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**Plain bearings — Thermoplastic  
bushes — Dimensions and tolerances**

*Paliers lisses — Bagues thermoplastiques — Dimensions et tolérances*

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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 16287 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 3, *Dimensions, tolerances and construction details*.

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# Plain bearings — Thermoplastic bushes — Dimensions and tolerances

## 1 Scope

This International Standard specifies the dimensions and tolerances for inserted thermoplastic bushes used as plain bearings with or without lubrication grooves in accordance with ISO 12128. These thermoplastic bushes are dimensionally exchangeable to wrapped bushes according to ISO 3547-1.

This International Standard is not applicable to reinforced plastics.

## 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 286-1, *ISO system of limits and fits — Part 1: Bases of tolerance, deviations and fits*

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

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

ISO 3547-2:1999, *Plain bearings — Wrapped bushes — Part 2: Test data for outside and inside diameter*

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

ISO 12128, *Plain bearings — Lubrication holes, grooves and pockets — Dimensions, types, designation and their application to bearing bushes*

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

## 3 Symbols

$B$	nominal width of bush
$B_{fl}$	flange thickness
$C_i$	inside chamfer
$C_o$	outside chamfer
$D_{fl}$	flange diameter
$D_H$	nominal housing bore diameter

- $D_i$  nominal inside diameter of the bush
- $D_{i,ch}$  inside diameter of the bush when inserted in a ring gauge middle H7
- $D_o$  nominal outside diameter of the bush
- $r$  radius for flange bushes

#### 4 Dimensions

The dimensions and tolerances of the thermoplastic bushes are shown in Figures 1 and 2, according to whether cylindrical (type C) or flanged (type F), and given, in millimetres, in Tables 1, 2, 3 and 4. The surface finishes  $x$  and  $y$  represented in Figures 1 and 2 are given in Table 5.

For determination of the IT value (see ISO 286-1) of the coaxiality tolerance, the dimensions of  $D_o$  are applicable.

For determination of the IT value (ISO 286-1) of the axial run-out tolerance, the dimensions of  $D_{fl}$  are applicable.

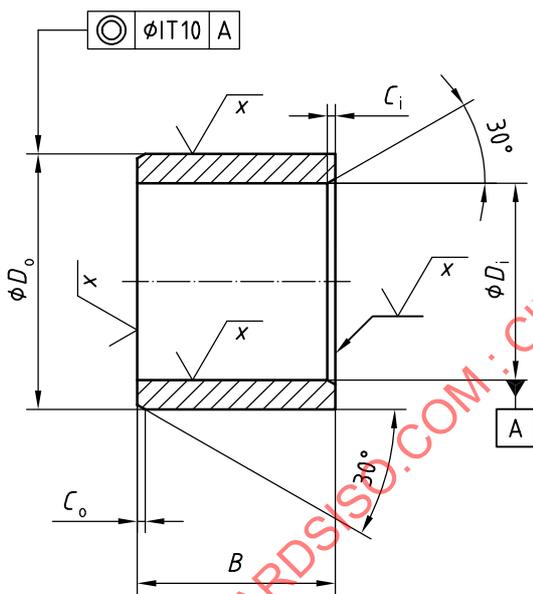


Figure 1 — Cylindrical bush

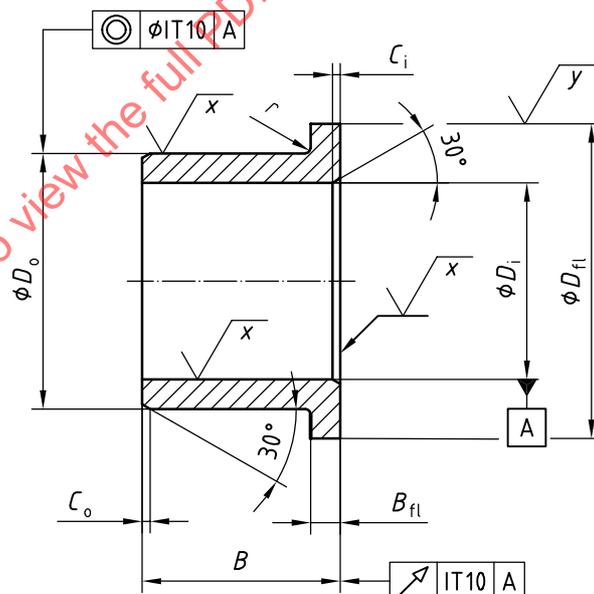


Figure 2 — Flanged bush

Table 1 — Nominal sizes and limits for thick-walled bushes type C and type F

$D_i$ nom.	$D_o$ nom.		Limits for tolerance group (see Table 5)		$D_{fi}$ h13	$B_{fi}$ h13	$B$ h13			$C_i$ $C_o$ max.	$r$ max.	
			A	B								
6	10	12	+0,21 +0,07	zb11	14	3	6	10	—	0,8	0,5	
8	12	14			+0,27 +0,09	18	3	6	10	15	0,8	0,5
10	14	16	+0,33 +0,11			20	3	6	10	15	0,8	0,5
12	16	18			+0,45 +0,15	22	3	10	15	20	0,8	0,8
14	18	20	+0,60 +0,20			25	3	10	15	20	0,8	0,8
15	18	21			+0,69 +0,23	27	3	10	15	20	0,8	0,8
16	20	22	+0,90 +0,30			28	3	12	15	20	0,8	0,8
18	22	24			To be agreed	30	3	12	20	30	0,8	0,8
20	24	26	za11			32	3	15	20	30	1,5	0,8
22	26	28			+0,45 +0,15	34	3	15	20	30	1,5	0,8
24	28	30				+0,60 +0,20	36	3	15	20	30	1,5
25	30	32			+0,69 +0,23		38	4	20	30	40	1,5
28	34	36				+0,90 +0,30	42	4	20	30	40	2
30	36	38			To be agreed		44	4	20	30	40	2
32	38	40				+0,69 +0,23	46	4	20	30	40	2
35	41	45			+0,90 +0,30		50	5	30	40	50	2
38	45	48				To be agreed	54	5	30	40	50	2
40	48	50			+0,69 +0,23		58	5	30	40	60	2
42	50	52				+0,90 +0,30	60	5	30	40	60	2
45	53	55			To be agreed		63	5	30	40	60	2,5
48	56	58		+0,69 +0,23		66	5	40	50	60	2,5	0,8
50	58	60			+0,90 +0,30	68	5	40	50	60	2,5	0,8
55	63	65		To be agreed		73	5	40	50	70	2,5	0,8
60	70	75			+0,69 +0,23	83	7,5	40	60	80	2,5	0,8
65	75	80		+0,90 +0,30		88	7,5	50	60	80	2,5	2
70	80	85			To be agreed	95	7,5	50	70	90	2,5	2
75	85	90		+0,69 +0,23		100	7,5	50	70	90	2,5	2
80	90	95			+0,90 +0,30	105	7,5	60	80	100	2,5	2
85	95	100	To be agreed	110		7,5	60	80	100	2,5	2	
90	105	110		+0,69 +0,23	120	10	60	80	120	2,5	2	
95	110	115	+0,90 +0,30		125	10	60	100	120	2,5	2	
100	115	120		To be agreed	130	10	80	100	120	2,5	2	
105	120	125	+0,69 +0,23		135	10	80	100	120	2,5	2	
110	125	130		+0,90 +0,30	140	10	80	100	120	2,5	2	
120	135	140	To be agreed		150	10	100	120	150	2,5	2	
130	145	150		+0,69 +0,23	160	10	100	120	150	3	2	
140	155	160	+0,90 +0,30		170	10	100	150	180	3	2	
150	165	170		To be agreed	180	10	120	150	180	3	2	
160	180	185	+0,69 +0,23		200	12,5	120	150	180	3	2	
170	190	195		+0,90 +0,30	210	12,5	120	180	200	3	2	
180	200	210	To be agreed		220	15	150	180	250	3	2	
190	210	220		+0,69 +0,23	230	15	150	180	250	3	2	
200	220	230	+0,90 +0,30		240	15	180	200	250	3	2	

Table 2 — Nominal sizes and limits for thin-walled cylindrical bushes type C

$D_i$	nom.	$D_o$		$B$						$C_i$ $C_o$	
		Limits for tolerance group (see Table 5)		h13							
nom.	nom.	A	B							max.	
6	8	+0,21 +0,07	zb11	4	6	8	10				0,8
8	10			6	8	10	12	15			0,8
10	12	+0,27 +0,09		6	8	10	12	15	20		0,8
12	14			8	10	12	15	20	25		0,8
14	16	10		12	15	20	25			0,8	
15	17	+0,33 +0,11		10	12	15	20	25			0,8
16	18			10	12	15	20	25			0,8
18	20	10		15	20	25				0,8	
20	23	+0,45 +0,15		10	15	20	25	30			1,5
22	25			15	20	25	30			1,5	
24	27			15	20	25	30			1,5	
25	28			15	20	25	30	50		1,5	
28	32	+0,60 +0,20		15	20	25	30				2
30	34			10	15	20	25	30	40		2
32	36	+0,69 +0,23		20	30	40					2
35	39			20	30	35	40	50			2
38	42			20	30	40					2
40	44			20	30	40	50				2
45	50	+0,90 +0,30		20	30	40	45	50			2,5
50	55			20	30	40	50	60			2,5
55	60	To be agreed		20	30	40	50	60			2,5
60	65			20	30	40	50	60	70		2,5
65	70			30	50	70					2,5
70	75			30	40	50	70				2,5
75	80			40	60	80				2,5	
80	85			40	60	80	100			2,5	
85	90		30	40	60	80	100			2,5	
90	95		za11	40	60	100					2,5
95	100			60	100					2,5	
100	105	50		60	100	115				2,5	
105	110	60		100	105					2,5	
110	115	60		100	115					2,5	
115	120	60		100						2,5	
120	125	60		100						2,5	
125	130	60		100						2,5	
130	135	60		100						3	
135	140	60		100						3	
140	145	60	100						3		
150	155	60	100						3		

Table 3 — Nominal sizes and limits for thin-walled flanged bushes type F

$D_i$	nom.	$D_o$		$D_{fl}$	$B_{fl}$	$B$			$C_i$	$r$
		Limits for tolerance group (see Table 5)								
		A	B			d13	h13	h13	max.	max.
6	8	+0,21	zb11	12	1	6	10		0,8	0,5
8	10	+0,07		15	1	6	10	15	0,8	0,5
10	12	+0,27 +0,09		18	1	6	10	15	0,8	0,5
12	14			20	1	10	15	20	0,8	0,8
14	16	+0,33 +0,11		22	1	10	15	20	0,8	0,8
15	17			23	1	10	15	20	0,8	0,8
16	18			24	1	12	15	20	0,8	0,8
18	20			26	1	12	20	30	0,8	0,8
20	23	+0,45 +0,15		30	1,5	15	20	30	1,5	0,8
22	25			31	1,5	15	20	30	1,5	0,8
24	27			34	1,5	15	20	30	1,5	0,8
25	28			35	1,5	20	30	40	1,5	0,8
28	32	+0,60 +0,20		39	2	20	30	40	2	0,8
30	34			42	2	20	30	40	2	0,8
32	36			44	2	20	30	40	2	0,8
35	39			47	2	30	40	50	2	0,8
38	42	+0,69 +0,23		50	2	30	40	50	2	0,8
40	44			53	2	30	40	60	2	0,8
42	47			55	2,5	30	40	60	2	0,8
45	50			58	2,5	30	40	60	2,5	0,8
48	53	+0,90 +0,30	62	2,5	40	50	60	2,5	0,8	
50	55		65	2,5	40	50	60	2,5	0,8	
55	60		70	2,5	40	50	70	2,5	0,8	
60	65		75	2,5	40	60	80	2,5	0,8	
65	70		80	2,5	50	60	80	2,5	2	
70	75		85	2,5	50	70	90	2,5	2	
75	80		90	2,5	50	70	90	2,5	2	
80	85		95	2,5	60	80	100	2,5	2	
85	90		100	2,5	60	80	100	2,5	2	
90	95		To be agreed	110	2,5	60	80	120	2,5	2
95	100	115		2,5	60	100		2,5	2	
100	105	120		2,5	80	100	120	2,5	2	
105	110	125		2,5	80	100		2,5	2	
110	115	130		2,5	80	100	120	2,5	2	
120	125	140		2,5	100			2,5	2	
130	135	150		2,5	100			3	2	
140	145	160		2,5	100			3	2	
150	155	170		2,5	100			3	2	
				za11						

**Table 4 — Nominal sizes and limits for thin-walled flanged bushes type F with widths *B* from ISO 3547-1**

<i>D<sub>i</sub></i>	nom.	<i>D<sub>o</sub></i>		<i>D<sub>fl</sub></i>	<i>B<sub>fl</sub></i>	<i>B<sup>a</sup></i>				<i>C<sub>i</sub></i>	<i>r</i>		
		Limits for tolerance group (see Table 5)				d13	h13	h13				max.	max.
		A	B										
6	8	+0,21 +0,07	zb11	12	1	4	8			0,8	0,5		
8	10			15	1	5,5	7,5	9,5			0,8	0,5	
10	12	+0,27 +0,09		18	1	7	9	12	17		0,8	0,5	
12	14			20	1	7	9	12	17		0,8	0,8	
14	16			22	1	12	17				0,8	0,8	
15	17	+0,33 +0,11		23	1	9	12	17			0,8	0,8	
16	18			24	1	12	17				0,8	0,8	
18	20			26	1	12	17	22			0,8	0,8	
20	23	+0,45 +0,15		30	1,5	11,5	16,5	21,5			1,5	0,8	
25	28			35	1,5	11,5	16,5	21,5			1,5	0,8	
30	34	+0,60 +0,20		42	2	16	26				2	0,8	
35	39			47	2	16	26				2	0,8	
40	44	+0,69 +0,23		53	2	16	26				2	0,8	
45	50			58	2,5	16	26				2,5	0,8	

<sup>a</sup> With the exception of widths 4 mm, 8 mm and 12 mm, these widths form the subject of a revision of ISO 3547-1:1999, under preparation.

According to Tables 1, 2 and 3: if it is necessary to use non-standard widths *B*, then these should be arranged to have a final digit of 0, 2, 5 or 8.

As an alternative to chamfer *C<sub>i</sub>*, a 45° angle may be used.

As an alternative to chamfer *C<sub>o</sub>*, radius *r* may be used.

Depending on the material, the wall thickness shall be rated so that the inside diameter *D<sub>i</sub>* of the fitted bush is within tolerance class F10 to D12 respectively.

For *D<sub>fl</sub>*, the tolerance class d13 is preferred. Other tolerance classes up to h13 are allowable and shall be subject to agreement between supplier and purchaser.

### 5 Material

Thermoplastics shall be in accordance with ISO 6691, e.g. PA, PET, PE, POM.

For modified or other materials, details shall be subject to agreement between the supplier and purchaser.

NOTE Thermoplastics have a higher coefficient of linear thermal expansion than metals. PA absorbs more moisture than the other materials given and thus, in addition, will alter in volume.

With the tolerance zones and fits specified in this International Standard, these properties are taken into account under the following conditions:

- the bearing clearance is designed for an operating temperature of the bush of  $-10\text{ °C}$  to  $+50\text{ °C}$  and a relative ambient humidity of 20 % to 95 %;
- interference fit in the housing is achieved by the insertion interference (limit deviation of  $D_0$ ) and is also maintained at operating temperatures of  $-10\text{ °C}$  to  $+50\text{ °C}$ ;
- Tables 1, 2, 3 and 4 are based upon shaft and housing having coefficients of linear thermal expansion of 10 to  $12 \times 10^{-6}/\text{K}$ .

For other operating conditions than those given above, the bearing clearance and the type of fixing shall be reviewed and validated. The tolerances are applicable in the conditioned state of the bushes, i.e. they shall have the temperature and the moisture content resulting at a standard atmosphere in accordance with ISO 554 (23/50).

To maintain their dimensions, bushes made of PA shall be stored in the above given standard atmosphere or in a suitable hermetically sealed condition.

## 6 Design

The surface finish and tolerance classes shall be in accordance with Table 5, for group A or B.

Table 5 — Surface finish and limits

Tolerance group	Method of manufacture	Surface finish of bush				Tolerance class for $D_i$ resulting after insertion into the housing bore	Tolerance class of housing bore diameter $D_H$	Tolerance class of shaft
		$x^a$ $Rz$	$Ra$	$y^a$ $Rz$	$Ra$			
A	Moulded	16	2,5	100	25	F10 to D12	H7	h7 to h9
B	Machined	25	6,3			C11		

<sup>a</sup>  $Rz$  or  $Ra$  on agreement.

Edges shall be free from flash or burrs.

Due to the large insertion interference, the leading edge of the housing bore shall be suitably chamfered or rounded in order to avoid damage during insertion.

The standard bearings (type C and type F) shall have a minimum of one outside diameter chamfer and one inside diameter chamfer at opposite ends. By agreement, additional chamfers may be provided.

## 7 Testing

### 7.1 General

The dimensions of the bush shall be tested in the conditioned state (see also the note in Clause 5).