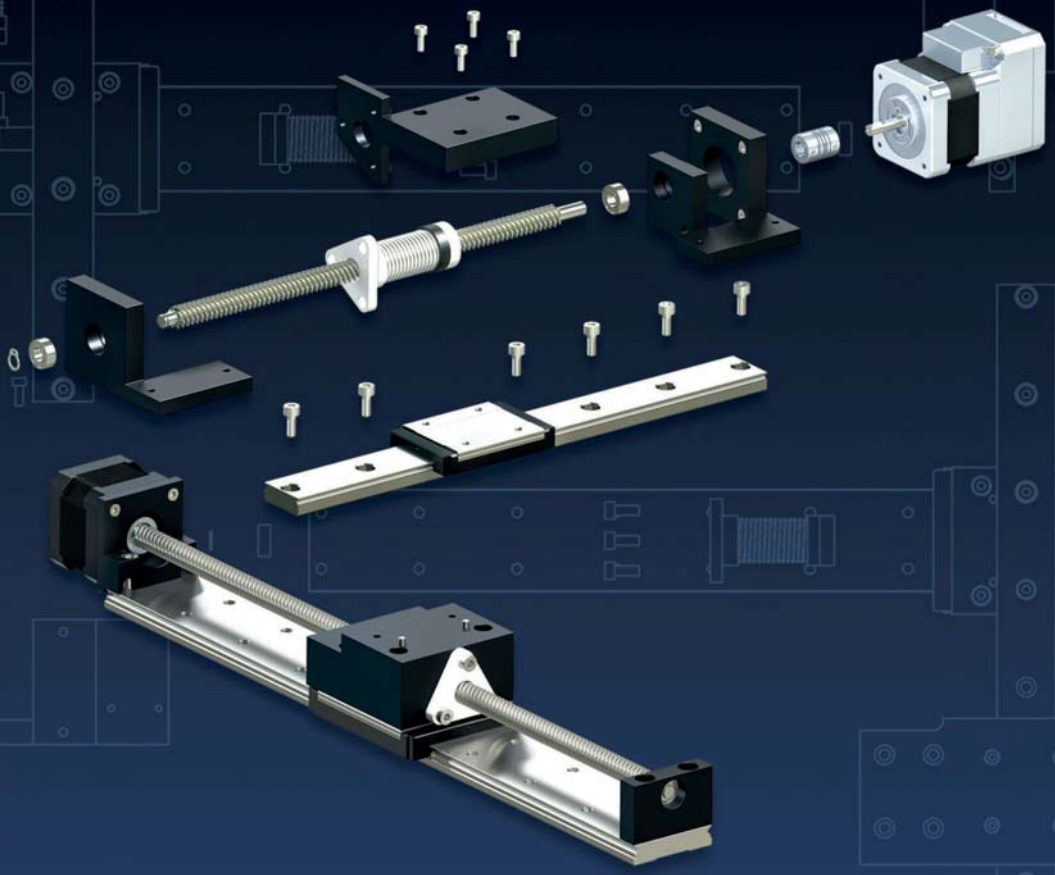
Reliance®
Precision Limited



Precise Motion Control Solutions

Bearings and Spacers

Contents

Section Contents

All dimensions in mm
Generally in accordance with ISO 492,
tolerance class 4
Material: X65Cr13 stainless steel

Associated Products
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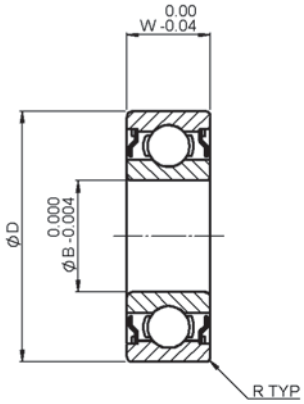
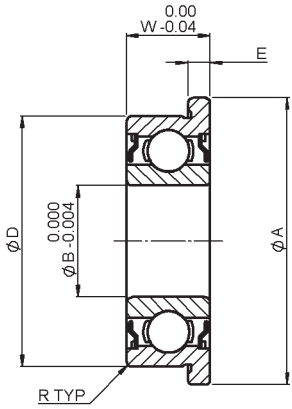
Bearing pre-load washers: page 12-5
Bearing spacers: page 12-6



Plain



Flanged

Part number selection table

Part Number		Dimensions									Specification	
Plain	Flanged	Bore Dia ØB	O/D ØD		Width W	Radii R (min)	Flange Dia ØA		Flange Width E		Load Ratings N	
			Max	Min			Max	Min	Max	Min	Dynamic C	Static Co
B1-102-S-P4	B2-102-S-P4	2	5	4.996	2.3	0.08	6.15	6.05	0.6	0.56	192	59
B1-103-S-P4	B2-103-S-P4	3	7	6.996	3.0	0.10	8.15	8.05	0.8	0.76	432	149
B1-104-S-P4	B2-104-S-P4	4	9	8.996	4.0	0.10	10.35	10.25	1.0	0.96	658	226
B1-105-S-P4	B2-105-S-P4	5	11	10.996	5.0	0.15	12.55	12.45	1.0	0.92	734	282
B1-106-S-P4	B2-106-S-P4	6	13	12.996	5.0	0.15	15.05	14.95	1.1	1.02	1096	437
B1-108-S-P4	B2-108-S-P4	8	16	15.996	6.0	0.20	18.05	17.95	1.3	1.22	1795	776
B1-110-S-P4	B2-110-S-P4	10	19	18.995	7.0	0.30	21.05	20.95	1.5	1.38	1922	915

Features and options

- Operating temperature range: -73ºC to +121ºC
- Lubricant: grease to MIL-G-21164 and MIL-G-23827
- Double shielded
- Imperial sizes available

Technical support

- Spur gear and bearing load calculation - see page T12-1
- Bearing force sharing - see page T12-3
- Bearing installation and housing considerations - see page T12-4

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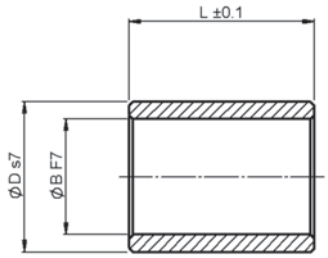
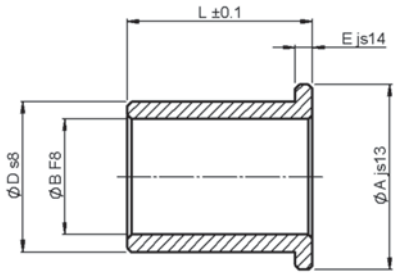
Associated Products
Shafts: page 11-2

All dimensions in mm
General tolerances ±0.13 mm
Material: Bronze ASTM B 438
Type 2, Grade 1



Plain



Flanged

Part number selection table

Part Number		Bore	O/D	Length	Flange Dia	Flange Width
Plain	Flanged	ØB[1]	ØD	L	ØA	E
BBM1-3	BBM2-3	3	6	6	9	1.5
BBM1-4	BBM2-4	4	8	12	12	2.0
BBM1-5	BBM2-5	5	8	12	--	--
BBM1-6	BBM2-6	6	10	12	14	2.0
BBM1-8	BBM2-8	8	12	12	16	2.0
BBM1-10	BBM2-10	10	13	16	16	1.5

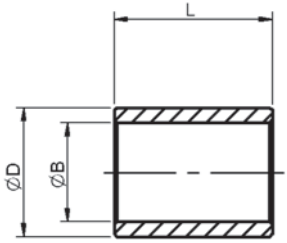
[1] Bearing bore tolerances after assembly are: plain bearings H7, flanged bearings H8.
Recommended housing bore H7

Features and options

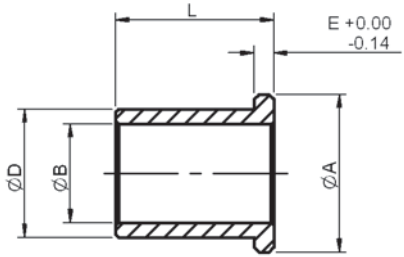
- Operating temperature range: -20ºC to +100ºC
- Oil impregnated
- Max speed 30,000 rpm
- p.v (@0.5 m/s) = 1.75 N/mm².m/s
- p_{max} =13.8 N/mm
- v_{max} = 6.1 m/s (rotational)
- Imperial sizes available

All dimensions in mm
General tolerances ±0.13 mm
Material: Self lubricating moulded thermo-plastic

Associated Products
Shafts: page 11-2
Leadscrews: page 7-1
Bearing spacers: page 12-6



Plain



Flanged

Part number selection table

Part Number		Bore	O/D	Length	Flange Dia	Flange Width
Plain	Flanged	ØB #	ØD	L	ØA	E
BM8-2	----------	2.054 2.014	3.5	3.00 2.86	----------	----------
BM8-3	BM9-3	3.054 3.014	4.5	3.00 2.86	7.46 7.24	0.75
BM8-4	BM9-4	4.068 4.020	5.5	4.00 3.82	9.46 9.24	0.75
BM8-5	----------	5.040 5.010	7.0	5.00 4.82	----------	----------
----------	BM9-5	5.068 5.020	7.0	5.00 4.82	10.95 10.68	1.00
BM8-6	BM9-6	6.068 6.020	8.0	6.00 5.82	11.95 11.68	1.00
BM8-8	----------	8.083 8.025	10.0	8.00 7.78	----------	----------
----------	BM9-8	8.083 8.025	10.0	9.50 9.28	14.95 14.68	1.00
BM8-10	BM9-10	10.083 10.025	12.0	10.00 9.78	17.95 17.68	1.00
BM8-12	BM9-12	12.102 12.032	14.0	12.00 11.73	19.93 19.61	1.00

Tolerance for ØB is after press fitting into a housing bore of tolerance H7

Features and options

- Operating temperature tange: -40ºC to +130ºC
- $(p.v)_{max}$ = 1.0 N/mm².m/s
- p_{max} = 80 N/mm²
- v_{max} = 1.0 m/s (rotational) or 4.0 m/s (linear)
- Imperial sizes available

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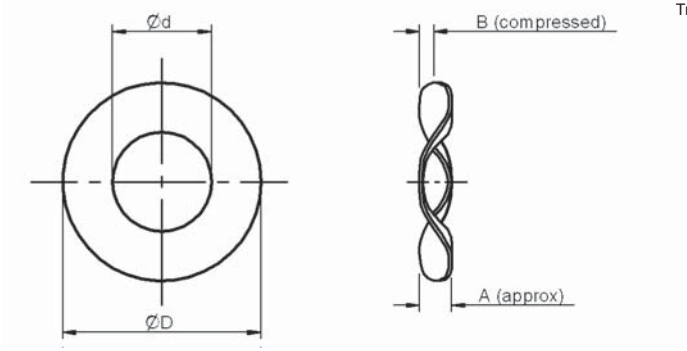
Associated Products
Internal circlips: page 13-21
Bearings: page 12-2

All dimensions in mm
General tolerances ±0.13 mm
Material: Stainless steel 300 series
Treatment: Spring tempered



Part number selection table

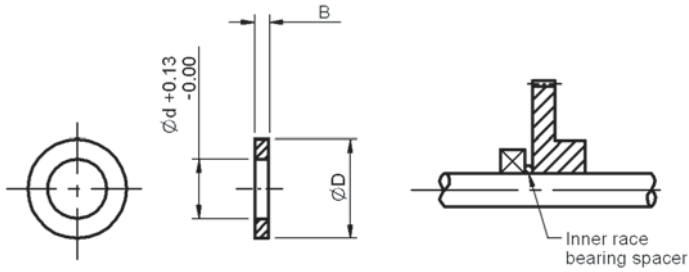
Part Number	Housing Bore (nominal)	O/D ØD	Bore Ød	Free Height A	Compressed Height B	Load in N to Deflect to B
EPL-1	10	9.5	4.5	1.2		15
EPL-2	13	12.5	7.5	1.5		19
EPL-4	16	15.5	10.5	1.5	1.0	19
EPL-8	19	18.5	13.0	1.5		29
EPL-10	21	20.5	15.0	1.8		29

Features and options

- Imperial bearing pre-load washers
- Available in spring steel, add **-ST** to part number eg **EPL-4-ST**

All dimensions in mm
General tolerances ±0.13 mm
Material: Stainless steel 300 series

Associated Products
Shafts: page 11-2
Leadscrews: page 7-1
Bearings: page 12-2



Dimensions

Shaft Nominal	Spacer Bore Ød	Spacer O/D ØD
2	2	3.0
3	3	4.1
4	4	5.3
5	5	6.7
6	6	7.9
8	8	10.2
10	10	12.3

Part number selection table

Nominal Shaft Dia Ød	Thickness B ± 0.025							
	0.05	0.10	0.15	0.20	0.25	0.30	0.40	0.50
2	SS1-117	SS1-118	SS1-119	SS1-120	SS1-121	SS1-122	SS1-123	SS1-124
3	SS1-125	SS1-126	SS1-127	SS1-128	SS1-129	SS1-130	SS1-131	SS1-132
4	SS1-133	SS1-101	SS1-102	SS1-134	SS1-103	SS1-135	SS1-104	SS1-136
5	SS1-137	SS1-138	SS1-139	SS1-140	SS1-141	SS1-142	SS1-143	SS1-144
6	SS1-145	SS1-105	SS1-106	SS1-146	SS1-107	SS1-147	SS1-108	SS1-148
8	SS1-149	SS1-109	SS1-110	SS1-150	SS1-111	SS1-151	SS1-112	SS1-152
10	SS1-153	SS1-113	SS1-114	SS1-154	SS1-115	SS1-155	SS1-116	SS1-156

Product options

- Imperial sizes available

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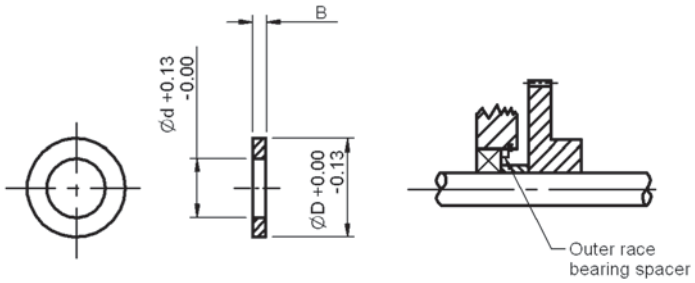
Associated Products
Internal circlips: page 13-21
Bearings: page 12-2

All dimensions in mm
General tolerances ±0.13 mm
Material: Stainless steel 300 series



Dimensions

Bearing OD Nominal	Spacer O/D ØD	Spacer Bore Ød
5	5	4.2
7	7	5.7
9	9	7.8
11	11	9.7
13	13	11.1
16	16	13.8
19	19	16.6

Part number selection table

Bearing[1]		Thickness B							
Bore (nom)	OD (nom)	± 0.025							
		0.05	0.10	0.15	0.20	0.25	0.30	0.40	0.50
2	5	SS3-113	SS3-114	SS3-115	SS3-116	SS3-117	SS3-118	SS3-119	SS3-120
3	7	SS3-121	SS3-122	SS3-123	SS3-124	SS3-125	SS3-126	SS3-127	SS3-128
4	9	SS3-129	SS3-130	SS3-101	SS3-131	SS3-102	SS3-132	SS3-103	SS3-133
5	11	SS3-134	SS3-135	SS3-136	SS3-137	SS3-138	SS3-139	SS3-140	SS3-141
6	13	SS3-142	SS3-143	SS3-104	SS3-144	SS3-105	SS3-145	SS3-106	SS3-146
8	16	SS3-147	SS3-148	SS3-107	SS3-149	SS3-108	SS3-150	SS3-109	SS3-151
10	19	SS3-152	SS3-153	SS3-110	SS3-154	SS3-111	SS3-155	SS3-112	SS3-157

[1] Applies to standard Reliance bearing sizes

Product options

- Imperial sizes available

SPECIFICATION

The first step in choosing the correct bearing for an application is to determine the forces which it will support in service. The forces will depend on the exact configuration of the system and will probably include some, or all, of the following:

- The weight of the shaft, including gears and other shaft attachments.
- Gear mesh reaction forces, due to torque transmission (see below).
- Gear separation due to anti-backlash forces.
- Forces due to belt or pulley tensions.
- Axial pre-load forces.

GEAR MESH REACTIONS

In order to calculate the loads which will be applied to the bearings in the simply supported spur gear pass arrangement shown on the next page, it is first necessary to calculate the forces at the gear mesh.

The tangential force at the gear mesh can be calculated from the following equation:

$W_t = T/r$ where T = Torque and r = Radius

and the separating force at the gear mesh can be calculated from:

$W_r' = W_t \tan\phi_t$ where ϕ_t = transverse pressure angle = normal pressure angle for spur gears = 20º for our standard gears

$W_r' = 0.364W_t$ (for 20º pressure angle spur gear)

If required, the total radial load at the gear mesh can be calculated from the final equation:

$$W_r = \sqrt{(W_t)^2 + (W_r')^2}$$

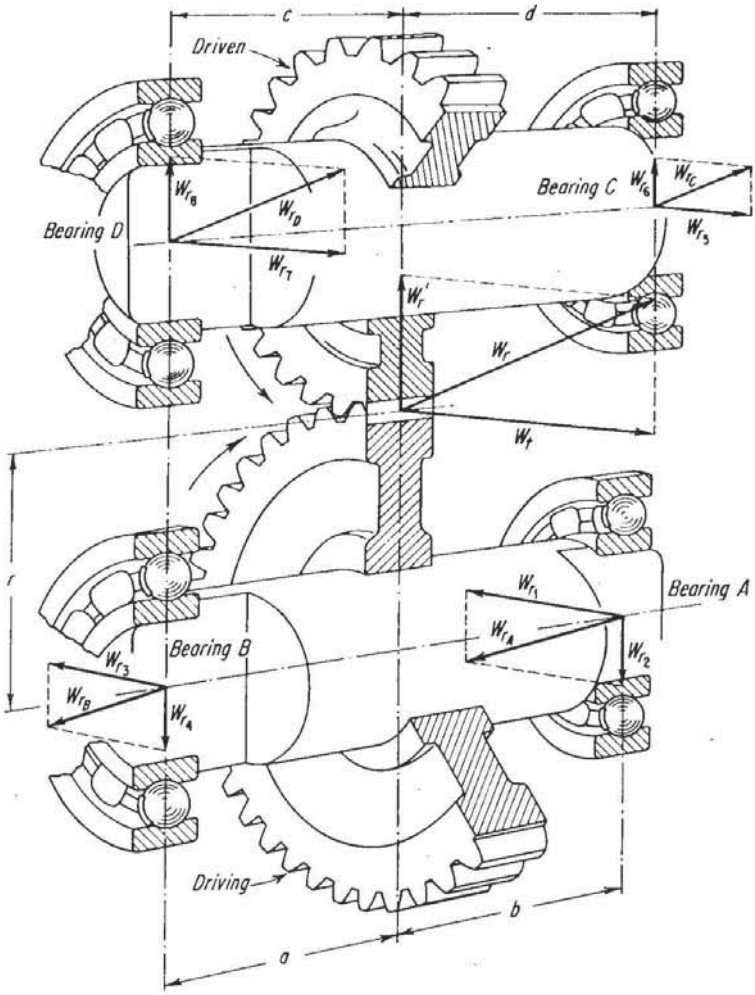
Bearing loads

Position	Forces At These Positions		
	Tangential Force	Separating Force	Total Radial Load
Gear Mesh	W_t	W_r'	W_r
Bearing A	$W_{r1} = \frac{W_t a}{a+b}$	$W_{r2} = \frac{W_r' a}{a+b}$	$W_{rA} = \sqrt{(W_{r1})^2 + (W_{r2})^2}$
Bearing B	$W_{r3} = \frac{W_t b}{a+b}$	$W_{r4} = \frac{W_r' b}{a+b}$	$W_{rB} = \sqrt{(W_{r3})^2 + (W_{r4})^2}$
Bearing C	$W_{r5} = \frac{W_t c}{c+d}$	$W_{r6} = \frac{W_r' c}{c+d}$	$W_{rC} = \sqrt{(W_{r5})^2 + (W_{r6})^2}$
Bearing D	$W_{r7} = \frac{W_t d}{c+d}$	$W_{r8} = \frac{W_r' d}{c+d}$	$W_{rD} = \sqrt{(W_{r7})^2 + (W_{r8})^2}$

For bearing life calculations based on these radial loads see page T12-3.

Note - These equations can only be used for spur gear calculations, because they are not affected by self-generated axial forces.

Bearing loads and gear mesh forces diagram

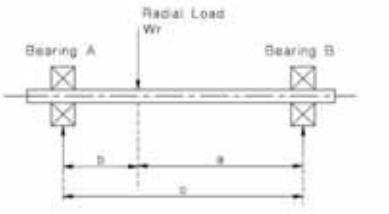


FORCE SHARING

To determine how the forces are shared between a pair of bearings, use the equations below for these two most frequently occurring configurations:

1. Radial Shaft Load Between Two Bearings

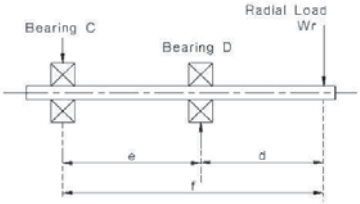
Loads are in constant units



Radial load on bearing $A = \frac{Wr * a}{c}$

Radial load on bearing $B = \frac{Wr * b}{c}$

2. Overhung Radial Load



Radial load on bearing $C = \frac{Wr * d}{e}$

Radial load on bearing $D = \frac{Wr * f}{e}$

The individual bearing loads can then be used to predict the bearing life.

BEARING LIFE

The life of a bearing is defined as the length of time a bearing will operate satisfactorily in the application at its operating speed under applied load. Life predictions depend on a careful definition of failure criteria and consideration of operating environment, mounting practice, lubrication, operating speed and loading. As a guide, the relationship between actual applied load and bearing fatigue life is given below:

$$L_H = \frac{16667}{N}\left(\frac{C}{P}\right)^3$$

L_H = Rated life in hours
N = Speed in rpm
P = Bearing load (e.g. N)
C = Bearing capacity (e.g. N)

INSTALLATION AND HOUSING CONSIDERATIONS

The installation of a bearing will usually be determined by how it fits with its mating components. Interference or transition fits provide the most positive location of the bearing, however, they will require pressing during installation. Clearance fits allow the bearing to be assembled very easily, but could potentially lead to problems depending on the operating conditions. If a press fit is required, it is essential that no appreciable force is transferred through the rolling elements of the bearing during installation.

Special care must be taken when using bearings in aluminium housings, especially when wide temperature variations are expected. It is possible for the contraction of the housing to squash the bearing raceway and remove the radial clearance required for the bearing to operate.

Potential problems with clearance fits:
Fretting - Wearing away of the surface due to rubbing of the components.
Accuracy - Accuracy can be compromised due to unpredictable movement.

Potential problems with interference fits:
Assembly - Can be difficult or impossible without damaging the bearing.
Radial clearance - Can be reduced if the interference is too great.

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