Plain bearings — Wrapped bushes —

Part 1: Dimensions

BSi

British Standards

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National foreword

This British Standard was published by BSI. It is the UK implementation of ISO 3547-1:2006. It supersedes BS ISO 3547-1:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/12, Plain bearings.

A list of organizations represented on MCE/12 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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INTERNATIONAL STANDARD

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Plain bearings — Wrapped bushes —

Part 1:
Dimensions

Paliers lisses — Bagues roulées —

Partie 1: Dimensions

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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 3547-1 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 3, *Dimensions, tolerances and construction details*.

This second edition cancels and replaces the first edition (ISO 3547-1:1999), which has been technically revised.

ISO 3547 consists of the following parts, under the general title *Plain bearings — Wrapped bushes*:

— *Part 1: Dimensions*

— *Part 2: Test data for outside and inside diameters*

— *Part 3: Lubrication holes, grooves and indentations*

— *Part 4: Materials*

The following parts are under preparation:

— *Part 5: Checking the outside diameter*

— *Part 6: Checking the inside diameter*

— *Part 7: Measurement of wall thickness of thin-walled half-bearings and thin-walled bushes*

Plain bearings — Wrapped bushes —

Part 1:
Dimensions

1 Scope

This part of ISO 3547 specifies the dimensions and designations of cylindrical and flanged wrapped bushes made of solid and multi-layer bearing material for plain bearing applications.

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 3547-2:2006, *Plain bearings — Wrapped bushes — Part 2: Test data for outside and inside diameters*

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

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

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

ISO 13715, *Technical drawings — Edges of undefined shape — Vocabulary and indication*

3 Terms and definitions

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

1

4 Symbols and units

See Table 1.

Table 1 — Symbols and units

Symbol	Description	Unit
B	Width of the bush	mm
C_i	Inside chamfer	mm
C_o	Outside chamfer	mm
D_i	Inside diameter of the bush	mm
$D_{i,\,ch}$	Inside diameter of the bush in the ring gauge	mm
D_{fl}	Flange diameter	mm
D_H	Housing bore diameter	mm
D_o	Outside diameter of the bush	mm
D_S	Shaft diameter	mm
$d_{ch,\,1}$	Diameter of the checking block or ring gauge	mm
r	Flange radius	mm
Ra	Surface roughness	µm
s_1	Thickness of the backing layer[a]	mm
s_2	Thickness of the bearing material layer[a]	mm
s_3	Wall thickness[a]	mm
s_{fl}	Flange thickness	mm

[a]   For bushes which are made of a single material $s_1 = s_3$ or $s_2 = s_3$.

5 Dimensions

See Figure 1 and Tables 2 to 4.

The largest dimension of the inside diameter of the bush in its pressed-in condition is obtained from the largest dimension of the bore in the housing minus twice the smallest dimension of the wall thickness, s_3. The smallest dimension of the inside diameter of the bush in its pressed-in condition can be obtained from the smallest dimension of the bore in the housing minus twice the greatest dimension of the wall thickness, s_3. This assumes that there is no expansion of the bore in the housing caused by pressing in the bush. In reality, the expansion depends on several factors, such as the stiffness of the housing and the bush. An example of the calculation is given in Clause 7.

The wall thickness limit deviation depends on whether or not there is a machining allowance in the bush bore and on the material type, as specified in ISO 3547-4. The preferred limit deviation series (A to E) is specified in Table 5.

Instead of the wall thickness, the inside diameter, $D_{i,\,ch}$, of the bush may be specified. $D_{i,\,ch}$ is the inside diameter of the bush, when this is pressed into a ring gauge (Test C — gauging — in accordance with ISO 3547-2:2006, see also ISO 3547-6).

For bushes which are supplied with a machined bore (Series W), the limit deviations of the inside diameter of the bush, $D_{i, ch}$, checked in a ring gauge, are given in Table 6.

In no case shall wall thickness and inside diameter be given at the same time as the dimensions that are to be checked.

The tolerance for the inside diameter, $D_{i, ch}$, of the bush in the ring gauge is given in Table 6. The tolerance of the inside diameter of a bush pressed into a housing is found from the sum of the tolerance for, $D_{i, ch}$, and the tolerance of the housing bore. As in the case of the calculation of the inside diameter from the wall thickness, it is assumed that there is no expansion of the housing bore.

Dimensions for the outside diameter, D_o, of the bush are given in Table 7.

Dimensions in millimetres
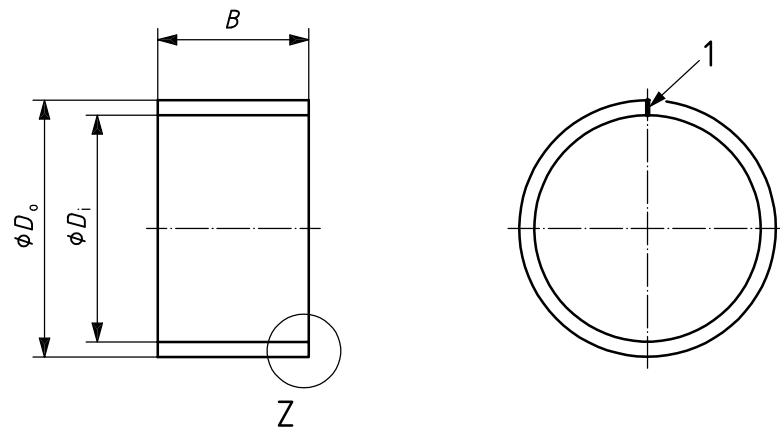
Type C cylindrical bush
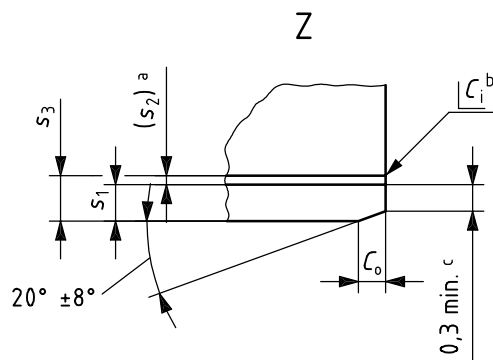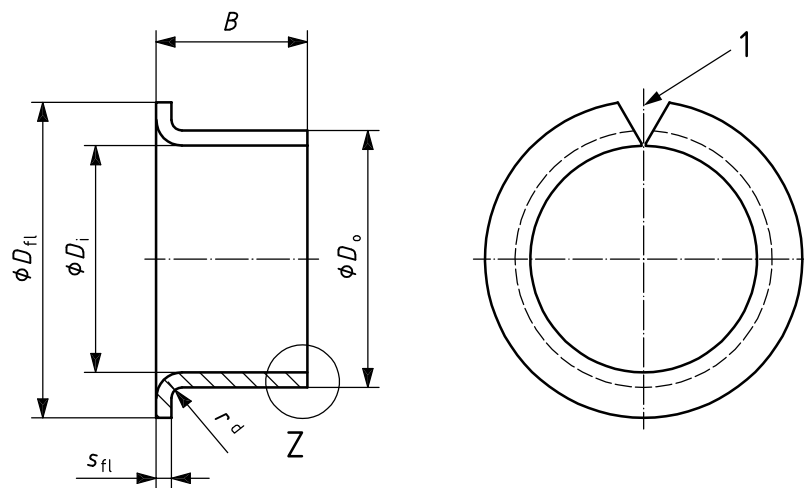
Type F flanged bush

Key

1   split

[a]   Thickness of the bearing material layer: only valid as a basis for calculation in accordance with ISO 3547-2.

[b] C_i may be a chamfer or break edge, in accordance with ISO 13715.

[c]   0,2 mm min. for nominal wall thickness 0,5 mm.

[d] $r_{max} = s_3$

Figure 1 — Cylindrical and flanged bush

Table 2 — Preferred nominal dimensions for inside diameter, D_i, outside diameter, D_o, wall thickness, s_3, and bush width, B

Dimensions in millimetres

			B						

$s_3 = 0,5$

D_i	D_o	s_3	B 3	4	5	6	8	10	12
2	3	0,5	a		a				
3	4	0,5	a		a	a			
4	5	0,5	a	a		a			
5	6	0,5			a		a	a	
6	7	0,5		a		a	a	a	
8	9	0,5				a	a	a	a
10	11	0,5					a	a	a

$s_3 = 0,75$

D_i	D_o	s_3	B 3	4	5	6	7	8	10
2	3,5	0,75	a		a				
3	4,5	0,75	a		a	a			
4	5,5	0,75	a	a		a			a

$s_3 = 1,0$

D_i	D_o	s_3	B 3	4	5	6	7	8	10	12	15	20	25
3	5	1,0	a	a	a	a							
4	6	1,0	a	a		a							
6	8	1,0			a	a	a	a	a				
7	9	1,0			a		a		a	a			
8	10	1,0			a	a	a	a	a	a			
9	11	1,0							a				
10	12	1,0				a	a	a	a	a	b	b	
12	14	1,0				a	a	a	a	a	b	b	b
13	15	1,0							a		b	b	
14	16	1,0							a	a	b	b	b
15	17	1,0							a	a	b	b	b
16	18	1,0							a	a	b	b	b
17	19	1,0									b	b	
18	20	1,0							a		b	b	b

Table 2 (*continued*)

$s_3 = 1,5$ mm										
D_i	D_o	s_3	B							
			8	10	12	15	20	25	30	40
8	11	1,5		b	b					
10	13	1,5		a	a	a	a			
12	15	1,5		b	b	b				
13	16	1,5		b	b	b	b			
14	17	1,5		b	b	b	b			
15	18	1,5		a	a	a	a	a		
16	19	1,5		a	a	a	b	a		
18	21	1,5				a	b	b		
20	23	1,5			a	a	b	b	b	
22	25	1,5				a	b	b	b	
24	27	1,5				a	b	b	b	
25	28	1,5				a	b	b	b	
28	31	1,5					b	b	b	

$s_3 = 2$ mm										
D_i	D_o	s_3	B							
			15	20	25	30	40	50	60	70	80
28	32	2,0	a	a	a	b		b			
30	34	2,0	a	a	a	b	b				
32	36	2,0		a		b	b				
35	39	2,0		a		b	b	b			
37	40	2,0		a		b	b				
38	42	2,0		a		b	b				
40	44	2,0		a		b	b	b			

$s_3 = 2,5$ mm											
D_i	D_o	s_3	B								
			20	25	30	40	50	60	70	80	100	115
45	50	2,5	a		a	b	b					
50	55	2,5	a	a	a	b	b	b				
55	60	2,5	a		a	b		b				
60	65	2,5	a		a	b	b		c			
65	70	2,5			a		b		c			
70	75	2,5			a		b		c			
75	80	2,5				b		b		c		
80	85	2,5				b		b		c	c	
85	90	2,5				b		b		c	c	

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Table 2 (*continued*)

D_i	D_o	s_3	B									
			20	25	30	40	50	60	70	80	100	115
90	95	2,5				b		b			c	
95	100	2,5						b			c	
100	105	2,5					b	b			c	c
105	110	2,5						b			c	c
110	115	2,5						b			c	c
115	120	2,5					b	b	b		c	
120	125	2,5					b	b			c	
125	130	2,5						b			c	
130	135	2,5						b			c	
135	140	2,5						b		b	c	
140	145	2,5						b			c	
150	155	2,5						b		b	c	
160	165	2,5						b		b	c	
170	175	2,5									c	
180	185	2,5									c	
200	205	2,5									c	
220	225	2,5									c	
250	255	2,5									c	
300	305	2,5									c	

Limit deviations for B:

    a   ± 0,25

    b   ± 0,5

    c   ± 0,75

Bush widths B outside the tolerance ranges a, b or c should be agreed between the manufacturer and user and stated after the nominal sizes in the standard designation.

If it is necessary to use non-standard widths B, then these should be arranged to have an end figure of 2, 5 and 8 up to D_i = 50 mm, and an end figure of 5 over D_i = 50 mm. Check bush width B in accordance with ISO 12301.

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Table 3 — Preferred nominal dimensions and limit deviations for wrapped flanged bushes

Dimensions in millimetres

D_i	D_o	s_3	D_{fl} nominal	D_{fl} limit deviation	S_{fl}	r_{max}	4	5,5	7	7,5	8	9	9,5	11,5	12	16	16,5	17	21,5	22	26
6	8	1	12	+0,5 / −0,8	1,05 / 0,80	1	a					a									
8	10	1	15			1		a		a			a								
10	12	1	18			1			a			a			a			b			
12	14	1	20			1			a			a			a			b			
14	16	1	22			1									a			b			
15	17	1	23			1						a			a			b			
16	18	1	24			1									a			b			
18	20	1	26			1									a			b		b	
20	23	1,5	30	+1 / −0,8	1,6	1,5								a			a		b		
25	28	1,5	35		1,3	1,5								a			a		b		
30	34	2	42	+2 / −0,8	2,1 / 1,8	2										a					b
35	39	2	47			2										a					b
40	44	2	52			2										a					b
45	50	2,5	58		2,6 / 2,3	2,5										a					b

Limit deviations for B:

a ± 0,25

b ± 0,5

Table 4 — Outside, C_o, and inside, C_i, chamfers

Dimensions in millimetres

Wall thickness s_3 Nominal dimension	Chamfer C_o machined	Chamfer C_o rolled	C_i
0,5	0,2 ± 0,1	0,2 ± 0,1	−0,05 / −0,30
0,75	0,5 ± 0,3	0,5 ± 0,3	−0,1 / −0,4
1	0,6 ± 0,4	0,6 ± 0,4	−0,1 / −0,6
1,5	0,6 ± 0,4	0,6 ± 0,4	−0,1 / −0,7
2	1,2 ± 0,4	1,0 ± 0,4	−0,1 / −0,7
2,5	1,8 ± 0,6	1,2 ± 0,4	−0,2 / −1,0

For bushes which have to be machined to size in the bush bore, C_i should be made correspondingly bigger.

C_o may be machined or rolled at the option of the manufacturer.

C_i may be a chamfer or break edge in accordance with ISO 13715.

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Table 5 — Nominal dimensions and limit deviations for wall thickness, s_3

Dimensions in millimetres

Nominal dimension		Limit deviations for s_3				
		No machining allowance in bush bore			Machining allowance in bush bore	
		Series A	Series B	Series D	Series C	Series E
0,5		0 − 0,015	0 − 0,030	—	—	—
0,75		0 − 0,015	0 − 0,020	—	+ 0,25 + 0,15	—
1		0 − 0,015	+ 0,005 − 0,020	− 0,020 − 0,045	+ 0,25 + 0,15	+ 0,11 + 0,07
1,5		0 − 0,015	+ 0,005 − 0,025	− 0,025 − 0,055	+ 0,25 + 0,15	+ 0,11 + 0,07
2		0 − 0,015	+ 0,005 − 0,030	− 0,030 − 0,065	+ 0,25 + 0,15	+ 0,11 + 0,07
2,5	$D_o \leqslant 80$	0 − 0,020	+ 0,005 − 0,040	− 0,040 − 0,085	+ 0,30 + 0,15	+ 0,14 + 0,07
	$80 < D_o \leqslant 120$	0 − 0,025	− 0,010 − 0,060			
	$D_o > 120$	0 − 0,030	− 0,035 − 0,085			
Depending on the manufacturing process used, the back of bushes can show isolated slight depressions. The thickness of the walls shall, therefore, be measured at places away from these depressions.						

Table 6 — Series W — Limit deviations for inside diameter, $D_{i, ch}$, of bush in ring gauge in accordance with ISO 3547-2

Dimensions in millimetres

D_i nominal		Limit deviations for $D_{i, ch}$
	$\leqslant 10$	+ 0,036 0
> 10	$\leqslant 18$	+ 0,043 0
> 18	$\leqslant 30$	+ 0,052 0
> 30	$\leqslant 50$	+ 0,062 0
> 50	$\leqslant 80$	+ 0,074 0
> 80	$\leqslant 120$	+ 0,087 0
> 120	$\leqslant 175$	+ 0,100 0
The concentricity of the inside and outside diameters of the bush should be 0,05 mm, unless otherwise agreed.		

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Table 7 — Dimensions and limit deviations for outside diameter, D_o

D_o nominal		Limit deviations for bushes made of	
		steel, steel/backed material	aluminium alloys, copper alloys, aluminium alloy backed material, copper alloy backed material
	⩽ 10	+ 0,055 + 0,025	+ 0,075 + 0,045
> 10	⩽ 18	+ 0,065 + 0,030	+ 0,080 + 0,050
> 18	⩽ 30	+ 0,075 + 0,035	+ 0,095 + 0,055
> 30	⩽ 50	+ 0,085 + 0,045	+ 0,110 + 0,065
> 50	⩽ 80	+ 0,100 + 0,055	+ 0,125 + 0,075
> 80	⩽ 120	+ 0,120 + 0,070	+ 0,140 + 0,090
> 120	⩽ 180	+ 0,170 + 0,100	+ 0,190 + 0,120
> 180	⩽ 305	+ 0,255 + 0,125	+ 0,245 + 0,145

6 Design

In its free state, a wrapped bush might not be perfectly cylindrical and its split can be open. After it has been pressed into its housing, in general, a wrapped bush is round and its split is closed. Wrapped bushes can be closed by an interlocked split. The design of the split is left at the discretion of the manufacturer.

Wrapped bushes are supplied with or without a machining allowance in the bore. Bushes supplied with a machining allowance are finish-machined to the desired dimensions by the customer after they have been pressed into their housings. Such bushes cannot be supplied in all materials.

Wrapped bushes which comply with this part of ISO 3547 are supplied in the limit deviations series A to E, as specified in Table 5, and Series W, as specified in Table 6.

Lubrication holes, lubrication grooves or lubrication indents should preferably be designed such that they can be stamped or punched. Distortion caused by the wrapping operation is permissible. All edges and corners shall be free from loose burrs. Burrs which do not affect installation or function are permissible.

ISO 3547-2:2006, Test B, does not stipulate any figure for outside diameter, D_o. In order to obtain a sufficiently tight fit of the bush in the housing bore when using test B, experimentally determined gauge inside diameters are used. These depend on the method of manufacture and cannot therefore apply in every single case. Specification of a maximum and minimum pressing in force increases the safety of this test method. The details of test should be agreed for each individual case.

The tolerance class of the housing bore diameter is given in Table 8.

Table 8 — Tolerance class of the housing bore diameter, D_H

Dimensions in millimetres

D_i Nominal		Tolerance class of housing bore D_H
	$\leqslant 4$	H 6
> 4	$\leqslant 75$	H 7
> 75		H 7

Selection of the tolerance class of the shaft will depend on the material type and application

The recommended surface roughness of the housing bore is Ra 1,6 to 3,2 µm and of the shaft Ra 0,2 to 0,4 µm.

Surface roughness values are given in accordance with Table 9.

Table 9 — Surface roughness, Ra, for bushes (in accordance with ISO 4288)

Surface	Ra µm Series				
	A	**B**	**C/E**	**D**	**W**
Bearing bore, D_i	0,8	1,6[a]	6,3	1,6	1,6
Back of bearing, D_o	1,6	1,6	1,6	1,6	1,6
Other surfaces	25	25	25	25	25
[a] For bushes made of B1 and P1 material according to ISO 3547-4, $Ra \leqslant 6,3$ µm.					

7 Example for calculation of inside diameter, D_i

Calculation of the size limits of inside diameter, D_i, in the pressed in condition of a bush of nominal outside diameter of 34 mm and nominal wall thickness of 2 mm:

bore diameter of housing $\qquad D_H = \left(34 \begin{smallmatrix} +\,0,025 \\ 0 \end{smallmatrix} \right)$ mm

outside diameter of bush $\qquad D_o = \left(34 \begin{smallmatrix} +\,0,085 \\ +\,0,045 \end{smallmatrix} \right)$ mm

wall thickness of bush $\qquad s_3 = \left(2 \begin{smallmatrix} 0 \\ -\,0,015 \end{smallmatrix} \right)$ mm

$D_{i,max} = 34,025 - (2 \times 1,985) = 30,055$ mm

$D_{i,min} = 34,000 - (2 \times 2,000) = 30,000$ mm

As a result of interference fit there will be a small expansion of the housing bore diameter, D_H, after assembly of the bush. This will depend on the rigidity of the housing.

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For rigid housing bores (steel), a figure of approximately one sixth of the difference between the mid-limit of the bush outside diameter, D_o, and the mid-limit of the diameter of the housing bore may be taken for the expansion of the housing bore due to the pressing in of the bush.

8 Designation

The following are examples of the designation of bushes conforming to ISO 3547.

EXAMPLE 1   A wrapped cylindrical bush (Type C) of inside diameter $D_i = 30$ mm, wall thickness deviation limit Series A, having an outside diameter $D_o = 34$ mm and width $B = 20$ mm, made of a multi-layer material, code S5, in accordance with ISO 3547-4, with a lubrication hole and a circumferential groove of design M1A, and with lubrication indentations of design N1B, in accordance with ISO 3547-3, and where ISO 3547-2:2006, test A, and wall thickness measurements are specified, is designated as follows:

Bush ISO 3547 — C30 A 34 × 20 — S5 — M1A N1B — AS

NOTE   "S" signifies the required wall thickness measurement in accordance with ISO 3547-7.

EXAMPLE 2   A wrapped flanged bush (Type F) of inside diameter $D_i = 30$ mm, wall thickness deviation limit Series B, having an outside diameter $D_o = 34$ mm and width $B = 16$ mm, made of a multi-layer material, code P1, in accordance with ISO 3547-4, and where ISO 3547-2:2006, Tests A and C, are specified, is designated as follows:

Bush ISO 3547 — F30 B 34 × 16 — P1 — AC

EXAMPLE 3   A wrapped cylindrical bush (Type C) of inside diameter $D_i = 30$ mm, wall thickness deviation limit Series W, having an outside diameter $D_o = 34$ mm and width $B = 20$ mm, made in a single material, code Y1, in accordance with ISO 3547-4, and where ISO 3547-2:2006, Tests A and C, are specified, is designated as follows:

Bush ISO 3547 — C30 W 34 × 20 — Y1 — AC

Bibliography

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

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