1](#).



^a Split line.

NOTE The free diameter of a wrapped bush is not measured directly because of the flexible nature of the component.

Figure 1 — Outside diameter of a wrapped bush

6 Purpose of checking

The outside diameter shall be checked to ensure the designated mounting compression (interference fit) for the wrapped bush in the housing bore.

7 Methods of checking

7.1 General

Checking method C is for measuring the inside diameter and is covered by ISO 3547-6.

For the methods described in [7.2](#) to [7.4](#), see also ISO 3547-2.

7.2 Checking method A — Measurement of outside diameter, D_o

Check the outside diameter of a wrapped bush using measuring equipment as shown in [Figure 2](#), with a checking block consisting of upper and lower halves (see [Figures 3](#) and [4](#)) and setting plugs (see [Figures 5](#) and [6](#)), at a determined checking load, F_{ch} .

Measure the outside diameter indirectly as the difference in the value of z , Δz .

The checking load is calculated so that the bush outside diameter is reduced only elastically during checking and that there is no permanent deformation.

7.3 Checking method B — Gauging of outside diameter, D_o

Check the outside diameter of a wrapped bush in “GO” and “NO GO” ring gauges.

7.4 Checking method D — Measurement of outside diameter, $D_o > 120$ mm

Check the outside diameter of a wrapped bush above 120 mm diameter using a precision measuring tape.

8 Selection of checking method for outside diameter

Method A is a precise method involving complex tooling. Method B is an attributive method using simpler tooling. Method D is used only for wrapped bushes with an outside diameter > 120 mm. All three methods are in general use. Method A is generally unsuitable for small bushes up to 10 mm outside diameter but is preferred for bushes over 10 mm outside diameter.

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9 ISO 3547-2:2017, test A — Outside diameter, D_o

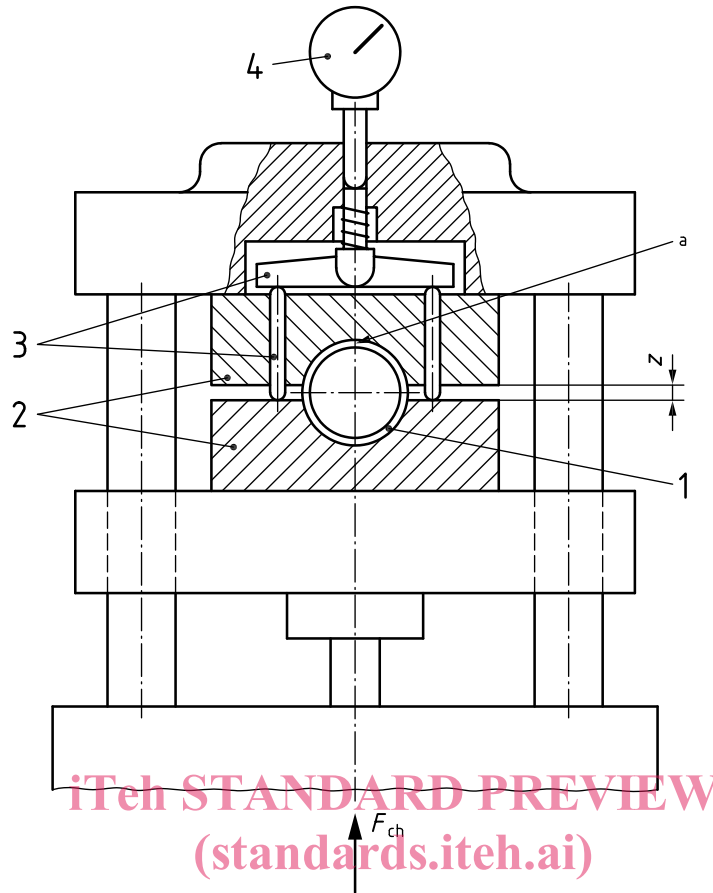
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9.1 Measuring equipment

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Typical equipment for measuring the bush consists essentially of the following components:

- base plate used as fixture and guiding device for the split checking block;
- means to generate the checking load;
- means to calibrate the measuring load (see [Table 2](#));
- upper plate;
- system for transmitting the distance, z , of both checking block halves to the measuring pin (see [Figure 2](#));
- measuring pin with indicating instrument (see [Table 3](#));
- checking block (see [Figures 3](#) and [4](#)) with setting plug (see [Figures 5](#) and [6](#)).



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Key

- 1 bush
- 2 checking block
- 3 measuring pins
- 4 indicating instrument
- a Split line.

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Figure 2 — Typical outside diameter measuring system

Figure 2 shows a typical outside diameter measuring system. This may be operated hydraulically, pneumatically or mechanically.

The force, F_{ch} , may be smoothly applied from the top or from below.

The bush split shall be in the vertical direction and pointing towards the upper checking block.

Table 2 — Checking loads and their limiting deviations, speed of approach and temperature

Checking load		Permissible limiting deviations of the checking load	Maximum speed of approach to apply the checking load, F_{ch}	Test temperature ^a
	F_{ch} N	%	mm/s	°C
—	≤2 000	±1,25	12	20 to 25
>2 000	≤5 000	±1		
>5 000	≤10 000	±0,75		
>10 000	≤50 000	±0,5		

^a The difference in temperature between the checking block and the bush to be measured shall not exceed 1 °C.

Table 3 — Deviations for dial gauge and electronic gauge

Dimensions in millimetres

Outside diameter Tolerance ΔD_o		Resolution		Total deviation ^a	
		dial gauge	electronic gauge	dial gauge	electronic gauge
—	$\leq 0,1$	0,001	0,001	0,001 2	0,5 % of measuring range
>0,1		0,005	0,005	0,006	

^a Maximum measuring value indication (for a full-scale range of $\pm 500 \mu\text{m}$).

9.2 Requirements for checking the block and the setting plug

The requirements for the checking block and the setting plug for measuring the bush outside diameter, D_o , shall be as shown in Figures 3 to 6 and as given in Table 4. Manufacturing tolerances and wear limits are given in Table 5.

Table 4 — Maximum difference between the diameters of the checking block, $d_{ch,1}$, and setting plug, $d_{ch,2}$, for a usable combination

Dimensions in millimetres

D_o nominal	$d_{ch,1} - d_{ch,2}$ max.
≤ 18	0,006
>18 ≤ 50	0,008
>50 ≤ 80	0,01
>80 ≤ 120	0,012
>120 ≤ 180	0,016