EZO
PRECISION BALL BEARINGS

SMB BEARINGS

Miniature bearings
Thin-section bearings
Corrosion-resistant bearings
Bearing relubrication services

www.smbbearings.com

About Us

Originally founded in 1985, SMB Bearings are a specialised worldwide supplier of miniature bearings, thin-section bearings, corrosion resistant bearings and bearing relubrication services.

We have a superior level of product knowledge and a high level of service and responsiveness that comes with being a small and specialised company. We are dedicated to providing bearing solutions for all types of customer, from the individual to the large corporation.



EZO Agents

We are authorised distributors for Sapporo Precision of Japan who manufacture EZO brand miniature bearings, thin section bearings and stainless steel bearings.

Sapporo Precision have been manufacturing bearings for over 50 years and have expanded significantly during that time to become a world-leading producer of smaller bearings. They have a reputation for consistent quality and reliability throughout the world thanks to continuous improvement in manufacturing and quality control. The EZO brand guarantees you a high precision product every time.

Specialists

As specialists, we have a high level of expertise which allows us to give you better service and greater technical support. Our range includes miniature bearings, stainless steel bearings, thin section bearings, marine grade stainless steel bearings, plastic bearings and full ceramic bearings..

Relubrication

During the early years of SMB Bearings, we noticed that customers were asking for small quantities of ball bearings with non-standard lubricants but did not want long delivery times or minimum order quantities. In response, we established a bearing relubrication facility so that we can relubricate our bearings or our customers' bearings with a large range of oils, greases, solid lubricants or dry lubricants.

Index

Numbering System 3

Product Tables 4

Metric Series

Miniature Series 5
Stainless Steel Miniature Series 10
Flanged Miniature Series 15
Stainless Steel Flanged Miniature Series 19
Thin-section Series 23
Stainless Steel Thin-section Series 26
Flanged Thin-section Series 28
Stainless Steel Flanged Thin-section Series 29
Popular Metric Series 30
Stainless Steel Popular Metric Series 32
Electric Motor Series Radial Play 34
Plastic Series 36
Flanged Plastic Series 40
Ceramic Series 41
316 Stainless Steel Series 51
Three-Part Thrust Series - flat washers 54
Three-Part Thrust Series - grooved washers 55

Imperial Series

Miniature Series 56
Stainless Steel Miniature Series 59
Flanged Miniature Series 61
Stainless Steel Flanged Miniature Series 62
Extended Inner Series 64
Flanged Extended Inner Series 66
Plastic Series 68
Flanged Plastic Series 69
Ceramic Series 70
316 Stainless Steel Series 72
Taper O.D. Series 73

Relubrication Services 74

Engineering Data 75
Bearing Material 76
Retainer 80
Closures 81
Load Rating 82
Internal Clearance & preloads 83
Maximum Speeds 86
Shaft / Housing Fits 87
Tolerances 89
Frictional Torque 94
Noise Rating 95
Lubricants 96
Metric to imperial conversion table 99

Contact Us 100

SMB Numbering System

1	2	3	4	5	6	7	8	9	10	11
S		6800	Si3N4	TW	ZZ	W7	P6	C3	EMQ	PS2
	R	4		J	2RS		P5	MC3		SRL

1. BEARING MATERIAL

No prefix	Chrome steel
AC	Acetal resin (POM)
CB	Chrome steel + ceramic balls
CCSI	Full ceramic - silicon nitride
CCZR	Full ceramic - Zirconia
PK	PEEK
PT	PTFE
PP	Polypropylene
S	440 stainless steel
S316	316 stainless steel
S316CB	316 stainless + ceramic balls
SCB	440 stainless + ceramic balls

2. SERIES

No prefix	Metric series, 1600 series
F	Flanged metric series, Thrust series, Taper OD series
FR	Flanged inch series
FRW	Flanged extended inner series
MF	Flanged metric miniature series
MR	Metric miniature series
R	Inch series
RW	Extended inner series

3. BASIC REFERENCE

See the following product tables for details of the different SMB bearing types and SMB bearing references

4. BALL MATERIAL

No suffix	Same material as bearing rings
316	316 stainless steel
GL	Glass
PK	PEEK
PP	Polypropylene
PT	PTFE
Si3N4	Silicon nitride
ZrO2	Zirconia

5. RETAINER TYPE

No suffix	Standard for bearing type
316	316 stainless steel
FC	Full complement (no retainer)
PA	Nylon crown
PE	Polyethylene crown
PK	PEEK crown
PP	Polypropylene crown
PT	PTFE crown
RJ	Riveted steel ribbon
TP	Phenolic crown
TW	High speed nylon crown

6. CLOSURE TYPE

No suffix	Open bearing
2RS	Contact rubber seals
2RSV	Contact Viton seals
2RU	Non contact rubber seals
2PES	Low friction polyethylene seals
2PKS	Low friction PEEK seals
2PTS	Low friction PTFE seals
TTS	Contact teflon seals
ZZ	Metal shields

7. MODIFIED DIMENSION

A	Non-standard OD
B	Non-standard bore
W	Non-standard width

8. TOLERANCE GRADE

See the Engineering Data section for tolerance tables and more details on ISO tolerances.

9. RADIAL PLAY

... or 'internal clearance'. See the Engineering Data section for more details and radial play tables.

10. NOISE RATING

EMQ	Low noise electric motor quality
EMQ2	Lower noise electric motor quality

Further details can be found in 'Engineering Data'

11. LUBRICANT

See 'Engineering Data' for lubricant tables.

Product Tables

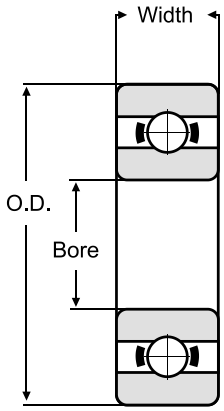
The tables in the following pages show dimensions and performance data for the SMB range of radial and thrust ball bearings. Technical drawings are available to download from our website.

For a cross-reference of different manufacturer's part numbers and SMB references, please see our BEARING INTERCHANGE at the top of every page at www.smbbearings.com

Metric Miniature

Miniature bearings

These are sometimes referred to as instrument bearings or micro bearings. We provide miniature bearings for applications as varied as gyros, anemometers, miniature gearboxes, small motors and radio controlled models. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
1.5	4	1.2	681X			11	3	120
	4	2		681XZZ		11	3	120
	5	2	691X			24	7	100
	5	2.6		691XZZ		24	7	100
	6	2.5	601X			33	10	90
	6	3		601XZZ		33	10	90
2	5	1.5	682			17	5	100
	5	2.3		682ZZ		17	5	100
	5	2	MR52			17	5	100
	5	2.5		MR52ZZ		17	5	100
	6	2.3	692	692ZZW23		33	10	75
	6	3		692ZZ		33	10	90
	6	2.5	MR62	MR62ZZ		33	10	90
	7	2.5	MR72			38	13	75
	7	3		MR72ZZ		38	13	75
	7	2.8	602			38	13	71
	7	3.5		602ZZ		38	13	71
2.5	6	1.8	682X			21	7	80
	6	2.6		682XZZ		21	7	80
	7	2.5	692X			39	13	75
	7	3.5		692XZZ		39	13	75
	8	2.8	602X	602XZZW28		55	18	59
	8	4		602XZZ		55	18	69

** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

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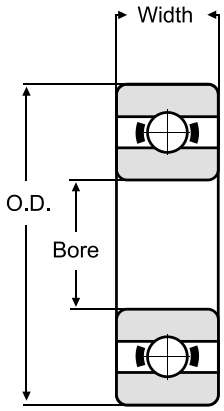

CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
3	6	2	MR63			21	7	80
	6	2.5		MR63ZZ		21	7	80
	7	2	683			31	11	75
	7	3		683ZZ	683-2RS	31	11	75
	8	2.5	MR83			40	14	67
	8	3		MR83ZZ		40	14	67
	8	3	693			55	18	67
	8	4		693ZZ	693-2RS	55	18	67
	9	2.5	MR93			58	19	67
	9	4		MR93ZZ		58	19	67
	9	3	603			58	19	67
	9	5		603ZZ		58	19	67
	10	4	623	623ZZ	623-2RS	63	22	60
	13	5	633	633ZZ	633-2RS	130	49	45
4	7	2	MR74			31	11	67
	7	2.5		MR74ZZ		31	11	67
	8	2	MR84			39	14	67
	8	3		MR84ZZ	MR84-2RS	39	14	67
	9	2.5	684			65	22	62
	9	3.5		684ZZW35		65	22	55
	10	3	MR104			71	27	54
	10	4		MR104ZZ		71	27	54
	11	4	694	694ZZ	694-2RS	95	34	54
	12	4	604	604ZZ	604-2RS	95	34	54
	13	5	624	624ZZ	624-2RS	130	49	50
	16	5	634	634ZZ	634-2RS	134	52	41

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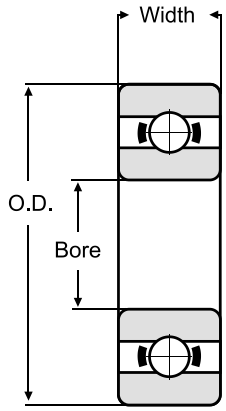

CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
5	8	2	MR85			29	11	63
	8	2.5		MR85ZZ	MR85-2RS	29	11	63
	9	2.5	MR95			42	16	60
	9	3		MR95ZZ	MR95-2RS	42	16	60
	10	3	MR105			42	16	60
	10	4		MR105ZZ	MR105-2RS	42	16	60
	11	3	685			71	28	54
	11	4		MR115ZZ	MR115-2RS	71	28	54
	11	5		685ZZ	685-2RS	71	28	54
	13	4	695	695ZZ	695-2RS	102	41	48
	13	5		695ZZW5		102	41	42
	14	5	605	605ZZ	605-2RS	129	48	48
	16	5	625	625ZZ	625-2RS	168	64	43
	19	6	635	635ZZ	635-2RS	234	90	38
6	10	2.5	MR106			48	20	52
	10	3		MR106ZZ	MR106-2RS	48	20	52
	12	3	MR126			69	27	49
	12	4		MR126ZZ	MR126-2RS	69	27	49
	13	3.5	686			102	41	49
	13	4.5		686ZZW45	686-2RSW45	102	41	42
	13	5		686ZZ	686-2RS	102	41	49
	15	5	696	696ZZ	696-2RS	134	52	45
	16	5		696AZZ	696A-2RS	134	52	40
	17	6	606	606ZZ	606-2RS	226	84	45
	19	5.15			626-2RSW515	233	89	32
	19	6	626	626ZZ	626-2RS	233	89	40
	19	8		626ZZW8		233	89	32
	22	7	636	636ZZ	636-2RS	333	140	35

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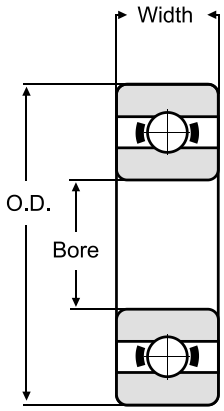

CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
	11	2.5	MR117			45	20	50
	11	3		MR117ZZ	MR117-2RS	45	20	50
	13	3	MR137			54	27	48
	13	4		MR137ZZ	MR137-2RS	54	27	48
	14	3.5	687			117	51	50
7	14	4	687W4			117	51	50
	14	5		687ZZ	687-2RS	117	51	50
	17	5	697	697ZZ	697-2RS	160	71	43
	19	6	607	607ZZ	607-2RS	228	87	43
	22	7	627	627ZZ	627-2RS	328	137	36
	26	9	637	637ZZ	637-2RS	456	198	32
	12	2.5	MR128			54	27	48
	12	3.5		MR128ZZ	MR128-2RS	54	27	48
	14	3.5	MR148			81	38	45
	14	4		MR148ZZ	MR148-2RS	81	38	45
	16	4	688	688ZZW4	688-2RSW4	125	59	36
	16	5		688ZZ	688-2RS	125	59	43
8	16	6		688ZZW6	688-2RSW6	125	59	36
	19	6	698	698ZZ	698-2RS	221	89	43
	22	6	608W6			327	136	39
	22	7	608	608ZZ	608-2RS	327	136	39
	22	11			608-2RSW11	327	136	23
	24	8	628	628ZZ	628-2RS	330	138	34
	28	9	638	638ZZ	638-2RS	451	197	32

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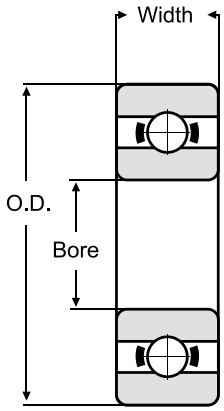

CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
	14	3	**679**			91	47	42
	14	4.5		**679ZZ**		91	47	42
	17	4	**689**			132	67	43
	17	5		**689ZZ**	**689-2RS**	132	67	43
9	17	6		**689ZZW6**	**689-2RSW6**	132	67	36
	20	6	**699**	**699ZZ**	**699-2RS**	246	108	40
	24	7	**609**	**609ZZ**	**609-2RS**	329	140	38
	26	8	**629**	**629ZZ**	**629-2RS**	457	198	34
	30	10	**639**	**639ZZ**	**639-2RS**	465	208	30

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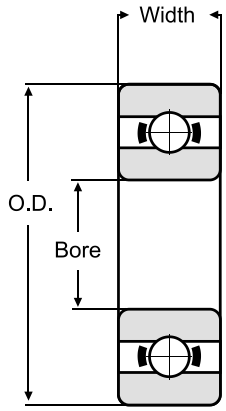
See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Stainless Steel Miniature

Corrosion resistant miniature bearings

These miniature bearings are designed for use in mildly corrosive conditions or for high temperature use. We provide stainless steel miniature bearings for a wide range of applications. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.6	2.5	1	S68/0.6			5	1	160
1	3	1	S681			8	2	150
	3	1.5	SMR31			8	2	150
	4	1.6	S691			11	3	120
1.5	4	1.8	SMR41X			9	2	130
	4	2.5		SMR41XZZ		9	2	130
	4	1.2	S681X			9	2	115
	4	2		S681XZZ		9	2	115
	5	2	S691X			19	6	100
	5	2.6		S691XZZ		19	6	100
	6	2.5	S601X			28	8	90
	6	3		S601XZZ		28	8	90
2	4	1.2	S672			10	3	104
	4	2		S672ZZ		10	3	104
	5	1.5	S682			15	4	100
	5	2.3		S682ZZ		15	4	100
	5	2	SMR52			15	4	100
	5	2.5		SMR52ZZ		15	4	100
	6	2.3	S692	S692ZZW23		27	8	75
	6	3		S692ZZ		27	8	90
	6	2.5	SMR62	SMR62ZZ		27	8	90
	7	2.5	SMR72			32	10	75
	7	3		SMR72ZZ		32	10	75
	7	2.8	S602			32	10	71
	7	3.5		S602ZZ		32	10	71

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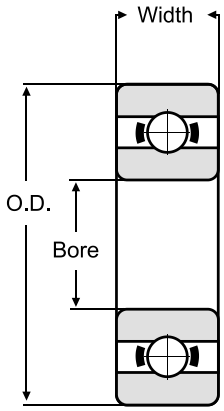

STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
2.5	6	1.8	S682X			18	6	80
	6	2.6		S682XZZ		18	6	80
	7	2.5	S692X			33	11	75
	7	3.5		S692XZZ		33	11	75
	8	2.5	SMR82X			48	14	69
	8	2.8	S602X	S602XZZW28		48	14	59
	8	4		S602XZZ		48	14	69
3	6	2	SMR63			18	6	80
	6	2.5		SMR63ZZ		18	6	80
	6	3		SMR63ZZW3		18	6	71
	7	2	S683			26	9	75
	7	3		S683ZZ	S683-2RS	26	9	75
	8	2.5	SMR83			34	11	67
	8	3	S693	SMR83ZZ		34	11	67
	8	4		S693ZZ	S693-2RS	46	14	67
	9	2.5	SMR93			48	15	67
	9	3	S603			48	15	67
	9	4		SMR93ZZ		48	15	67
	9	5		S603ZZ		48	15	67
	10	4	S623	S623ZZ	S623-2RS	52	18	60
	13	5	S633	S633ZZ	S633-2RS	110	42	45

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Corrosion resistant miniature bearings

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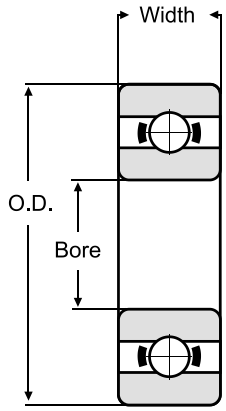

STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
	7	2	SMR74			25	9	67
	7	2.5		SMR74ZZ		25	9	67
	8	2	SMR84			31	11	67
	8	3		SMR84ZZ	SMR84-2RS	31	11	67
	9	2.5	S684			52	18	55
	9	3.5		S684ZZW35		52	18	62
4	9	4		S684ZZ	S684-2RS	52	18	62
	10	3	SMR104			60	23	54
	10	4		SMR104ZZ	SMR104-2RS	60	23	54
	11	4	S694	S694ZZ	S694-2RS	81	29	54
	12	4	S604	S604ZZ	S604-2RS	81	29	54
	13	5	S624	S624ZZ	S624-2RS	108	40	50
	16	5	S634	S634ZZ	S634-2RS	111	42	41
	8	2	SMR85			23	8	63
	8	2.5		SMR85ZZ		23	8	63
	8	3		SMR85ZZW3		23	8	53
	9	2.5	SMR95			36	13	60
	9	3		SMR95ZZ		36	13	60
	10	3	SMR105			36	13	60
	10	4		SMR105ZZ	SMR105-2RS	36	13	60
5	11	3	S685			61	23	54
	11	4		SMR115ZZ	SMR115-2RS	61	23	54
	11	5		S685ZZ	S685-2RS	61	23	54
	13	4	S695	S695ZZ	S695-2RS	87	33	48
	13	5		S695ZZW5	S695-2RSW5	87	33	42
	14	5	S605	S605ZZ	S605-2RS	110	41	48
	16	5	S625	S625ZZ	S625-2RS	142	54	43
	19	6	S635	S635ZZ	S635-2RS	198	72	38

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*** Reduce maximum Rpm by 40% for 2RS types.*

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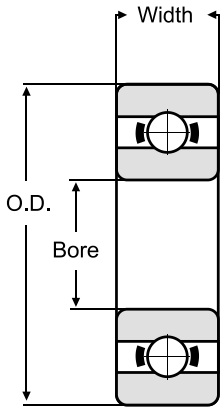


STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
6	10	2.5	SMR106			41	16	52
	10	3		SMR106ZZ	SMR106-2RS	41	16	52
	12	3	SMR126			59	23	49
	12	4		SMR126ZZ	SMR126-2RS	59	23	49
	13	3.5	S686			87	33	42
	13	4.5		S686ZZW45	S686-2RSW45	87	33	49
	13	5		S686ZZ	S686-2RS	87	33	49
	15	5	S696	S696ZZ	S696-2RS	114	42	45
	16	5		S696AZZ	S696A-2RS	114	42	40
	17	6	S606	S606ZZ	S606-2RS	192	67	45
	19	6	S626	S626ZZ	S626-2RS	197	71	40
	22	7	S636	S636ZZ	S636-2RS	279	111	35
7	11	2.5	SMR117			37	16	50
	11	3		SMR117ZZ		37	16	50
	13	3	SMR137			46	21	48
	13	4		SMR137ZZ		46	21	48
	14	4	S687			98	41	50
	14	5		S687ZZ	S687-2RS	98	41	50
	17	5	S697	S697ZZ	S697-2RS	136	57	43
	19	6	S607	S607ZZ	S607-2RS	193	69	43
	22	7	S627	S627ZZ	S627-2RS	278	109	36

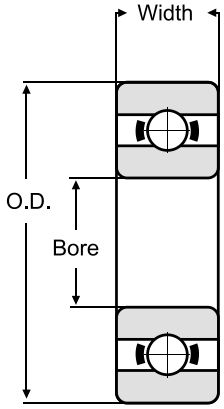
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Stainless Steel Miniature

Corrosion resistant miniature bearings

These miniature bearings are designed for use in mildly corrosive conditions or for high temperature use. We provide stainless steel miniature bearings for a wide range of applications. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
8	12	2.5	SMR128			46	21	48
	12	4		SMR128ZZ	SMR128-2RS	46	21	48
	14	3.5	SMR148			68	30	45
	14	4		SMR148ZZ	SMR148-2RS	68	30	45
	16	4	S688	S688ZZW4	S688-2RSW4	105	47	36
	16	5		S688ZZ	S688-2RS	105	47	43
	16	6		S688ZZW6	S688-2RSW6	105	47	36
	19	6	S698	S698ZZ	S698-2RS	188	71	43
	22	7	S608	S608ZZ	S608-2RS	278	109	39
	24	8	S628	S628ZZ	S628-2RS	281	111	34
9	14	3	S679			79	38	42
	14	5		S679ZZ		79	38	42
	17	4	S689			112	54	43
	17	5		S689ZZ	S689-2RS	112	54	43
	17	6		S689ZZW6	S689-2RSW6	112	54	36
	20	6	S699	S699ZZ	S699-2RS	209	84	40
	24	7	S609	S609ZZ	S609-2RS	288	115	38
	26	8	S629	S629ZZ	S629-2RS	388	158	34

** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

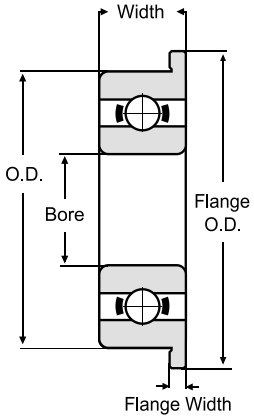
See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Flanged Miniature

Flanged miniature bearings

The flange allows easier location in a housing. The smaller sizes are sometimes referred to as instrument bearings or micro bearings. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

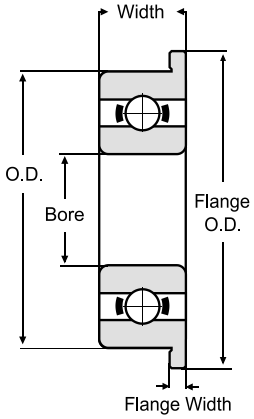
Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing
	5	2	6.1	0.5	F682		
	5	2.3	6.1	0.6		F682ZZ	
	5	2	6.2	0.6	MF52		
	5	3	6.2	0.6		MF52ZZ	
	6	2.3	7.5	0.6	F692	F692ZZW23	
2	6	3	7.5	0.8		F692ZZ	
	6	2.5	7.2	0.6	MF62	MF62ZZ	
	7	2.5	8.2	0.6	MF72		
	7	3	8.2	0.6		MF72ZZ	
	7	2.8	8.5	0.7	F602		
	7	3.5	8.5	0.9		F602ZZ	
	6	1.8	7.1	0.5	F682X		
	6	3	7.1	0.8		F682XZZ	
	7	2.5	8.5	0.7	F692X		
2.5	7	4	8.5	0.9		F692XZZ	
	8	3	9.2	0.6	MF82X		
	8	2.8	9.5	0.7	F602X		
	8	4.0	9.5	0.9		F602XZZ	

Metric Flanged Miniature

Flanged miniature bearings

The flange allows easier location in a housing. The smaller sizes are sometimes referred to as instrument bearings or micro bearings. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
3	6	2	7.2	0.6	MF63		
	6	2.5	7.2	0.6		MF63ZZ	
	7	2	8.1	0.5	F683		
	7	3	8.1	0.8		F683ZZ	
	8	2.5	9.2	0.6	MF83		
	8	3	9.5	0.7	F693		
	8	4	9.5	0.9		F693ZZ	
	9	2.5	10.2	0.6	MF93		
	9	4	10.6	0.8		MF93ZZ	
	9	3	10.5	0.7	F603		
	9	5	10.5	1		F603ZZ	
	10	4	11.5	1	F623	F623ZZ	F623-2RS
4	7	2	8.2	0.6	MF74		
	7	2.5	8.2	0.6		MF74ZZ	
	8	2	9.2	0.6	MF84		
	8	3	9.2	0.6		MF84ZZ	
	9	3.5	10.3	1		F684ZZW35	
	9	2.5	10.3	0.6	F684		
	9	4	10.3	1		F684ZZ	F684-2RS
	10	3	11.2	0.6	MF104		
	10	4	11.6	0.8		MF104ZZ	MF104-2RS
	11	4	12.5	1	F694	F694ZZ	F694-2RS
	12	4	13.5	1	F604	F604ZZ	F604-2RS
	13	5	15	1	F624	F624ZZ	F624-2RS
	16	5	18	1	F634	F634ZZ	F634-2RS

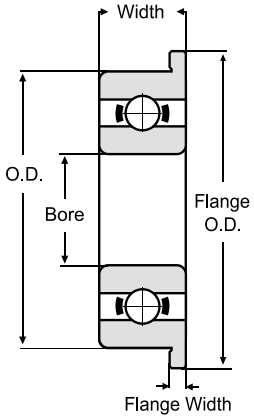
* *Some types may be available with non-contact seals or teflon seals*

Metric Flanged Miniature

Flanged miniature bearings

The flange allows easier location in a housing. The smaller sizes are sometimes referred to as instrument bearings or micro bearings. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
5	8	2	9.2	0.6	MF85		
	8	2.5	9.2	0.6		MF85ZZ	
	9	2.5	10.2	0.6	MF95		
	9	3	10.2	0.6		MF95ZZ	
	10	3	11.2	0.6	MF105		
	10	4	11.6	0.8		MF105ZZ	MF105-2RS
	11	3	12.5	0.8	F685		
	11	4	12.6	0.8		MF115ZZ	MF115-2RS
	11	5	12.5	1		F685ZZ	F685-2RS
	13	4	15	1	F695	F695ZZ	F695-2RS
	14	5	16	1	F605	F605ZZ	F605-2RS
	16	5	18	1	F625	F625ZZ	F625-2RS
	19	6	22	1.5	F635	F635ZZ	F635-2RS
6	10	2.5	11.2	0.6	MF106		
	10	3	11.2	0.6		MF106ZZ	MF106-2RS
	12	3	13.2	0.6	MF126		
	12	4	13.6	0.8		MF126ZZ	MF126-2RS
	13	3.5	15	1	F686		
	13	4.5	15	1.1		F686ZZW45	F686-2RSW45
	13	5	15	1.1		F686ZZ	F686-2RS
	15	5	17	1.2	F696	F696ZZ	F696-2RS
	17	6	19	1.2	F606	F606ZZ	F606-2RS
	19	6	22	1.5	F626	F626ZZ	F626-2RS

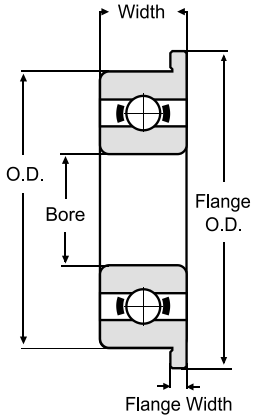
* *Some types may be available with non-contact seals or teflon seals*

Metric Flanged Miniature

Flanged miniature bearings

The flange allows easier location in a housing. The smaller sizes are sometimes referred to as instrument bearings or micro bearings. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
7	11	3	12.2	0.6	MF117		
	11	3	12.2	0.6		MF117ZZ	
	13	3	14.2	0.6	MF137		
	13	4	14.6	0.8		MF137ZZ	
	14	4	16	1	F687		
	14	5	16	1.1		F687ZZ	F687-2RS
	17	5	19	1.2	F697	F697ZZ	F697-2RS
	19	6	22	1.5	F607	F607ZZ	F607-2RS
	22	7	25	1.5	F627	F627ZZ	F627-2RS
8	12	2.5	13	0.6	MF128		
	12	3.5	14	0.8		MF128ZZ	MF128-2RS
	14	4	16	0.8	MF148		
	14	4	16	0.8		MF148ZZ	MF148-2RS
	16	4	18	1	F688		
	16	5	18	1.1		F688ZZ	F688-2RS
	16	6	18	1.3		F688ZZW6	F688-2RSW6
	19	6	22	1.5	F698	F698ZZ	F698-2RS
	22	7	25	1.5	F608	F608ZZ	F608-2RS
9	17	4	19	1	F689		
	17	5	19	1.1		F689ZZ	F689-2RS
	17	6	19	1.1		F689ZZW6	F689-2RSW6
	20	6	23	1.5	F699	F699ZZ	F699-2RS

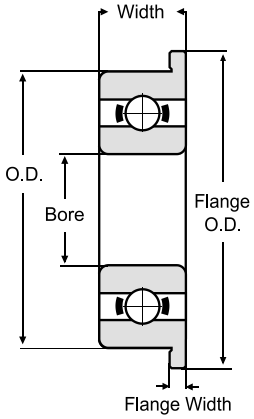
* *Some types may be available with non-contact seals or teflon seals*

Metric Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

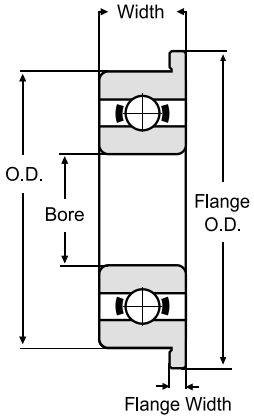
Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing
1	3	1	3.8	0.3	SF681		
	4	1.6	5	0.5	SF691		
1.5	4	1.2	5	0.4	SF681X		
	4	2	5	0.6		SF681XZZ	
	5	2	6.5	0.6	SF691X		
	5	2.6	6.5	0.8		SF691XZZ	
	6	3	7.5	0.6	SF601X		
	6	3	7.5	0.8		SF601XZZ	
2	5	1.5	6.1	0.5	SF682		
	5	2.3	6	0.6		SF682ZZ	
	5	2	6	0.6	SMF52		
	5	3	6	0.6		SMF52ZZ	
	6	2	8	0.6	SF692	SF692ZZW23	
	6	3	7.5	0.8		SF692ZZ	
	7	3	8.5	0.7	SF602		
	7	4	8.5	0.9		SF602ZZ	
2.5	6	2	7.1	0.5	SF682X		
	6	2.6	7	0.8		SF682XZZ	
	7	2.5	9	0.7	SF692X		
	7	4	9	0.9		SF692XZZ	
	8	3	10	0.7	SF602X		
	8	4	10	0.9		SF602XZZ	

Metric Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
	6	2	7.2	0.6	SMF63		
	6	2.5	7	0.6		SMF63ZZ	
	7	2.0	8	0.5	SF683		
	7	3	8.1	0.8		SF683ZZ	
	8	3	9.2	0.6	SMF83		
	8	3	9.2	0.7		SMF83ZZ	
3	8	3	9.5	0.7	SF693		
	8	4	9.5	0.9		SF693ZZ	
	9	2.5	10.2	0.6	SMF93		
	9	4	11	0.8		SMF93ZZ	
	9	3	11	0.7	SF603		
	9	5	11	1		SF603ZZ	
	10	4	12	1	SF623	SF623ZZ	SF623-2RS
	7	2	8.2	0.6	SMF74		
	7	3	8.2	0.6		SMF74ZZ	
	8	2	9.2	0.6	SMF84		
	8	3	9.2	0.6		SMF84ZZ	
	9	2.5	10	0.6	SF684		
	9	3.5	10	1		SF684ZZW35	
4	9	4	10	1		SF684ZZ	SF684-2RS
	10	3	11	0.6	SMF104		
	10	4	12	0.8		SMF104ZZ	SMF104-2RS
	11	4	13	1	SF694	SF694ZZ	SF694-2RS
	12	4	13.5	1	SF604	SF604ZZ	SF604-2RS
	13	5	15	1	SF624	SF624ZZ	SF624-2RS
	16	5	18	1	SF634	SF634ZZ	SF634-2RS

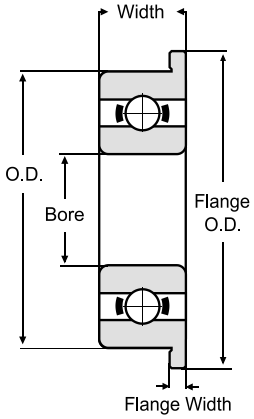
* *Some types may be available with non-contact seals or teflon seals*

Metric Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
5	8	2	9.2	0.6	SMF85		
	8	2.5	9.2	0.6		SMF85ZZ	
	9	2.5	10.2	0.6	SMF95		
	9	3	10.2	0.6		SMF95ZZ	
	10	3	11.2	0.6	SMF105		
	10	4	11.6	0.8		SMF105ZZ	SMF105-2RS
	11	3	12.5	0.8	SF685		
	11	4	12.6	0.8		SMF115ZZ	SMF115-2RS
	11	5	12.5	1		SF685ZZ	SF685-2RS
	13	4	15	1	SF695	SF695ZZ	SF695-2RS
	14	5	16	1	SF605	SF605ZZ	SF605-2RS
	16	5	18	1	SF625	SF625ZZ	SF625-2RS
	19	6	22	1.5	SF635	SF635ZZ	SF635-2RS
6	10	2.5	11.2	0.6	SMF106		
	10	3	11.2	0.6		SMF106ZZ	SMF106-2RS
	12	3	13.2	0.6	SMF126		
	12	4	13.6	0.8		SMF126ZZ	SMF126-2RS
	13	3.5	15	1	SF686		
	13	4.5	15	1.1		SF686ZZW45	SF686-2RSW45
	13	5	15	1.1		SF686ZZ	SF686-2RS
	15	5	17	1.2	SF696	SF696ZZ	SF696-2RS
	17	6	19	1.2	SF606	SF606ZZ	SF606-2RS
	19	6	22	1.5	SF626	SF626ZZ	SF626-2RS

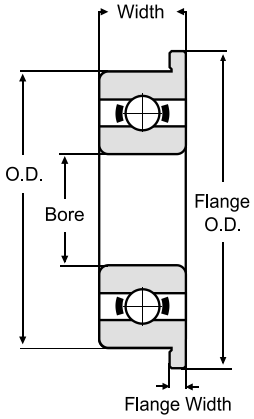
* *Some types may be available with non-contact seals or teflon seals*

Metric Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

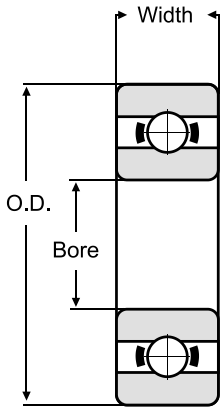
Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
7	11	3	12.2	0.6	SMF117		
	11	3	12.2	0.6		SMF117ZZ	
	13	3	14.2	0.6	SMF137		
	13	4	14.6	0.8		SMF137ZZ	
	14	4	16	1	SF687		
	14	5	16	1.1		SF687ZZ	SF687-2RS
	17	5	19	1.2	SF697	SF697ZZ	SF697-2RS
	19	6	22	1.5	SF607	SF607ZZ	SF607-2RS
8	12	2.5	13.2	0.6	SMF128		
	12	3.5	14	0.8		SMF128ZZ	SMF128-2RS
	14	3.5	16	0.8	SMF148		
	14	4	16	0.8		SMF148ZZ	SMF148-2RS
	16	4	18	1	SF688		
	16	5	18	1.1		SF688ZZ	SF688-2RS
	16	6	18	1.3		SF688ZZW6	SF688-2RSW6
	19	6	22	1.5	SF698	SF698ZZ	SF698-2RS
	22	7	25	1.5	SF608	SF608ZZ	SF608-2RS
9	17	4	19	1	SF689		
	17	5	19	1.1		SF689ZZ	SF689-2RS
	17	6	19	1.1		SF689ZZW6	SF689-2RSW6
	20	6	23	1.5	SF699	SF699ZZ	SF699-2RS

* *Some types may be available with non-contact seals or teflon seals*

Metric Thin-Section

Thin section bearings

For use in instrumentation, robotics, aerospace, medical equipment, cameras and optical equipment or any industrial application where space is at a premium or weight reduction is required. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
10	15	3	6700			85	43	17
	15	4		6700ZZ	6700-2RS	85	43	15
	19	5	6800	6800ZZ	6800-2RS	172	84	43
	19	6		6800ZZW6	6800-2RSW6	172	84	37
	19	7		6800ZZW7	6800-2RSW7	172	84	37
	22	6	6900	6900ZZ	6900-2RS	269	127	41
12	18	4	6701	6701ZZ	6701-2RS	93	53	15
	21	5	6801	6801ZZ	6801-2RS	191	104	39
	21	7		6801ZZW7	6801-2RSW7	191	104	32
	24	6	6901	6901ZZ	6901-2RS	288	146	36
13	24	6	6901TW13			288	146	57
14	25	6	6901ATW14			280	140	57
15	20	4	ET2015			94	58	13
	21	4	ET2115			94	58	13
	21	4	6702	6702ZZ	6702-2RS	94	58	13
	24	5	6802	6802ZZ	6802-2RS	207	125	33
	24	7		6802ZZW7	6802-2RSW7	207	125	28
	28	7	6902	6902ZZ	6902-2RS	428	223	28
16	22	4	ET2216			97	62	11
17	23	4	6703	6703ZZ	6703-2RS	100	65	11
	26	5	6803	6803ZZ	6803-2RS	219	144	30
	26	7		6803ZZW7	6803-2RSW7	219	144	26
	30	7	6903	6903ZZ	6903-2RS	453	256	25
	32	8	6903A	6903AZZ		453	256	25

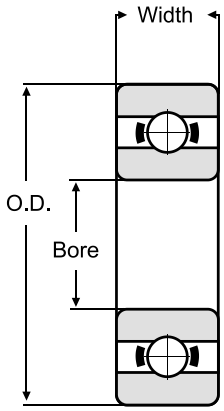
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Thin-Section

Thin section bearings

For use in instrumentation, robotics, aerospace, medical equipment, cameras and optical equipment or any industrial application where space is at a premium or weight reduction is required. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
20	25	4	ET2520	ET2520ZZ		101	69	10
	27	4	6704	6704ZZ	6704-2RS	104	72	10
	32	7	6804	6804ZZ	6804-2RS	398	244	24
	32	10	6804W10	6804ZZW10	6804-2RSW10	398	244	24
	37	9	6904	6904ZZ	6904-2RS	628	364	22
25	32	4	6705	6705ZZ	6705-2RS	109	84	8
	37	7	6805	6805ZZ	6805-2RS	426	289	20
	37	10	6805W10	6805ZZW10	6805-2RSW10	426	289	20
	42	9	6905	6905ZZ	6905-2RS	689	447	18
30	37	4	6706	6706ZZ	6706-2RS	113	95	7
	42	7	6806	6806ZZ	6806-2RS	455	339	18
	42	10	6806W10	6806ZZW10	6806-2RSW10	455	339	18
	47	9	6906	6906ZZ	6906-2RS	721	499	17
35	44	5	6707	6707ZZ	6707-2RS	182	163	6
	47	7	6807	6807ZZ	6807-2RS	469	381	16
	55	10	6907	6907ZZ	6907-2RS	1090	781	14
40	50	6	6708		6708-2RS	249	221	5
	52	7	6808	6808ZZ	6808-2RS	492	416	14
	62	12	6908	6908ZZ	6908-2RS	1358	992	13
45	55	6	6709		6709-2RS	258	239	5
	58	7	6809	6809ZZ	6809-2RS	618	538	12
	68	12	6909	6909ZZ	6909-2RS	1380	1082	11
50	62	6	6710		6710-2RS	267	264	4
	65	7	6810	6810ZZ	6810-2RS	647	576	11
	72	12	6910	6910ZZ	6910-2RS	1410	1103	10
55	72	9	6811	6811ZZ	6811-2RS	880	810	10
	80	13	6911	6911ZZ	6911-2RS	1660	1410	10

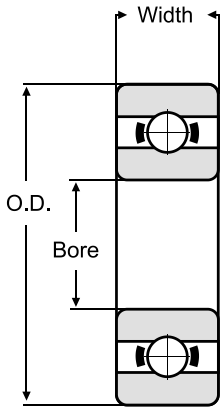
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Thin-Section

Thin section bearings

For use in instrumentation, robotics, aerospace, medical equipment, cameras and optical equipment or any industrial application where space is at a premium or weight reduction is required. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
60	78	10	6812	6812ZZ	6812-2RS	1150	1060	9
	85	13	6912	6912ZZ	6912-2RS	2020	1730	9
65	85	10	6813	6813ZZ	6813-2RS	1190	1150	9
	90	13	6913	6913ZZ	6913-2RS	1740	1610	8
70	90	10	6814	6814ZZ	6814-2RS	1210	1190	8
	100	16	6914	6914ZZ	6914-2RS	2370	2120	8
75	95	10	6815	6815ZZ	6815-2RS	1290	1250	8
	100	16	6915	6915ZZ	6915-2RS	2440	2260	7
80	100	10	6816	6816ZZ	6816-2RS	1330	1270	7
	110	16	6916	6916ZZ	6916-2RS	2500	2400	7
85	110	13	6817	6817ZZ	6817-2RS	1900	1870	7
	120	18	6917	6917ZZ	6917-2RS	3190	2960	6
90	115	13	6818	6818ZZ	6818-2RS	1970	1900	6
	125	18	6918	6918ZZ	6918-2RS	3280	3160	6

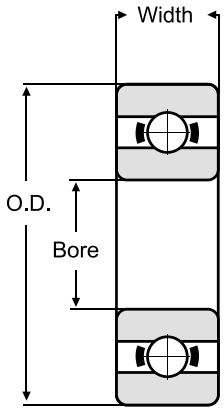
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Stainless Steel Thin-Section

Corrosion resistant thin section bearings

For use in mildly corrosive conditions or for high temperature use, these thin section bearings are used in industrial applications where space is at a premium or weight reduction is required. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
10	15	3	S6700			71	34	17
	15	4		S6700ZZ	S6700-2RS	71	34	17
	19	5	S6800	S6800ZZ	S6800-2RS	147	67	43
	19	6		S6800ZZW6		147	67	37
	19	7		S6800ZZW7	S6800-2RSW7	147	67	37
	22	6	S6900	S6900ZZ	S6900-2RS	229	102	41
12	18	4	S6701	S6701ZZ	S6701-2RS	76	43	15
	21	5	S6801	S6801ZZ	S6801-2RS	160	87	39
	21	7		S6801ZZW7	S6801-2RSW7	160	87	32
	24	6	S6901	S6901ZZ	S6901-2RS	245	117	36
15	21	4	S6702	S6702ZZ	S6702-2RS	79	48	13
	24	5	S6802	S6802ZZ	S6802-2RS	176	101	33
	24	7		S6802ZZW7	S6802-2RSW7	176	101	28
	28	7	S6902	S6902ZZ	S6902-2RS	364	178	28
17	23	4	S6703	S6703ZZ	S6703-2RS	85	52	11
	26	5	S6803	S6803ZZ	S6803-2RS	186	115	30
	26	7		S6803ZZW7	S6803-2RSW7	186	115	26
	30	7	S6903	S6903ZZ	S6903-2RS	385	205	25
20	25	4	SET2520	SET2520ZZ		82	52	10
	27	4	S6704	S6704ZZ	S6704-2RS	88	57	10
	32	7	S6804	S6804ZZ	S6804-2RS	338	195	24
	37	9	S6904	S6904ZZ	S6904-2RS	533	291	22
25	32	4	S6705		S6705-2RS	93	67	8
	37	7	S6805	S6805ZZ	S6805-2RS	362	231	20
	42	9	S6905	S6905ZZ	S6905-2RS	586	358	18
30	37	4	S6706		S6706-2RS	96	76	7
	42	7	S6806	S6806ZZ	S6806-2RS	387	231	18
	47	9	S6906	S6906ZZ	S6906-2RS	613	399	17

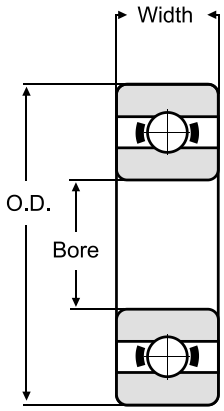
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Stainless Steel Thin-Section

Corrosion resistant thin section bearings

For use in mildly corrosive conditions or for high temperature use, these thin section bearings are used in industrial applications where space is at a premium or weight reduction is required. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
35	44	5	S6707		S6707-2RS	159	131	6
	47	7	S6807	S6807ZZ	S6807-2RS	399	305	16
	55	10	S6907	S6907ZZ	S6907-2RS	926	624	14
40	50	6	S6708		S6708-2RS	212	177	5
	52	7	S6808	S6808ZZ	S6808-2RS	418	332	14
	62	12	S6908	S6908ZZ	S6908-2RS	1154	794	13
45	58	7	S6809	S6809ZZ	S6809-2RS	524	431	12
	68	12	S6909	S6909ZZ	S6909-2RS	1173	866	11
50	65	7	S6810	S6810ZZ	S6810-2RS	550	461	11
	72	12	S6910	S6910ZZ	S6910-2RS	1199	882	10
55	72	9	S6811	S6811ZZ	S6811-2RS	748	647	10
	80	13	S6911	S6911ZZ	S6911-2RS	1411	1128	10

** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

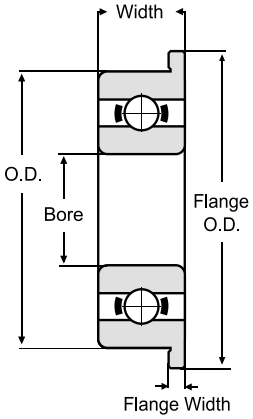
See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Flanged Thin-Section

Flanged thin section bearings.

The flanged allows easier location in a housing. Thin section bearings are suitable for industrial applications where space is at a premium or weight reduction is required. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
10	15	3	16.5	0.8	F6700		
	15	4	16.5	0.8		F6700ZZ	F6700-2RS
	19	5	21	1	F6800	F6800ZZ	F6800-2RS
	19	7	21	1.5		F6800ZZW7	F6800-2RSW7
	22	6	25	1.5	F6900	F6900ZZ	F6900-2RS
12	18	4	19.5	0.8	F6701	F6701ZZ	F6701-2RS
	21	5	23	1.1	F6801	F6801ZZ	F6801-2RS
	21	7	23	1.5		F6801ZZW7	F6801-2RSW7
	24	6	26.5	1.5	F6901	F6901ZZ	F6901-2RS
15	21	4	22.5	0.8	F6702	F6702ZZ	F6702-2RS
	24	5	26	1.1	F6802	F6802ZZ	F6802-2RS
	24	7	26	1.5		F6802ZZW7	F6802-2RSW7
	28	7	30.5	1.5	F6902	F6902ZZ	F6902-2RS
17	23	4	24.5	0.8	F6703	F6703ZZ	F6703-2RS
	26	5	28	1.1	F6803	F6803ZZ	F6803-2RS
	26	7	28	1.5		F6803ZZW7	F6803-2RSW7
	30	7	32.5	1.5	F6903	F6903ZZ	F6903-2RS
20	27	4	28.5	0.8	F6704	F6704ZZ	F6704-2RS
	32	7	35	1.5	F6804	F6804ZZ	F6804-2RS
	37	9	40	2	F6904	F6904ZZ	F6904-2RS
25	32	4	34	1	F6705	F6705ZZ	F6705-2RS
	37	7	40	2	F6805	F6805ZZ	F6805-2RS
	42	9	45	2	F6905	F6905ZZ	F6905-2RS
30	37	39	4	1	F6706	F6706ZZ	F6706-2RS
	42	45	7	1.5	F6806	F6806ZZ	F6806-2RS
	47	50	9	2	F6906	F6906ZZ	F6906-2RS

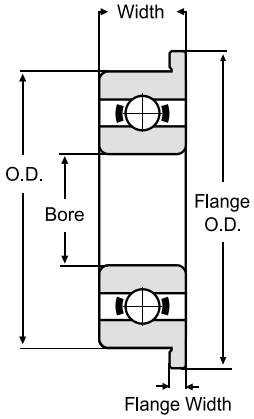
* *Some types may be available with non-contact seals or teflon seals*

Metric Stainless Steel Flanged Thin-Section

Corrosion resistant flanged thin section bearings.

For use in mildly corrosive conditions or high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

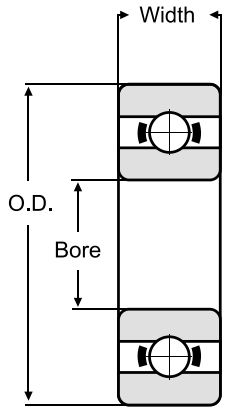
Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing *
	15	3	17	0.8	SF6700		
	15	4	17	0.8		SF6700ZZ	SF6700-2RS
10	19	5	21	1	SF6800	SF6800ZZ	SF6800-2RS
	19	7	21	1.5		SF6800ZZW7	SF6800-2RSW7
	22	6	25	1.5	SF6900	SF6900ZZ	SF6900-2RS
	18	4	19.5	0.8	SF6701	SF6701ZZ	
12	21	5	23	1.1	SF6801	SF6801ZZ	SF6801-2RS
	24	6	26.5	1.5	SF6901	SF6901ZZ	SF6901-2RS
	21	4	22.5	0.8	SF6702	SF6702ZZ	
15	24	5	26	1.1	SF6802	SF6802ZZ	SF6802-2RS
	28	7	30.5	1.5	SF6902	SF6902ZZ	SF6902-2RS

* *Some types may be available with non-contact seals or teflon seals*

Popular Metric

Chrome steel ball bearings in popular metric sizes for radial loads and moderate thrust loads in both directions.

These are deep groove radial ball bearings in the most popular sizes, hence the term “popular metric bearings”. These bearings are supplied in SAE52100 chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
10	26	8	6000	6000ZZ	6000-2RS	464	200	36
	28	8	16100	16100ZZ	16100-2RS	489	214	32
	30	9	6200	6200ZZ	6200-2RS	521	245	29
	35	11	6300	6300ZZ	6300-2RS	825	351	27
12	28	7	16001	16001ZZ	16001-2RS	521	244	31
	28	8	6001	6001ZZ	6001-2RS	521	244	32
	30	8	16101	16101ZZ	16101-2RS	693	312	29
	32	10	6201	6201ZZ	6201-2RS	693	312	27
	37	12	6301	6301ZZ	6301-2RS	989	428	25
12.7	28	8	6001-1/2	6001ZZ-1/2	6001-2RS-1/2	521	244	32
	32	10	6201-1/2	6201ZZ-1/2	6201-2RS-1/2	693	312	27
	35	11	6202-1/2	6202ZZ-1/2	6202-2RS-1/2	779	382	24
	40	12	6203-1/2	6203ZZ-1/2	6203-2RS-1/2	976	491	21
13	32	10	6201 -13	6201ZZ-13	6201-2RS-13	693	312	27
15	32	8	16002	16002ZZ	16002-2RS	570	290	26
	32	9	6002	6002ZZ	6002-2RS	570	290	27
	35	11	6202	6202ZZ	6202-2RS	779	382	24
	42	13	6302	6302ZZ	6302-2RS	1166	558	20
15.875	35	11	6202-5/8	6202ZZ-5/8	6202-2RS-5/8	779	382	24
	40	12	6203-5/8	6203ZZ-5/8	6203-2RS-5/8	976	491	21
16	35	11	6202 -16	6202ZZ-16	6202-2RS-16	611	335	25
	40	12	6203 -16	6203ZZ-16	6203-2RS-16	976	491	21
17	35	8	16003	16003ZZ	16003-2RS	573	321	24
	35	10	6003	6003ZZ	6003-2RS	611	335	25
	40	12	6203	6203ZZ	6203-2RS	976	491	21
	47	14	6303	6303ZZ	6303-2RS	1386	680	18
19.05	40	12	6203-3/4	6203ZZ-3/4	6203-2RS-3/4	859	433	21
	47	14	6204-3/4	6204ZZ-3/4	6204-2RS-3/4	1310	684	17

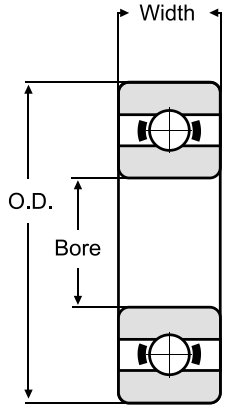
** Some types may be available with non-contact seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See “Engineering Data - Load Rating” for guidance on recommended loads.

Popular Metric

Chrome steel ball bearings in popular metric sizes for radial loads and moderate thrust loads in both directions.

These are deep groove radial ball bearings in the most popular sizes, hence the term “popular metric bearings”. These bearings are supplied in SAE52100 chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
20	42	8	16004	16004ZZ	16004-2RS	898	481	21
	42	12	6004	6004ZZ	6004-I22RS	956	517	21
	47	14	6204	6204ZZ	6204-2RS	1310	684	17
	52	15	6304	6304ZZ	6304-2RS	1619	805	17
22.225	47	14	6204-7/8	6204ZZ-7/8	6204-2RS-7/8	1164	611	17
25	47	8	16005	16005ZZ	16005-2RS	933	549	18
	47	12	6005	6005ZZ	6005-2RS	1026	597	18
	52	15	6205	6205ZZ	6205-2RS	1429	804	15
	62	17	6305	6305ZZ	6305-2RS	2100	1156	13
25.4	52	15	6205 -1	6205ZZ-1	6205-2RS-1	1429	804	15
30	55	9	16006	16006ZZ	16006-2RS	963	558	12
	55	13	6006	6006ZZ	6006-2RS	1349	843	15
	62	16	6206	6206ZZ	6206-2RS	1984	1158	13
	72	19	6306	6306ZZ	6306-2RS	2717	1541	12

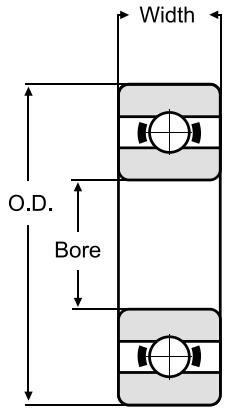
*** Reduce maximum Rpm by 40% for 2RS types.***

See “Engineering Data - Load Rating” for guidance on recommended loads.

Popular Metric Stainless Steel

Corrosion resistant popular metric ball bearings

For mildly corrosive conditions or high temperature use, these bearings can be re-lubricated with food grade lubricants or high temperature lubricants for up to 300°C. Some sizes can be supplied with Viton seals for high temperatures or chemical resistance. They are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
10	26	8	S6000	S6000ZZ	S6000-2RS	386	157	36
	30	9	S6200	S6200ZZ	S6200-2RS	434	192	29
	35	11	S6300	S6300ZZ	S6300-2RS	687	275	27
12	28	8	S6001	S6001ZZ	S6001-2RS	434	191	32
	32	10	S6201	S6201ZZ	S6201-2RS	577	245	27
	37	12	S6301	S6301ZZ	S6301-2RS	824	336	25
15	32	9	S6002	S6002ZZ	S6002-2RS	475	227	27
	35	11	S6202	S6202ZZ	S6202-2RS	649	300	24
	42	13	S6302	S6302ZZ	S6302-2RS	971	437	20
17	35	10	S6003	S6003ZZ	S6003-2RS	509	263	25
	40	12	S6203	S6203ZZ	S6203-2RS	813	385	21
	47	14	S6303	S6303ZZ	S6303-2RS	1155	533	18
20	42	12	S6004	S6004ZZ	S6004-2RS	796	405	21
	47	14	S6204	S6204ZZ	S6204-2RS	1091	536	17
	52	15	S6304	S6304ZZ	S6304-2RS	1349	631	17
25	47	12	S6005	S6005ZZ	S6005-2RS	855	469	18
	52	15	S6205	S6205ZZ	S6205-2RS	1190	630	15
	62	17	S6305	S6305ZZ	S6305-2RS	1749	906	13
30	55	13	S6006	S6006ZZ	S6006-2RS	1124	661	15
	62	16	S6206	S6206ZZ	S6206-2RS	1653	908	13
	72	19	S6306	S6306ZZ	S6306-2RS	2263	1208	12
35	62	14	S6007	S6007ZZ	S6007-2RS	1356	825	13
	72	17	S6207	S6207ZZ	S6207-2RS	2181	1236	11
40	68	15	S6008	S6008ZZ	S6008-2RS	1425	922	12
	80	18	S6208	S6208ZZ	S6208-2RS	2473	1433	10
45	75	16	S6009	S6009ZZ	S6009-2RS	1515	966	11
	85	19	S6209	S6209ZZ	S6209-2RS	2779	1630	9

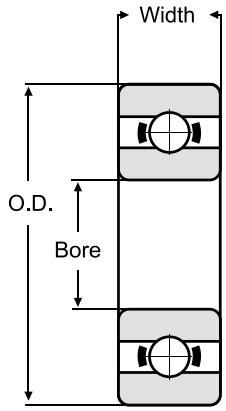
** Some types may be available with non-contact seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Popular Metric Stainless Steel

Corrosion resistant popular metric ball bearings

For mildly corrosive conditions or high temperature use, these bearings can be re-lubricated with food grade lubricants or high temperature lubricants for up to 300°C. Some sizes can be supplied with Viton seals for high temperatures or chemical resistance. They are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
50	80	16	S6010	S6010ZZ	S6010-2RS	1851	1326	10
	90	20	S6210	S6210ZZ	S6210-2RS	2980	1861	8

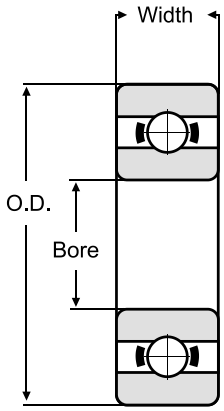
** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Popular Metric Electric Motor Grade

Extra low noise chrome steel ball bearings in popular metric sizes

These electric motor bearings are rated EMQ2 (ZV3) for very low noise or low vibration applications. These bearings are supplied in SAE52100 chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Shielded Bearing	Sealed Bearing	Max Load (kgf) Dyn	Stat	Rpm ** (x1000)
	26	8	6000ZZP6EMQ2	6000-2RSP6EMQ2	464	200	31
10	30	9	6200ZZP6EMQ2	6200-2RSP6EMQ2	521	245	24
	35	11	6300ZZP6EMQ2	6300-2RSP6EMQ2	825	351	22
	28	8	6001ZZP6EMQ2	6001-2RSP6EMQ2	521	244	27
12	32	10	6201ZZP6EMQ2	6201-2RSP6EMQ2	693	312	22
	37	12	6301ZZP6EMQ2	6301-2RSP6EMQ2	989	428	20
	32	9	6002ZZP6EMQ2	6002-2RSP6EMQ2	570	290	23
15	35	11	6202ZZP6EMQ2	6202-2RSP6EMQ2	779	382	20
	42	13	6302ZZP6EMQ2	6302-2RSP6EMQ2	1166	558	17
	35	10	6003ZZP6EMQ2	6003-2RSP6EMQ2	611	335	21
17	40	12	6203ZZP6EMQ2	6203-2RSP6EMQ2	976	491	17
	47	14	6303ZZP6EMQ2	6303-2RSP6EMQ2	1386	680	15
	42	12	6004ZZP6EMQ2	6004-2RSP6EMQ2	956	517	17
20	47	14	6204ZZP6EMQ2	6204-2RSP6EMQ2	1310	684	15
	52	15	6304ZZP6EMQ2	6304-2RSP6EMQ2	1619	805	14
	47	12	6005ZZP6EMQ2	6005-2RSP6EMQ2	1026	597	15
25	52	15	6205ZZP6EMQ2	6205-2RSP6EMQ2	1429	804	13
	62	17	6305ZZP6EMQ2	6305-2RSP6EMQ2	2100	1156	11
	55	13	6006ZZP6EMQ2	6006-2RSP6EMQ2	1349	843	13
30	62	16	6206ZZP6EMQ2	6206-2RSP6EMQ2	1984	1158	11
	72	19	6306ZZP6EMQ2	6306-2RSP6EMQ2	2717	1541	10

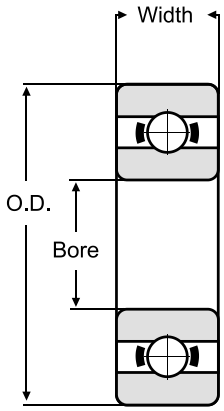
** *Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Popular Metric Electric Motor Grade (C3)

Extra low noise chrome steel ball bearings in popular metric sizes

These electric motor bearings are rated EMQ2 (ZV3) for very low noise or low vibration applications. These bearings are supplied in SAE52100 chrome steel.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Shielded Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
10	26	8	6000ZZP6C3EMQ2	6000-2RSP6C3EMQ2	464	200	31
	30	9	6200ZZP6C3EMQ2	6200-2RSP6C3EMQ2	521	245	24
	35	11	6300ZZP6C3EMQ2	6300-2RSP6C3EMQ2	825	351	22
12	28	8	6001ZZP6C3EMQ2	6001-2RSP6C3EMQ2	521	244	27
	32	10	6201ZZP6C3EMQ2	6201-2RSP6C3EMQ2	693	312	22
	37	12	6301ZZP6C3EMQ2	6301-2RSP6C3EMQ2	989	428	20
15	32	9	6002ZZP6C3EMQ2	6002-2RSP6C3EMQ2	570	290	23
	35	11	6202ZZP6C3EMQ2	6202-2RSP6C3EMQ2	779	382	20
	42	13	6302ZZP6C3EMQ2	6302-2RSP6C3EMQ2	1166	558	17
17	35	10	6003ZZP6C3EMQ2	6003-2RSP6C3EMQ2	611	335	21
	40	12	6203ZZP6C3EMQ2	6203-2RSP6C3EMQ2	976	491	17
	47	14	6303ZZP6C3EMQ2	6303-2RSP6C3EMQ2	1386	680	15
20	42	12	6004ZZP6C3EMQ2	6004-2RSP6C3EMQ2	956	517	17
	47	14	6204ZZP6C3EMQ2	6204-2RSP6C3EMQ2	1310	684	15
	52	15	6304ZZP6C3EMQ2	6304-2RSP6C3EMQ2	1619	805	14
25	47	12	6005ZZP6C3EMQ2	6005-2RSP6C3EMQ2	1026	597	15
	52	15	6205ZZP6C3EMQ2	6205-2RSP6C3EMQ2	1429	804	13
	62	17	6305ZZP6C3EMQ2	6305-2RSP6C3EMQ2	2100	1156	11
30	55	13	6006ZZP6C3EMQ2	6006-2RSP6C3EMQ2	1349	843	13
	62	16	6206ZZP6C3EMQ2	6206-2RSP6C3EMQ2	1984	1158	11
	72	19	6306ZZP6C3EMQ2	6306-2RSP6C3EMQ2	2717	1541	10

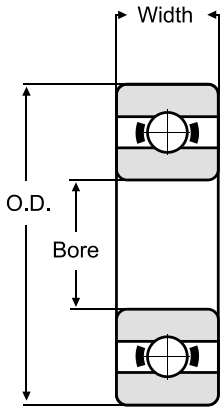
*** Reduce maximum Rpm by 40% for 2RS types.***

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Plastic

Semi-precision plastic bearings

These bearings have POM-C acetal rings and PA66 nylon cages. For greater chemical resistance or high temperatures, many sizes can be supplied in PTFE, PEEK or PVDF. Plastic bearings are only suitable for low loads and low speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.



ACETAL RESIN ***Dimensions in mm unless otherwise specified***

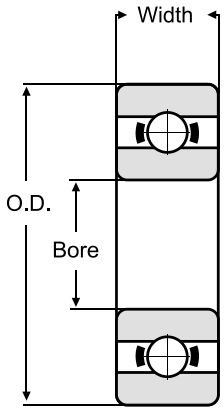
Bore	O.D.	Width	316 Stainless Steel Balls	Glass Balls	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
3	8	3	AC693-316	AC693-GL	3	2	3
	9	3	AC603-316	AC603-GL	4	3	3
	10	4	AC623-316	AC623-GL	7	5	3
	13	5	AC633-316	AC633-GL	9	7	3
4	9	3	AC684-316	AC684-GL	4	3	3
	11	4	AC694-316	AC694-GL	6	4	3
	12	4	AC604-316	AC604-GL	6	4	3
	13	5	AC624-316	AC624-GL	7	5	3
	16	5	AC634-316	AC634-GL	10	7	3
5	11	4	AC685-316	AC685-GL	5	3	3
	13	4	AC695-316	AC695-GL	7	5	3
	14	5	AC605-316	AC605-GL	7	5	3
	16	5	AC625-316	AC625-GL	9	7	2.6
	19	6	AC635-316	AC635-GL	12	9	2.6
6	13	4	AC686-316	AC686-GL	7	5	2.6
	15	5	AC696-316	AC696-GL	8	6	2.6
	17	6	AC606-316	AC606-GL	9	7	2.6
	19	6	AC626-316	AC626-GL	9	7	2.6
	22	7	AC636-316	AC636-GL	13	10	2.6
7	14	4	AC687-316	AC687-GL	7	5	2.6
	17	5	AC697-316	AC697-GL	8	6	2.6
	19	6	AC607-316	AC607-GL	9	7	2.6
	22	7	AC627-316	AC627-GL	12	9	2.4
	26	9	AC637-316	AC637-GL	14	11	2.4

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Plastic

Semi-precision plastic bearings

These bearings have POM-C acetal rings and PA66 nylon cages. For greater chemical resistance or high temperatures, many sizes can be supplied in PTFE, PEEK or PVDF. Plastic bearings are only suitable for low loads and low speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.



ACETAL RESIN ***Dimensions in mm unless otherwise specified***

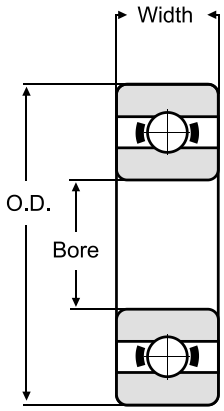
Bore	O.D.	Width	316 Stainless Steel Balls	Glass Balls	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
8	16	4	AC688-316	AC688-GL	7	5	2.6
	19	6	AC698-316	AC698-GL	8	6	2.6
	22	7	AC608-316	AC608-GL	12	9	2.6
	24	8	AC628-316	AC628-GL	12	9	2.4
	28	9	AC638-316	AC638-GL	15	12	2.4
9	17	4	AC689-316	AC689-GL	7	5	2.6
	20	6	AC699-316	AC699-GL	8	6	2.6
	24	7	AC609-316	AC609-GL	12	9	2.6
	26	8	AC629-316	AC629-GL	14	11	2.4
	30	10	AC639-316	AC639-GL	15	12	2.4
10	19	5	AC6800-316	AC6800-GL	10	8	2
	22	6	AC6900-316	AC6900-GL	11	9	2
	26	8	AC6000-316	AC6000-GL	14	11	2
	30	9	AC6200-316	AC6200-GL	16	13	1.9
	35	11	AC6300-316	AC6300-GL	19	16	1.6
12	21	5	AC6801-316	AC6801-GL	11	8	1.8
	24	6	AC6901-316	AC6901-GL	12	10	1.8
	28	7	AC16001-316	AC16001-GL	16	13	1.8
	28	8	AC6001-316	AC6001-GL	16	13	1.8
	32	10	AC6201-316	AC6201-GL	20	16	1.7
	37	12	AC6301-316	AC6301-GL	23	19	1.5
15	24	5	AC6802-316	AC6802-GL	12	9	1.6
	28	7	AC6902-316	AC6902-GL	14	11	1.6
	32	8	AC16002-316	AC16002-GL	18	15	1.6
	32	9	AC6002-316	AC6002-GL	18	15	1.6
	35	11	AC6202-316	AC6202-GL	23	19	1.5
	42	13	AC6302-316	AC6302-GL	29	24	1.4

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Plastic

Semi-precision plastic bearings

These bearings have POM-C acetal rings and PA66 nylon cages. For greater chemical resistance or high temperatures, many sizes can be supplied in PTFE, PEEK or PVDF. Plastic bearings are only suitable for low loads and low speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.



ACETAL RESIN ***Dimensions in mm unless otherwise specified***

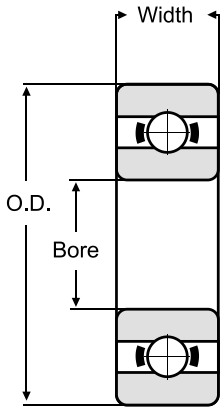
Bore	O.D.	Width	316 Stainless Steel Balls	Glass Balls	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
17	26	5	AC6803-316	AC6803-GL	14	11	1.5
	30	7	AC6903-316	AC6903-GL	15	12	1.5
	35	8	AC16003-316	AC16003-GL	20	16	1.5
	35	10	AC6003-316	AC6003-GL	20	16	1.5
	40	12	AC6203-316	AC6203-GL	24	19	1.4
	47	14	AC6303-316	AC6303-GL	34	27	1.3
20	32	7	AC6804-316	AC6804-GL	16	13	1.2
	37	9	AC6904-316	AC6904-GL	18	14	1.2
	42	8	AC16004-316	AC16004-GL	24	19	1.2
	42	12	AC6004-316	AC6004-GL	24	19	1.2
	47	14	AC6204-316	AC6204-GL	32	26	1.1
	52	15	AC6304-316	AC6304-GL	38	29	1
25	37	7	AC6805-316	AC6805-GL	18	15	1.2
	42	9	AC6905-316	AC6905-GL	20	16	1.2
	47	8	AC16005-316	AC16005-GL	29	22	1.2
	47	12	AC6005-316	AC6005-GL	29	22	1.2
	52	15	AC6205-316	AC6205-GL	37	29	1.1
	62	17	AC6305-316	AC6305-GL	43	33	1
30	42	7	AC6806-316	AC6806-GL	21	17	1.2
	47	9	AC6906-316	AC6906-GL	23	19	1.2
	55	9	AC16006-316	AC16006-GL	31	26	1.2
	55	13	AC6006-316	AC6006-GL	31	26	1.2
	62	16	AC6206-316	AC6206-GL	39	33	1.1
	72	19	AC6306-316	AC6306-GL	46	35	1
35	47	7	AC6807-316	AC6807-GL	24	20	1.1
	55	10	AC6907-316	AC6907-GL	26	22	1.1
	62	14	AC6007-316	AC6007-GL	37	30	1
	72	17	AC6207-316	AC6207-GL	43	36	1

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Plastic

Semi-precision plastic bearings

These bearings have POM-C acetal rings and PA66 nylon cages. For greater chemical resistance or high temperatures, many sizes can be supplied in PTFE, PEEK or PVDF. Plastic bearings are only suitable for low loads and low speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.



ACETAL RESIN ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	316 Stainless Steel Balls	Glass Balls	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
40	52	7	AC6808-316	AC6808-GL	27	22	1.1
	62	12	AC6908-316	AC6908-GL	29	25	1.1
	68	15	AC6008-316	AC6008-GL	40	33	1
	80	18	AC6208-316	AC6208-GL	47	40	1
45	58	7	AC6809-316	AC6809-GL	29	34	1
	68	12	AC6909-316	AC6909-GL	35	41	1
	75	16	AC6009-316	AC6009-GL	42	49	0.9
	85	19	AC6209-316	AC6209-GL	51	59	0.9
50	65	7	AC6810-316	AC6810-GL	31	36	0.9
	72	12	AC6910-316	AC6910-GL	38	44	0.9
	80	16	AC6010-316	AC6010-GL	45	52	0.8
	90	20	AC6210-316	AC6210-GL	55	64	0.8

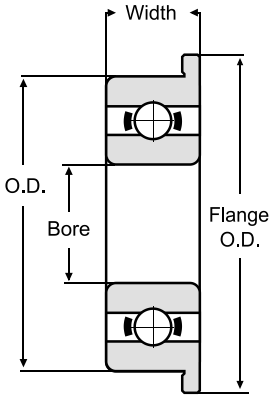
See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Plastic Flanged

Semi-precision flanged plastic bearings

These acetal bearings with nylon cages have a flanged outer ring for easier location in a housing. They are only suitable for low loads and speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.

For load/speed ratings, refer to non-flanged



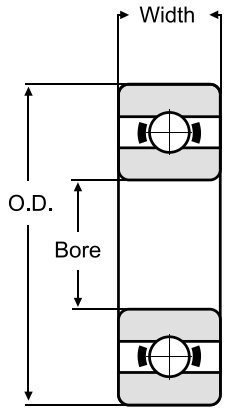
ACETAL RESIN ***Dimensions in mm unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	316 Stainless Steel Balls	Glass Balls
4	13	5	15	ACF624-316	ACF624-GL
	16	5	18	ACF634-316	ACF634-GL
5	16	5	18	ACF625-316	ACF625-GL
	19	6	22	ACF635-316	ACF635-GL
6	19	6	22	ACF626-316	ACF626-GL
7	19	6	22	ACF607-316	ACF607-GL
	22	7	25	ACF627-316	ACF627-GL
8	16	4	18	ACF688-316	ACF688-GL
	22	7	25	ACF608-316	ACF608-GL

Metric Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have non-contact PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in mm unless otherwise specified***

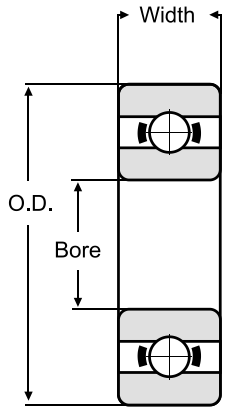
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
3	8	3	CCZR-693		40	13	13
	8	4		CCZR-693-2PKS	40	13	13
	9	3	CCZR-603	CCZR-603- PKS	43	14	13
	10	4	CCZR-623	CCZR-623- PKS	44	15	12
4	9	3	CCZR-684		38	12	12
	9	4		CCZR-684- PKS	38	12	12
	11	4	CCZR-694	CCZR-694- PKS	72	26	11
	12	4	CCZR-604	CCZR-604- PKS	72	25	11
	13	5	CCZR-624	CCZR-624- PKS	95	34	10
	16	5	CCZR-634	CCZR-634- PKS	100	39	8
5	11	3	CCZR-685		53	21	11
	11	5		CCZR-685- PKS	53	21	11
	13	4	CCZR-695	CCZR-695- PKS	76	30	10
	14	5	CCZR-605	CCZR-605- PKS	95	36	10
	16	5	CCZR-625	CCZR-625- PKS	121	48	9
	19	6	CCZR-635	CCZR-635- PKS	177	67	8
6	13	4	CCZR-686		76	33	10
	13	5		CCZR-686- PKS	76	33	10
	15	5	CCZR-696	CCZR-696- PKS	101	39	9
	17	6	CCZR-606	CCZR-606- PKS	169	63	9
	19	6	CCZR-626	CCZR-626- PKS	175	77	8
	22	7	CCZR-636	CCZR-636- PKS	149	105	7
7	14	4	CCZR-687		90	38	10
	14	5		CCZR-687- PKS	90	38	10
	17	5	CCZR-697	CCZR-697- PKS	120	55	9
	19	6	CCZR-607	CCZR-607- PKS	177	67	9
	22	7	CCZR-627	CCZR-627- PKS	254	106	7
	26	9	CCZR-637	CCZR-637- PKS	351	174	6.5

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have non-contact PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in mm unless otherwise specified***

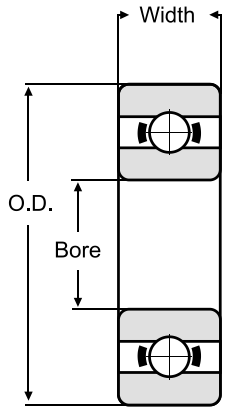
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
8	16	4	CCZR-688		94	44	9
	16	5		CCZR-688-2PKS	94	44	9
	19	6	CCZR-698	CCZR-698-2PKS	166	69	9
	22	7	CCZR-608	CCZR-608-2PKS	253	104	8
	24	8	CCZR-628	CCZR-628-2PKS	261	107	7
	28	9	CCZR-638	CCZR-638-2PKS	338	147	6.5
9	17	4	CCZR-689		101	51	9
	17	5		CCZR-689-2PKS	101	51	9
	20	6	CCZR-699	CCZR-699-2PKS	184	82	8
	24	7	CCZR-609	CCZR-609-2PKS	254	89	8
	26	8	CCZR-629	CCZR-629-2PKS	343	149	7
	30	10	CCZR-639	CCZR-639-2PKS	351	153	6
10	15	3	CCZR-6700		61	33	4.5
	15	4		CCZR-6700-2PKS	61	33	4.5
	19	5	CCZR-6800	CCZR-6800-2PKS	138	62	8.8
	22	6	CCZR-6900	CCZR-6900-2PKS	202	96	8.2
	26	8	CCZR-6000	CCZR-6000-2PKS	348	149	7
	30	9	CCZR-6200	CCZR-6200-2PKS	392	182	6
	35	11	CCZR-6300	CCZR-6300-2PKS	618	263	5.5
12	18	4	CCZR-6701	CCZR-6701-2PKS	69	39	3
	21	5	CCZR-6801	CCZR-6801-2PKS	143	76	8
	24	6	CCZR-6901	CCZR-6901-2PKS	215	110	7.2
	28	8	CCZR-6001	CCZR-6001-2PKS	391	183	6.4
	32	10	CCZR-6201	CCZR-6201-2PKS	519	249	5.4
	37	12	CCZR-6301	CCZR-6301-2PKS	742	321	5

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have non-contact PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in mm unless otherwise specified***

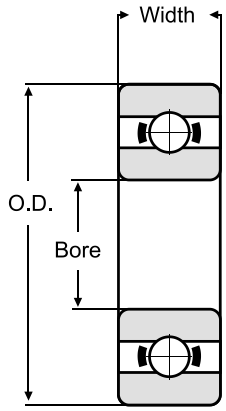
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
15	21	4	CCZR-6702	CCZR-6702-2PKS	71	44	2.6
	24	5	CCZR-6802	CCZR-6802-2PKS	153	94	6.6
	28	7	CCZR-6902	CCZR-6902-2PKS	321	167	6.2
	32	9	CCZR-6002	CCZR-6002-2PKS	446	216	5.5
	35	11	CCZR-6202	CCZR-6202-2PKS	583	287	4.8
	42	13	CCZR-6302	CCZR-6302-2PKS	874	419	4
17	23	4	CCZR-6703	CCZR-6703-2PKS	75	49	2.1
	26	5	CCZR-6803	CCZR-6803-2PKS	164	108	6
	30	7	CCZR-6903	CCZR-6903-2PKS	340	192	5.6
	35	10	CCZR-6003	CCZR-6003-2PKS	458	251	5
	40	12	CCZR-6203	CCZR-6203-2PKS	732	368	4.2
	47	14	CCZR-6303	CCZR-6303-2PKS	1039	510	3.6
20	27	4	CCZR-6704	CCZR-6704-2PKS	77	54	2
	32	7	CCZR-6804	CCZR-6804-2PKS	299	183	4.8
	37	9	CCZR-6904	CCZR-6904-2PKS	464	273	4.6
	42	12	CCZR-6004	CCZR-6004-2PKS	717	388	4.2
	47	14	CCZR-6204	CCZR-6204-2PKS	982	513	3.4
	52	15	CCZR-6304	CCZR-6304-2PKS	1214	604	2.8
25	32	4	CCZR-6705	CCZR-6705-2PKS	79	61	1.6
	37	7	CCZR-6805	CCZR-6805-2PKS	320	217	4
	42	9	CCZR-6905	CCZR-6905-2PKS	517	335	3.6
	47	12	CCZR-6005	CCZR-6005-2PKS	770	448	3.4
	52	15	CCZR-6205	CCZR-6205-2PKS	1072	603	3
	62	17	CCZR-6305	CCZR-6305-2PKS	1575	867	2.6

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have non-contact PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in mm unless otherwise specified***

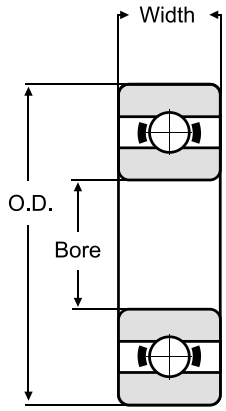
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
30	37	4	CCZR-6706	CCZR-6706-2PKS	85	71	1.4
	42	7	CCZR-6806	CCZR-6806-2PKS	341	254	3.6
	47	9	CCZR-6906	CCZR-6906-2PKS	540	374	3.4
	55	13	CCZR-6006	CCZR-6006-2PKS	1011	632	3
	62	16	CCZR-6206	CCZR-6206-2PKS	1488	869	2.6
	72	19	CCZR-6306	CCZR-6306-2PKS	2037	1155	2.4
35	44	5	CCZR-6707	CCZR-6707-2PKS	137	122	1.2
	47	7	CCZR-6807	CCZR-6807-2PKS	352	286	3.2
	55	10	CCZR-6907	CCZR-6907-2PKS	818	586	2.8
	62	14	CCZR-6007	CCZR-6007-2PKS	1219	788	2.6
	72	17	CCZR-6207	CCZR-6207-2PKS	1963	1182	2.2
	80	21	CCZR-6307	CCZR-6307-2PKS	2520	1478	2.1
40	50	6	CCZR-6708	CCZR-6708-2PKS	187	166	1
	52	7	CCZR-6808	CCZR-6808-2PKS	369	312	2.8
	62	12	CCZR-6908	CCZR-6908-2PKS	982	744	2.6
	68	15	CCZR-6008	CCZR-6008-2PKS	1283	882	2.4
	80	18	CCZR-6208	CCZR-6208-2PKS	2226	1371	2
	90	23	CCZR-6308	CCZR-6308-2PKS	3090	1842	1.9
45	55	6	CCZR-6709	CCZR-6709-2PKS	193	179	1
	58	7	CCZR-6809	CCZR-6809-2PKS	464	403	2.4
	68	12	CCZR-6909	CCZR-6909-2PKS	1035	811	2.2
	75	16	CCZR-6009	CCZR-6009-2PKS	1357	922	2
	85	19	CCZR-6209	CCZR-6209-2PKS	2084	1222	1.8
	100	25	CCZR-6309	CCZR-6309-2PKS	3996	2454	1.7

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have non-contact PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in mm unless otherwise specified***

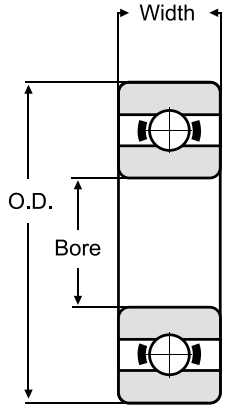
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
50	62	6	CCZR-6710	CCZR-6710-2PKS	202	190	0.9
	65	7	CCZR-6810	CCZR-6810-2PKS	472	420	2.2
	72	12	CCZR-6910	CCZR-6910-2PKS	1058	827	2
	80	16	CCZR-6010	CCZR-6010-2PKS	1388	995	1.8
	90	20	CCZR-6210	CCZR-6210-2PKS	2235	1395	1.6
	110	27	CCZR-6310	CCZR-6310-2PKS	4680	2965	1.5

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK non-contact seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in mm unless otherwise specified***

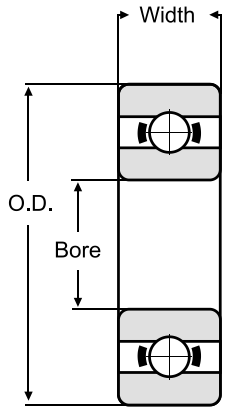
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
3	8	3	CCSI-693		34	11	16
	8	4		CCSI-693-2PKS	34	11	16
	9	3	CCSI-603	CCSI-603-2PKS	37	12	16
	10	4	CCSI-623	CCSI-623-2PKS	37	13	15
4	9	3	CCSI-684		41	14	16
	9	4		CCSI-684-2PKS	41	14	16
	11	4	CCSI-694	CCSI-694-2PKS	62	21	14
	12	4	CCSI-604	CCSI-604-2PKS	61	21	14
	13	5	CCSI-624	CCSI-624-2PKS	81	29	12
	16	5	CCSI-634	CCSI-634-2PKS	85	33	10
5	11	3	CCSI-685	CCSI-685-2PKS	45	18	14
	11	5	CCSI-685	CCSI-685-2PKS	45	18	14
	13	4	CCSI-695	CCSI-695-2PKS	65	26	12.5
	14	5	CCSI-605	CCSI-605-2PKS	81	30	12.5
	16	5	CCSI-625	CCSI-625-2PKS	103	41	11
	19	6	CCSI-635	CCSI-635-2PKS	151	57	10
6	13	4	CCSI-686		65	28	12
	13	5		CCSI-686-2PKS	65	28	12
	15	5	CCSI-696	CCSI-696-2PKS	86	33	11
	17	6	CCSI-606	CCSI-606-2PKS	144	54	11
	19	6	CCSI-626	CCSI-626-2PKS	149	67	10
	22	7	CCSI-636	CCSI-636-2PKS	128	89	8.5
7	14	4	CCSI-687		77	32	12
	14	5		CCSI-687-2PKS	77	32	12
	17	5	CCSI-697	CCSI-697-2PKS	102	47	11
	19	6	CCSI-607	CCSI-607-2PKS	150	57	11
	22	7	CCSI-627	CCSI-627-2PKS	217	90	8.5
	26	9	CCSI-637	CCSI-637-2PKS	297	149	8

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK non-contact seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in mm unless otherwise specified***

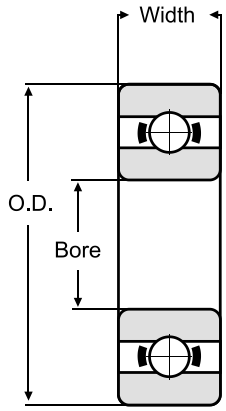
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
8	16	4	CCSI-688		80	38	11
	16	5		CCSI-688-2PKS	80	38	11
	19	6	CCSI-698	CCSI-698-2PKS	142	60	11
	22	7	CCSI-608	CCSI-608-2PKS	216	88	10
	24	8	CCSI-628	CCSI-628-2PKS	223	91	8.5
	28	9	CCSI-638	CCSI-638-2PKS	287	126	8
9	17	4	CCSI-689		85	43	11
	17	5		CCSI-689-2PKS	85	43	11
	20	6	CCSI-699	CCSI-699-2PKS	157	70	10
	24	7	CCSI-609	CCSI-609-2PKS	217	76	10
	26	8	CCSI-629	CCSI-629-2PKS	292	128	9
	30	10	CCSI-639	CCSI-639-2PKS	299	130	7.2
10	15	3	CCSI-6700		52	28	5.6
	15	4		CCSI-6700-2PKS	52	28	5.6
	19	5	CCSI-6800	CCSI-6800-2PKS	118	53	11
	22	6	CCSI-6900	CCSI-6900-2PKS	172	81	10.2
	26	8	CCSI-6000	CCSI-6000-2PKS	297	127	8.5
	30	9	CCSI-6200	CCSI-6200-2PKS	334	155	7.2
	35	11	CCSI-6300	CCSI-6300-2PKS	529	224	6.8
12	18	4	CCSI-6701	CCSI-6701-2PKS	59	33	3.8
	21	5	CCSI-6801	CCSI-6801-2PKS	122	65	10
	24	6	CCSI-6901	CCSI-6901-2PKS	183	94	9
	28	8	CCSI-6001	CCSI-6001-2PKS	333	156	8
	32	10	CCSI-6201	CCSI-6201-2PKS	443	213	6.8
	37	12	CCSI-6301	CCSI-6301-2PKS	632	273	6.2

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK non-contact seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in mm unless otherwise specified***

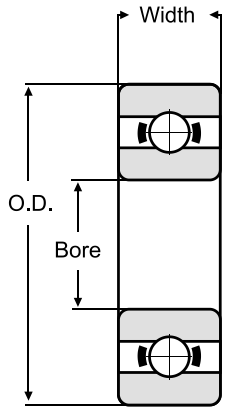
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
15	21	4	CCSI-6702	CCSI-6702-2PKS	61	38	3.2
	24	5	CCSI-6802	CCSI-6802-2PKS	131	79	8.2
	28	7	CCSI-6902	CCSI-6902-2PKS	273	143	7.6
	32	9	CCSI-6002	CCSI-6002-2PKS	380	183	6.8
	35	11	CCSI-6202	CCSI-6202-2PKS	496	245	6
	42	13	CCSI-6302	CCSI-6302-2PKS	749	356	5
17	23	4	CCSI-6703	CCSI-6703-2PKS	64	41	2.6
	26	5	CCSI-6803	CCSI-6803-2PKS	140	92	7.5
	30	7	CCSI-6903	CCSI-6903-2PKS	289	163	7
	35	10	CCSI-6003	CCSI-6003-2PKS	390	214	6.2
	40	12	CCSI-6203	CCSI-6203-2PKS	634	314	5.2
	47	14	CCSI-6303	CCSI-6303-2PKS	889	435	4.5
20	27	4	CCSI-6704	CCSI-6704-2PKS	66	47	2.5
	32	7	CCSI-6804	CCSI-6804-2PKS	254	146	6
	37	9	CCSI-6904	CCSI-6904-2PKS	395	231	5.7
	42	12	CCSI-6004	CCSI-6004-2PKS	611	329	5.2
	47	14	CCSI-6204	CCSI-6204-2PKS	834	438	4.2
	52	15	CCSI-6304	CCSI-6304-2PKS	1034	514	3.6
25	32	4	CCSI-6705	CCSI-6705-2PKS	67	51	2
	37	7	CCSI-6805	CCSI-6805-2PKS	272	186	5
	42	9	CCSI-6905	CCSI-6905-2PKS	446	287	4.5
	47	12	CCSI-6005	CCSI-6005-2PKS	659	382	4.3
	52	15	CCSI-6205	CCSI-6205-2PKS	918	513	3.6
	62	17	CCSI-6305	CCSI-6305-2PKS	1348	739	3.2

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK non-contact seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in mm unless otherwise specified***

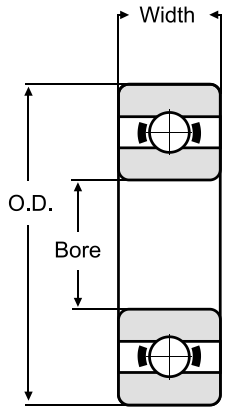
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
30	37	4	CCSI-6706	CCSI-6706-2PKS	72	61	1.8
	42	7	CCSI-6806	CCSI-6806-2PKS	291	214	4.5
	47	9	CCSI-6906	CCSI-6906-2PKS	463	319	4
	55	13	CCSI-6006	CCSI-6006-2PKS	857	539	3.6
	62	16	CCSI-6206	CCSI-6206-2PKS	1264	736	3.2
	72	19	CCSI-6306	CCSI-6306-2PKS	1728	974	3
35	44	5	CCSI-6707	CCSI-6707-2PKS	118	104	1.5
	47	7	CCSI-6807	CCSI-6807-2PKS	298	244	4
	55	10	CCSI-6907	CCSI-6907-2PKS	698	593	3.5
	62	14	CCSI-6007	CCSI-6007-2PKS	1038	671	3.2
	72	17	CCSI-6207	CCSI-6207-2PKS	1681	1009	2.8
	80	21	CCSI-6307	CCSI-6307-2PKS	2170	1248	2.7
40	50	6	CCSI-6708	CCSI-6708-2PKS	161	142	1.3
	52	7	CCSI-6808	CCSI-6808-2PKS	315	267	3.5
	62	12	CCSI-6908	CCSI-6908-2PKS	831	638	3.2
	68	15	CCSI-6008	CCSI-6008-2PKS	1096	748	3
	80	18	CCSI-6208	CCSI-6208-2PKS	1893	1167	2.5
	90	23	CCSI-6308	CCSI-6308-2PKS	2666	1560	2.4
45	55	6	CCSI-6709	CCSI-6709-2PKS	165	153	1.3
	58	7	CCSI-6809	CCSI-6809-2PKS	395	342	3
	68	12	CCSI-6909	CCSI-6909-2PKS	884	692	2.7
	75	16	CCSI-6009	CCSI-6009-2PKS	1151	787	2.4
	85	19	CCSI-6209	CCSI-6209-2PKS	1772	1039	2.2
	100	25	CCSI-6309	CCSI-6309-2PKS	2950	1800	2.1

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK non-contact seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in mm unless otherwise specified***

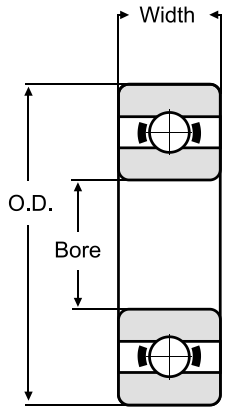
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
50	62	6	CCSI-6710	CCSI-6710-2PKS	173	161	1.1
	65	7	CCSI-6810	CCSI-6810-2PKS	407	463	2.8
	72	12	CCSI-6910	CCSI-6910-2PKS	906	703	2.5
	80	16	CCSI-6010	CCSI-6010-2PKS	1181	846	2.2
	90	20	CCSI-6210	CCSI-6210-2PKS	1905	1187	2
	110	27	CCSI-6310	CCSI-6310-2PKS	3450	2150	1.9

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric 316 Stainless Steel

Marine grade highly corrosion resistant ball bearings

These semi-precision bearings are resistant to seawater and many chemicals. The cages and non-contact seals are polyethylene but can be offered in PEEK or PTFE. Full complement types can be used in very high temperatures and cryogenic applications. As 316 is softer than 440 grade steel, these bearings are only suitable for low loads and speeds.



316 STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

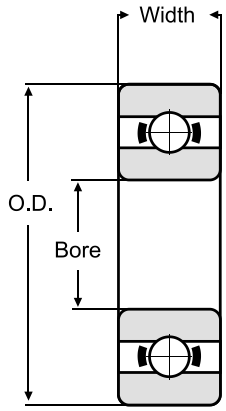
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
3	10	4	S316-623	S316-623-2PES	8	4	4.2
4	13	5	S316-624	S316-624-2PES	16	8	3.2
5	15	5	S316-625	S316-625-2PES	21	11	2.8
6	17	6	S316-606	S316-606-2PES	27	14	2.7
	19	6	S316-626	S316-626-2PES	28	14	2.4
7	19	6	S316-607	S316-607-2PES	29	15	2.6
	22	7	S316-627	S316-627-2PES	40	22	2.2
8	22	7	S316-608	S316-608-2PES	40	22	2.4
	24	8	S316-628	S316-628-2PES	41	23	2.1
9	24	7	S316-609	S316-609-2PES	41	23	2.3
	26	8	S316-629	S316-629-2PES	56	32	2
10	19	5	S316-6800	S316-6800-2PES	22	13	2.6
	22	6	S316-6900	S316-6900-2PES	34	20	2.5
	26	8	S316-6000	S316-6000-2PES	56	32	2.2
	30	9	S316-6200	S316-6200-2PES	62	39	1.7
	35	11	S316-6300	S316-6300-2PES	99	56	1.6
12	21	5	S316-6801	S316-6801-2PES	24	17	2.3
	24	6	S316-6901	S316-6901-2PES	37	23	2.2
	28	8	S316-6001	S316-6001-2PES	62	39	1.9
	32	10	S316-6201	S316-6201-2PES	83	49	1.6
	37	12	S316-6301	S316-6301-2PES	119	68	1.5
15	24	5	S316-6802	S316-6802-2PES	26	20	2
	28	7	S316-6902	S316-6902-2PES	55	36	1.7
	32	9	S316-6002	S316-6002-2PES	68	46	1.6
	35	11	S316-6202	S316-6202-2PES	93	61	1.4
	42	13	S316-6302	S316-6302-2PES	140	89	1.4

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric 316 Stainless Steel

Marine grade highly corrosion resistant ball bearings

These semi-precision bearings are resistant to seawater and many chemicals. The cages and non-contact seals are polyethylene but can be offered in PEEK or PTFE. Full complement types can be used in very high temperatures and cryogenic applications. As 316 is softer than 440 grade steel, these bearings are only suitable for low loads and speeds.



316 STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

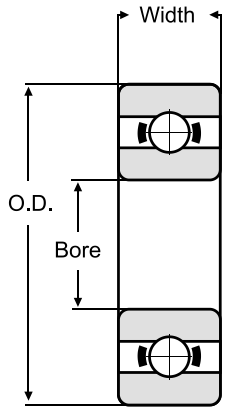
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
	26	5	S316-6803	S316-6803-2PES	28	23	1.8
	30	7	S316-6903	S316-6903-2PES	58	41	1.5
17	35	10	S316-6003	S316-6003-2PES	73	54	1.4
	40	12	S316-6203	S316-6203-2PES	117	79	1.3
	47	14	S316-6303	S316-6303-2PES	166	109	1.1
	32	7	S316-6804	S316-6804-2PES	51	39	1.4
	37	9	S316-6904	S316-6904-2PES	80	58	1.3
20	42	12	S316-6004	S316-6004-2PES	115	83	1.3
	47	14	S316-6204	S316-6204-2PES	157	109	1.1
	52	15	S316-6304	S316-6304-2PES	194	129	1
	37	7	S316-6805	S316-6805-2PES	54	46	1.2
	42	9	S316-6905	S316-6905-2PES	94	72	1.1
25	47	12	S316-6005	S316-6005-2PES	123	96	1.1
	52	15	S316-6205	S316-6205-2PES	171	128	0.9
	62	17	S316-6305	S316-6305-2PES	252	185	0.8
	42	7	S316-6806	S316-6806-2PES	58	46	1.1
	47	9	S316-6906	S316-6906-2PES	104	80	1
30	55	13	S316-6006	S316-6006-2PES	162	135	0.9
	62	16	S316-6206	S316-6206-2PES	238	184	0.8
	72	19	S316-6306	S316-6306-2PES	326	247	0.7
	47	7	S316-6807	S316-6807-2PES	76	61	1
	55	10	S316-6907	S316-6907-2PES	153	124	0.9
35	62	14	S316-6007	S316-6007-2PES	195	168	0.8
	72	17	S316-6207	S316-6207-2PES	314	252	0.7
	80	21	S316-6307	S316-6307-2PES	401	309	0.6

See "Engineering Data - Load Rating" for guidance on recommended loads.

Metric 316 Stainless Steel

Marine grade highly corrosion resistant ball bearings

These semi-precision bearings are resistant to seawater and many chemicals. The cages and non-contact seals are polyethylene but can be offered in PEEK or PTFE. Full complement types can be used in very high temperatures and cryogenic applications. As 316 is softer than 440 grade steel, these bearings are only suitable for low loads and speeds.



316 STAINLESS STEEL ***Dimensions in mm unless otherwise specified***

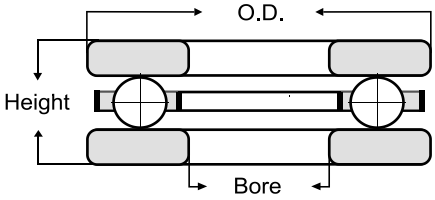
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
	52	7	S316-6808	S316-6808-2PES	78	66	0.9
	62	12	S316-6908	S316-6908-2PES	174	158	0.8
40	68	15	S316-6008	S316-6008-2PES	205	188	0.7
	80	18	S316-6208	S316-6208-2PES	356	299	0.6
	90	23	S316-6308	S316-6308-2PES	488	384	0.5
	58	7	S316-6809	S316-6809-2PES	101	86	0.7
	68	12	S316-6909	S316-6909-2PES	194	172	0.7
45	75	16	S316-6009	S316-6009-2PES	218	197	0.6
	85	19	S316-6209	S316-6209-2PES	333	261	0.5
	100	25	S316-6309	S316-6309-2PES	587	472	0.4
	65	7	S316-6810	S316-6810-2PES	108	92	0.7
	72	12	S316-6910	S316-6910-2PES	198	176	0.6
50	80	16	S316-6010	S316-6010-2PES	223	212	0.6
	90	20	S316-6210	S316-6210-2PES	357	298	0.5
	110	27	S316-6310	S316-6310-2PES	744	459	0.4

See "Engineering Data - Load Rating" for guidance on recommended loads.

Three part thrust - flat washers

Miniature thrust bearings without raceways for axial loads in both directions

These bearings can accept only axial loads in both directions but have a smaller load capacity than the grooved washer type and are for low speed use only. They are supplied in chrome steel with a brass retainer.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

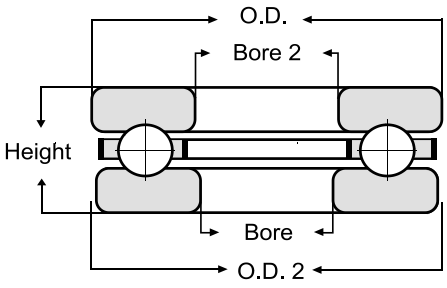
Bore	O.D.	Height	Flat Washers	Max Load (kgf) Dyn	Stat
2	6	3	**F2-6**	14	8
3	8	4	**F3-8**	21	14
4	10	5	**F4-10**	36	24
5	11	5	**F5-11**	34	25
6	12	5	**F6-12**	39	31
7	15	5	**F7-15**	79	63
8	16	5	**F8-16**	54	44
9	17	5	**F9-17**	57	50
10	18	6	**F10-18**	80	71

See "Engineering Data - Load Rating" for guidance on recommended loads.

Three part thrust - grooved washers

Miniature thrust bearings with raceways for axial loads in one direction only

These bearings can accept only axial loads in one direction due to different sized washers. They have a much greater load and speed capacity than the flat washer type. They are supplied in chrome steel with a brass or 304 stainless steel retainer.



CHROME STEEL ***Dimensions in mm unless otherwise specified***

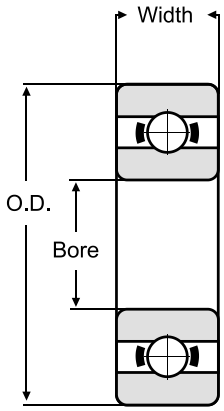
Bore	Bore2	O.D.	O.D.2	Height	Flat Washers	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
3	3.2	8	7.8	4	F3-8G	99	93	24
4	4.2	9	8.8	4	F4-9G	94	93	22
	4.2	10	9.8	4	F4-10G	92	93	21
5	5.2	10	9.8	4	F5-10G	92	93	21
	5.2	12	11.8	4	F5-12G	106	124	19
6	6.2	12	11.8	5	F6-12G	182	222	18
	6.2	13	12.8	5	F6-13G	182	222	18
	6.2	14	13.8	5	F6-14G	216	244	16
7	7.2	13	12.8	5	F7-13G	177	222	18
	7.2	17	16.8	6	F7-17G	309	380	14
8	8.2	16	15.8	5	F8-16G	392	499	16
	8.2	19	18.8	7	F8-19G	394	497	12
9	9.2	20	19.8	7	F9-20G	386	497	12
10	10.2	18	17.8	6	F10-18G	247	349	14

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Miniature

Miniature bearings

These are sometimes referred to as instrument bearings or micro bearings. We provide miniature bearings for applications as varied as gyros, anemometers, miniature gearboxes, small motors and radio controlled models. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.0937	0.1875	0.0625	R133			19	6	95
	0.1875	0.0937		R133ZZ		19	6	95
0.125	0.25	0.0937	R144			28	10	80
	0.25	0.1094		R144ZZ		28	10	80
	0.3125	0.1094	R2-5	R2-5ZZ		56	18	67
	0.3125	0.1406				56	18	67
	0.375	0.1094	R2-6			64	23	63
	0.375	0.1406		R2-6ZZ		64	23	63
	0.375	0.1562	R2	R2ZZ	R2-2RS	63	22	67
	0.5	0.1719	R2A	R2AZZ	R2A-2RS	64	28	63
0.1562	0.3125	0.1094	R155			36	15	63
	0.3125	0.125		R155ZZ		36	15	63
0.1875	0.3125	0.1094	R156			36	15	63
	0.3125	0.125		R156ZZ		36	15	63
	0.375	0.125	R166	R166ZZ	R166-2RS	71	27	60
	0.5	0.1562	R3			130	49	53
	0.5	0.196		R3ZZ	R3-2RS	130	49	53
	0.625	0.196	R3A	R3AZZ	R3A-2RS	148	62	45
	0.6875	0.25	1601	1601ZZ		153	64	43
	0.6875	0.3125			1601-2RS	153	64	26
0.25	0.375	0.125	R168	R168ZZ	R168-2RS	37	17	56
	0.5	0.125	R188			108	44	50
	0.5	0.1875		R188ZZ	R188-2RS	108	44	50
	0.625	0.196	R4	R4ZZ	R4-2RS	148	62	45
	0.6875	0.25	1602	1602ZZ		171	78	42
	0.6875	0.3125			1602-2RS	171	78	25
	0.75	0.2188	R4A			234	90	43
	0.75	0.2812		R4AZZ	R4A-2RS	234	90	43

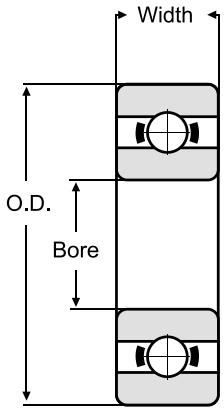
* *Some types may be available with non-contact seals or teflon seals*
** *Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Miniature

Miniature bearings

These are sometimes referred to as instrument bearings or micro bearings. We provide miniature bearings for applications as varied as gyros, anemometers, miniature gearboxes, small motors and radio controlled models. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.3125	0.5	0.1562	R1810	R1810ZZ	R1810-2RS	54	28	48
	0.875	0.2812	1603	1603ZZ		317	135	37
	0.875	0.3438			1603-2RS	317	135	22
	0.9062	0.3125	1605	1605ZZ	1605-2RS	317	135	37
0.375	0.625	0.1562	R1038	R1038ZZ	R1038-2RS	85	42	33
	0.875	0.2188	R6		R6-2RSW21	333	142	23
	0.875	0.2812		R6ZZ	R6-2RS	333	142	38
	0.875	0.2812	1604	1604ZZ		322	139	36
	0.875	0.3438			1604-2RS	322	139	22
	0.9062	0.3125	1606	1606ZZ	1606-2RS	322	139	36
	1.125	0.3750	1614	1614ZZ	1614-2RS	468	219	32
0.4375	0.9062	0.3125	1607	1607ZZ	1607-2RS	244	122	34
	1.125	0.3750	1615	1615ZZ	1615-2RS	468	219	32
	1.375	0.4375	1620	1620ZZ	1620-2RS	742	316	24
0.5	0.75	0.1562	R1212	R1212ZZ	R1212-2RS	78	45	27
	1.125	0.25	R8			511	241	32
	1.125	0.3125		R8ZZ	R8-2RS	511	241	32
	1.125	0.375	1616	1616ZZ	1616-2RS	498	231	30
	1.375	0.4375	1621	1621ZZ	1621-2RS	718	346	24
0.5625	1.375	0.4375	1622	1622ZZ	1622-2RS	718	346	24
0.625	1.375	0.2812	R10			599	329	25
	1.375	0.3438		R10ZZ	R10-2RS	599	329	25
	1.375	0.4375	1623	1623ZZ	1623-2RS	588	312	22
	1.625	0.5	1628	1628ZZ	1628-2RS	886	412	18
0.75	1.625	0.3125	R12	R12ZZ	R12-2RS	938	506	21
	1.625	0.4375				938	506	21
	1.625	0.5	1630	1630ZZ	1630-2RS	780	428	20

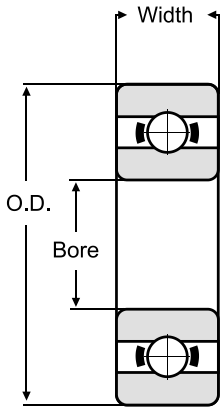
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Miniature

Miniature bearings

These are sometimes referred to as instrument bearings or micro bearings. We provide miniature bearings for applications as varied as gyros, anemometers, miniature gearboxes, small motors and radio controlled models. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.875	1.875	0.375	R14			1080	576	18
	1.875	0.5		R14ZZ	R14-2RS	1080	576	18
1	2	0.375	R16			1150	700	16
	2	0.5		R16ZZ	R16-2RS	1150	700	16

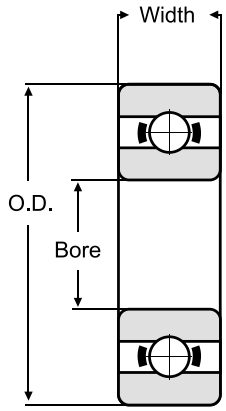
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Stainless Steel Miniature

Corrosion resistant miniature bearings

These miniature bearings are designed for use in mildly corrosive conditions or for high temperatures with a suitable lubricant. We provide stainless steel miniature bearings for a wide range of applications. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.04	0.125	0.0469	SR09			8	2	150
0.0469	0.1562	0.0625	SR0			9	3	130
	0.1562	0.0937		SR0ZZ		9	3	130
0.055	0.1875	0.0781	SR1			19	5	110
	0.1875	0.1094		SR1ZZ		19	5	110
0.0781	0.25	0.0937	SR1-4			23	7	80
	0.25	0.1406		SR1-4ZZ		23	7	80
0.0937	0.1875	0.0625	SR133			15	5	95
	0.1875	0.0937		SR133ZZ		15	5	95
	0.3125	0.1094	SR1-5			44	14	71
	0.3125	0.1406		SR1-5ZZ		44	14	71
0.125	0.25	0.0937	SR144	SR144ZZW09		23	8	80
	0.25	0.1094		SR144ZZ		23	8	67
	0.3125	0.1094	SR2-5	SR2-5ZZW10		45	14	67
	0.3125	0.1406		SR2-5ZZ		45	14	60
	0.375	0.1094	SR2-6	SR2-6ZZW10		51	17	63
	0.375	0.1406		SR2-6ZZ		51	17	53
	0.375	0.1562	SR2	SR2ZZ	SR2-2RS	50	17	67
	0.5	0.1094	SR184	SR184ZZ		52	17	67
	0.5	0.1719	SR2A	SR2AZZ	SR2A-2RS	51	21	63
0.1562	0.3125	0.1094	SR155			29	11	63
	0.3125	0.125		SR155ZZ		29	11	63
0.1875	0.3125	0.1094	SR156			29	11	63
	0.3125	0.125		SR156ZZ		29	11	63
	0.375	0.125	SR166	SR166ZZ	SR166-2RS	57	20	60
	0.5	0.1562	SR3	SR3ZZW15	SR3-2RS	104	37	53
	0.5	0.196		SR3ZZ	SR3-2RSW15	104	37	43

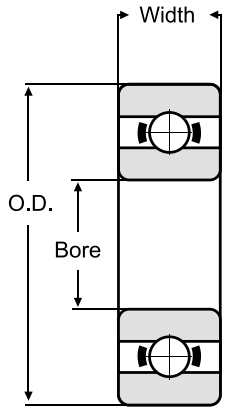
** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Stainless Steel Miniature

Corrosion resistant miniature bearings

These miniature bearings are designed for use in mildly corrosive conditions or for high temperatures with a suitable lubricant. We provide stainless steel miniature bearings for a wide range of applications. These bearings are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Open Bearing	Shielded Bearing	Sealed Bearing *	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.25	0.375	0.125	SR168	SR168ZZ	SR168-2RS	31	14	56
	0.5	0.125	SR188	SR188ZZW12		86	33	50
	0.5	0.1875		SR188ZZ	SR188-2RS	86	33	40
	0.625	0.196	SR4	SR4ZZ	SR4-2RS	118	47	45
	0.75	0.2188	SR4A			187	68	43
	0.75	0.2812		SR4AZZ	SR4A-2RS	187	68	43
0.3125	0.5	0.1562	SR1810	SR1810ZZ	SR1810-2RS	43	21	48
0.375	0.625	0.1562	SR1038	SR1038ZZ	SR1038-2RS	72	37	33
	0.875	0.2188	SR6			266	107	38
	0.875	0.2812		SR6ZZ	SR6-2RS	266	107	38
0.5	0.75	0.1562	SR1212	SR1212ZZ	SR1212-2RS	62	34	27
	0.75	0.196		SR1212ZZW19		62	34	23
	0.875	0.2188	SR6-1/2			232	93	36
	0.875	0.2812		SR6ZZ-1/2		232	93	36
	1.125	0.25	SR8			409	181	32
	1.125	0.3125		SR8ZZ	SR8-2RS	409	181	32
0.625	0.875	0.1562	SR1458	SR1458ZZ	SR1458-2RS	82	50	23
	1.375	0.2812	SR10			479	247	25
	1.375	0.3438		SR10ZZ	SR10-2RS	479	247	25
0.75	1	0.1562	SR1634	SR1634ZZ	SR1634-2RS	86	55	20
	1.625	0.3125	SR12			750	380	21
	1.625	0.4375		SR12ZZ	SR12-2RS	750	380	21
0.875	1.875	0.375	SR14			864	432	18
	1.875	0.5		SR14ZZ	SR14-2RS	864	432	18
1	2	0.375	SR16			920	525	16
	2	0.5		SR16ZZ	SR16-2RS	920	525	16

** Some types may be available with non-contact seals or teflon seals*
*** Reduce maximum Rpm by 40% for 2RS types.*

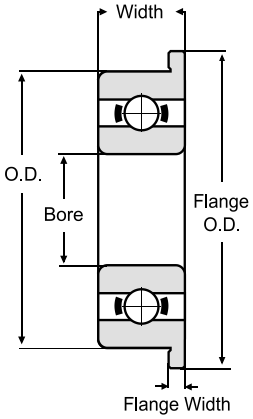
See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Flanged Miniature

Flanged miniature bearings

The flange allows easier location in a housing. The smaller sizes are sometimes referred to as instrument bearings or micro bearings. These bearings are supplied in chrome steel.

For load/speed ratings, refer to non-flanged.



CHROME STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing **
0.125	0.375	0.1562	0.44	0.03	**FR2**	**FR2ZZ**	**FR2-2RS**
0.1875	0.3125	0.1094	0.359	0.023	**FR156**		
	0.3125	0.125	0.359	0.036		**FR156ZZ**	
	0.5	0.1562	0.565	0.042	**FR3**		
	0.5	0.196	0.565	0.042		**FR3ZZ**	**FR3-2RS**
0.25	0.375	0.125	0.422	0.023	**FR168**	**FR168ZZ**	
	0.5	0.125	0.547	0.023	**FR188**		
	0.5	0.1875	0.547	0.045		**FR188ZZ**	
	0.625	0.196	0.69	0.042	**FR4**	**FR4ZZ**	**FR4-2RS**
0.375	0.875	0.2188	0.969	0.062	**FR6**		
	0.875	0.2812	0.969	0.062		**FR6ZZ**	**FR6-2RS**
0.5	1.125	0.25	1.225	0.062	**FR8**		
	1.125	0.3125	1.225	0.062		**FR8ZZ**	**FR8-2RS**
0.625	1.375	0.2812	1.49	0.0687	**FR10**		
	1.375	0.3438	1.49	0.0687		**FR10ZZ**	**FR10-2RS**

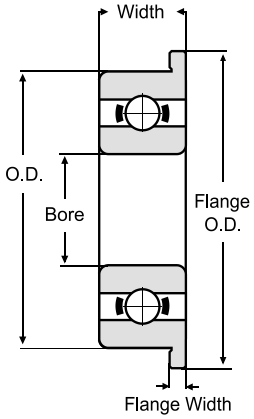
* ***Some sizes may be available with non-contact seals or teflon seals***

Inch Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing **
0.04	0.125	0.0469	0.171	0.013	SFR09		
0.0469	0.1562	0.6250	0.203	0.013	SFR0		
	0.1562	0.0937	0.203	0.031		SFR0ZZ	
0.055	0.1875	0.0781	0.234	0.023	SFR1		
	0.1875	0.1094	0.234	0.031		SFR1ZZ	
0.0781	0.25	0.0937	0.296	0.023	SFR1-4		
	0.25	0.1406	0.296	0.031		SFR1-4ZZ	
0.0937	0.1875	0.0625	0.234	0.018	SFR133		
	0.1875	0.0937	0.234	0.031		SFR133ZZ	
	0.3125	0.1094	0.359	0.023	SFR1-5		
	0.3125	0.1406	0.359	0.031		SFR1-5ZZ	
0.125	0.25	0.0937	0.296	0.023	SFR144		
	0.25	0.1094	0.296	0.031		SFR144ZZ	
	0.3125	0.1094	0.359	0.023	SFR2-5		
	0.3125	0.1406	0.359	0.031		SFR2-5ZZ	
	0.375	0.1094	0.422	0.023	SFR2-6		
	0.375	0.1406	0.422	0.031		SFR2-6ZZ	
	0.375	0.1562	0.44	0.030	SFR2	SFR2ZZ	SFR2-2RS
0.1562	0.3125	0.1094	0.359	0.023	SFR155		
	0.3125	0.125	0.359	0.036		SFR155ZZ	
0.1875	0.3125	0.1094	0.359	0.023	SFR156		
	0.3125	0.125	0.359	0.036		SFR156ZZ	
	0.375	0.125	0.422	0.023	SFR166		
	0.375	0.125	0.422	0.031		SFR166ZZ	SFR166-2RS
	0.5	0.1562	0.565	0.042	SFR3		
	0.5	0.196	0.565	0.042	SFR3W19	SFR3ZZ	SFR3-2RS

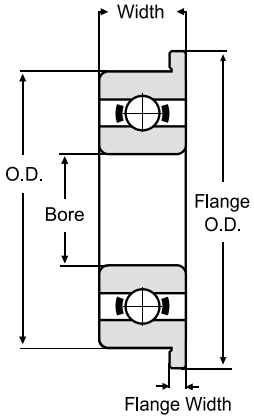
* *Some sizes may be available with non-contact seals or teflon seals*

Inch Stainless Steel Flanged Miniature

Corrosion resistant flanged miniature bearings

For use in mildly corrosive conditions or for high temperatures. The flange allows easier location in a housing. These bearings are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

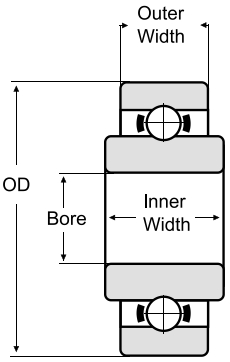
Bore	O.D.	Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing	Sealed Bearing **
0.25	0.375	0.125	0.422	0.023	SFR168		
	0.375	0.125	0.422	0.036		SFR168ZZ	SFR168-2RS
	0.5	0.125	0.547	0.023	SFR188		
	0.5	0.1875	0.547	0.045		SFR188ZZ	SFR188-2RS
	0.625	0.196	0.69	0.042	SFR4	SFR4ZZ	SFR4-2RS
0.3125	0.5	0.1562	0.547	0.031	SFR1810	SFR1810ZZ	SFR1810-2RS
0.375	0.875	0.2188	0.969	0.062	SFR6		
	0.875	0.2812	0.969	0.062		SFR6ZZ	SFR6-2RS
0.5	1.125	0.25	1.225	0.062	SFR8		
	1.125	0.3125	1.225	0.062		SFR8ZZ	SFR8-2RS

* ***Some sizes may be available with non-contact seals or teflon seals***

Inch Extended Inner Ring

Corrosion resistant miniature bearings with extended inner ring

With an inner ring wider than the outer ring by 0.0312", these bearings are easier to mount with no need for spacers or washers. These are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

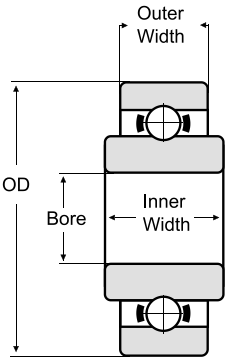
Bore	O.D.	Inner Width	Outer Width	Open Bearing	Shielded Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.0469	0.1562	0.0625	0.0937	SRW0		9	3	130
	0.1562	0.937	0.125		SRW0ZZ	9	3	130
0.055	0.1875	0.0781	0.1094	SRW1		19	5	110
	0.1875	0.1094	0.1406		SRW1ZZ	19	5	110
0.0781	0.25	0.0937	0.125	SRW1-4		23	7	80
	0.25	0.1406	0.1719		SRW1-4ZZ	23	7	80
0.0937	0.1875	0.0625	0.0937	SRW133		15	5	95
	0.1875	0.0937	0.125		SRW133ZZ	15	5	95
	0.3125	0.1094	0.1406	SRW1-5		44	14	71
	0.3125	0.1406	0.1719		SRW1-5ZZ	44	14	71
0.125	0.25	0.0937	0.125	SRW144		23	8	80
	0.25	0.1094	0.1406		SRW144ZZ	23	8	80
	0.3125	0.1094	0.1406	SRW2-5		45	14	67
	0.3125	0.1406	0.1719		SRW2-5ZZ	45	14	67
	0.375	0.1094	0.1406	SRW2-6		51	17	63
	0.375	0.1406	0.1719		SRW2-6ZZ	51	17	63
	0.375	0.1562	0.1875	SRW2	SRW2ZZ	50	17	67
0.1562	0.3125	0.1094	0.1406	SRW155		29	11	63
	0.3125	0.125	0.1562		SRW155ZZ	29	11	63
0.1875	0.3125	0.1094	0.1406	SRW156		29	11	63
	0.3125	0.125	0.1562		SRW156ZZ	29	11	63
	0.375	0.125	0.1562	SRW166	SRW166ZZ	57	20	60
	0.5	0.1562	0.1875	SRW3		104	37	53
	0.5	0.196	0.2272		SRW3ZZ	104	37	53

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Extended Inner Ring

Corrosion resistant miniature bearings with extended inner ring

With an inner ring wider than the outer ring by 0.0312", these bearings are easier to mount with no need for spacers or washers. These are supplied in 440 grade stainless steel.



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Inner Width	Outer Width	Open Bearing	Shielded Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm ** (x1000)
0.25	0.375	0.125	0.1562	SRW168	SRW168ZZ	31	14	56
	0.5	0.125	0.1562	SRW188		86	33	50
	0.5	0.1875	0.2188		SRW188ZZ	86	33	50
	0.625	0.196	0.2272	SRW4	SRW4ZZ	118	47	45
0.3125	0.5	0.1562	0.1875	SRW1810	SRW1810ZZ	43	21	48

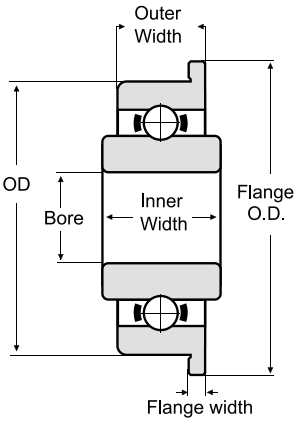
See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Flanged Extended Inner Ring

Corrosion resistant flanged miniature bearings with extended inner ring

With an inner ring wider than the outer ring by 0.0312", these bearings are easier to mount with no need for spacers or washers. The flange allows easier location in a housing. These are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

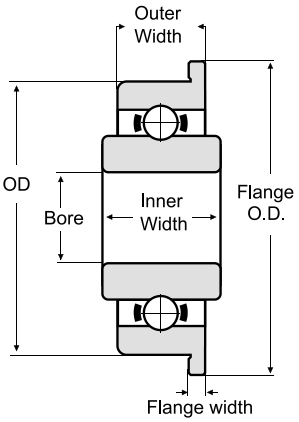
Bore	O.D.	Inner Width	Outer Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing
0.0469	0.1562	0.203	0.013	0.0625	0.0937	SFRW0	
	0.1562	0.203	0.031	0.0937	0.125		SFRW0ZZ
0.055	0.1875	0.234	0.023	0.0781	0.1094	SFRW1	
	0.1875	0.234	0.031	0.1094	0.1406		SFRW1ZZ
0.0781	0.25	0.296	0.023	0.0937	0.125	SFRW1-4	
	0.25	0.296	0.031	0.1406	0.1719		SFRW1-4ZZ
0.0937	0.1875	0.234	0.018	0.0625	0.0937	SFRW133	
	0.1875	0.234	0.031	0.0937	0.125		SFRW133ZZ
	0.3125	0.359	0.023	0.1094	0.1406	SFRW1-5	
	0.3125	0.359	0.031	0.1406	0.1719		SFRW1-5ZZ
0.125	0.25	0.296	0.023	0.0937	0.125	SFRW144	
	0.25	0.296	0.031	0.1094	0.1406		SFRW144ZZ
	0.3125	0.359	0.023	0.1094	0.1406	SFRW2-5	
	0.3125	0.359	0.031	0.1406	0.1719		SFRW2-5ZZ
	0.375	0.422	0.023	0.1094	0.1406	SFRW2-6	
	0.375	0.422	0.031	0.1406	0.1719		SFRW2-6ZZ
	0.375	0.44	0.03	0.1562	0.1875	SFRW2	SFRW2ZZ
0.1562	0.3125	0.359	0.023	0.1094	0.1406	SFRW155	
	0.3125	0.359	0.036	0.125	0.1562		SFRW155ZZ
0.1875	0.3125	0.359	0.023	0.1094	0.1406	SFRW156	
	0.3125	0.359	0.036	0.125	0.1562		SFRW156ZZ
	0.375	0.422	0.023	0.125	0.1562	SFRW166	
	0.375	0.422	0.031	0.125	0.1562		SFRW166ZZ
	0.5	0.565	0.042	0.1562	0.1875	SFRW3	
	0.5	0.565	0.042	0.196	0.2272		SFRW3ZZ

Inch Flanged Extended Inner Ring

Corrosion resistant flanged miniature bearings with extended inner ring

With an inner ring wider than the outer ring by 0.0312", these bearings are easier to mount with no need for spacers or washers. The flange allows easier location in a housing. These are supplied in 440 grade stainless steel.

For load/speed ratings, refer to non-flanged



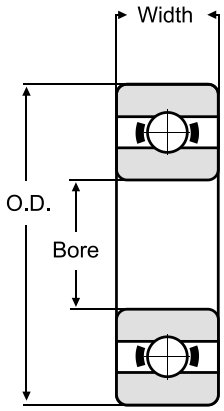
STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Inner Width	Outer Width	Flange O.D.	Flange Width	Open Bearing	Shielded Bearing
	0.375	0.422	0.023	0.125	0.1562	SFRW168	
	0.375	0.422	0.036	0.125	0.1562		SFRW168ZZ
0.25	0.5	0.547	0.023	0.125	0.1562	SFRW188	
	0.5	0.547	0.045	0.1875	0.2188		SFRW188ZZ
	0.625	0.690	0.042	0.196	0.2272	SFRW4	SFRW4ZZ
0.3125	0.5	0.547	0.031	0.1562	0.1875	SFRW1810	SFRW1810ZZ

Inch Plastic

Semi-precision plastic bearings

These bearings have POM-C acetal rings and PA66 nylon cages. For greater chemical resistance or high temperatures, many sizes can be supplied in PTFE, PEEK or PVDF. Plastic bearings are only suitable for low loads and low speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.



ACETAL RESIN ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	316 Stainless Steel Balls	Glass Balls	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
0.125	0.375	0.1562	**ACR2-316**	**ACR2-GL**	5	3	3
0.1875	0.5	0.1562	**ACR3-316**	**ACR3-GL**	7	5	3
0.25	0.625	0.196	**ACR4-316**	**ACR4-GL**	8	6	2.6
	0.75	0.2188	**ACR4A-316**	**ACR4A-GL**	9	7	2.6
0.375	0.875	0.2188	**ACR6-316**	**ACR6-GL**	12	9	2.6
0.5	1.125	0.25	**ACR8-316**	**ACR8-GL**	16	13	1.8
0.625	1.375	0.2812	**ACR10-316**	**ACR10-GL**	18	15	1.6
0.75	1.625	0.3125	**ACR12-316**	**ACR12-GL**	24	19	1.2
0.875	1.875	0.375	**ACR14-316**	**ACR14-GL**	29	22	1.2
1	2	0.375	**ACR16-316**	**ACR16-GL**	37	29	1.1

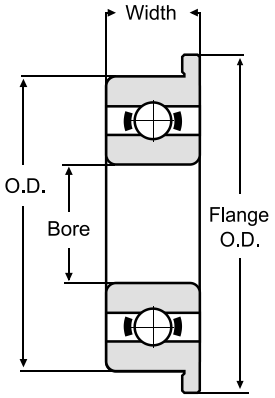
See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Plastic Flanged

Semi-precision flanged plastic bearings

These acetal bearings with nylon cages have a flanged outer ring for easier location in a housing. They are only suitable for low loads and speeds. Inner and outer ring tolerances on these bearings are +/- 0.1mm.

For load/speed ratings, refer to non-flanged



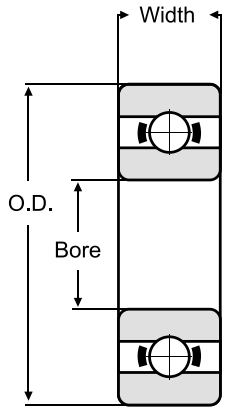
ACETAL RESIN ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Width	Flange O.D.	316 Stainless Steel Balls	Glass Balls
0.125	0.375	0.1562	0.44	**ACFR2-316**	**ACFR2-GL**
0.1875	0.5	0.1562	0.565	**ACFR3-316**	**ACFR3-GL**
0.25	0.625	0.196	0.69	**ACFR4-316**	**ACFR4-GL**
0.375	0.875	0.2188	0.969	**ACFR6-316**	**ACFR6-GL**
0.5	1.125	0.25	1.225	**ACFR8-316**	**ACFR8-GL**
0.625	1.375	0.2812	1.49	**ACFR10-316**	**ACFR10-GL**

Inch Ceramic - ZrO2

Full ceramic zirconia bearings

For highly corrosive conditions, high temperatures, marine applications and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK seals but they can also be supplied with PTFE seals.



ZIRCONIA ***Dimensions in inches unless otherwise specified***

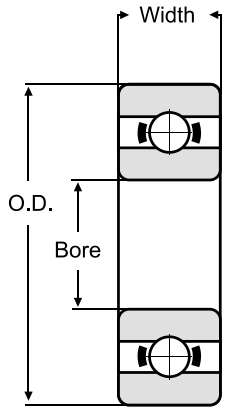
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
0.125	0.375	0.1562	CCZR-R2	CCZR-R2-2PKS	47	17	14
0.1875	0.5	0.1562	CCZR-R3		97	37	11
	0.5	0.196		CCZR-R3-2PKS	97	37	11
0.25	0.625	0.196	CCZR-R4	CCZR-R4-2PKS	109	46	9
	0.75	0.2188	CCZR-R4A		174	68	8.5
	0.75	0.2812		CCZR-R4A-2PKS	174	68	8.5
0.375	0.875	0.2188	CCZR-R6		253	104	8
	0.875	0.2812		CCZR-R6-2PKS	253	104	8
0.5	1.125	0.25	CCZR-R8		391	183	6.4
	1.125	0.3125		CCZR-R8-2PKS	391	183	6.4
0.625	1.375	0.2812	CCZR-R10		443	248	5
	1.375	0.3438		CCZR-R10-2PKS	443	248	5
0.75	1.625	0.3125	CCZR-R12		586	334	4.2
	1.625	0.4375		CCZR-R12-2PKS	586	334	4.2
0.875	1.875	0.375	CCZR-R14		810	433	3.6
	1.875	0.5		CCZR-R14-2PKS	810	433	3.6
1	2	0.375	CCZR-R16		862	525	3.2
	2	0.5		CCZR-R16-2PKS	862	525	3.2

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Ceramic - Si3N4

Full ceramic silicon nitride bearings

For highly corrosive conditions, very high temperatures and other specialist applications, these bearings have ceramic rings and balls. They are available as full complement or with cages made from PEEK, PTFE or 316 stainless steel. The bearings listed below are open or have PEEK seals but they can also be supplied with PTFE seals.



SILICON NITRIDE ***Dimensions in inches unless otherwise specified***

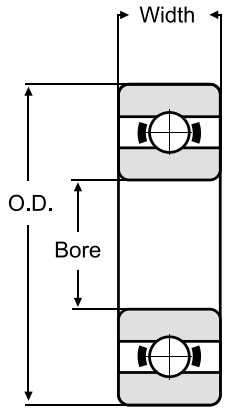
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
0.125	0.375	0.1562	CCSI-R2	CCSI-R2-2PKS	40	15	17
0.1875	0.5	0.1562	CCSI-R3		82	32	14
	0.5	0.196		CCSI-R3-2PKS	82	32	14
0.25	0.625	0.196	CCSI-R4	CCSI-R4-2PKS	83	40	11
	0.75	0.2188	CCSI-R4A		149	58	10.5
	0.75	0.2812		CCSI-R4A-2PKS	149	58	10.5
0.375	0.875	0.2188	CCSI-R6		216	89	10
	0.875	0.2812		CCSI-R6-2PKS	216	89	10
0.5	1.125	0.25	CCSI-R8		333	156	8
	1.125	0.3125		CCSI-R8-2PKS	333	156	8
0.625	1.375	0.2812	CCSI-R10		377	212	6.2
	1.375	0.3438		CCSI-R10-2PKS	377	212	6.2
0.75	1.625	0.3125	CCSI-R12		498	289	5.2
	1.625	0.4375		CCSI-R12-2PKS	498	289	5.2
0.875	1.875	0.375	CCSI-R14		689	370	4.5
	1.875	0.5		CCSI-R14-2PKS	689	370	4.5
1	2	0.375	CCSI-R16		733	447	4
	2	0.5		CCSI-R16-2PKS	733	447	4

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch 316 Stainless Steel

Marine grade highly corrosion resistant ball bearings

These semi-precision bearings are resistant to seawater and many chemicals. The cages and non-contact seals are polyethylene but can be offered in PEEK or PTFE. Full complement types can be used in very high temperatures and cryogenic applications. As 316 is softer than 440 grade steel, these bearings are only suitable for low loads and speeds.



316 STAINLESS STEEL ***Dimensions in inches unless otherwise specified***

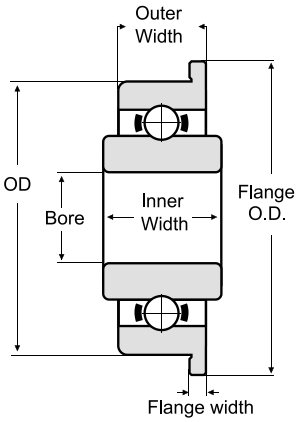
Bore	O.D.	Width	Open Bearing	Sealed Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
0.125	0.375	0.1562	**S316-R2**	**S316-R2-2PES**	8	4	4.2
0.1875	0.5	0.1562	**S316-R3**		16	8	3.2
	0.5	0.196		**S316-R3-2PES**	16	8	3.2
0.25	0.625	0.196	**S316-R4**	**S316-R4-2PES**	27	14	2.7
	0.75	0.2188	**S316-R4A**		28	14	2.4
	0.75	0.2812		**S316-R4A-2PES**	28	14	2.4
0.375	0.875	0.2188	**S316-R6**		40	23	1.9
	0.875	0.2812		**S316-R6-2PES**	40	23	1.9
0.5	1.125	0.25	**S316-R8**		61	38	1.5
	1.125	0.3125		**S316-R8-2PES**	61	38	1.5
0.625	1.375	0.2812	**S316-R10**		72	39	1.2
	1.375	0.3438		**S316-R10-2PES**	72	39	1.2
0.75	1.625	0.3125	**S316-R12**		95	71	1
	1.625	0.4375		**S316-R12-2PES**	95	71	1
0.875	1.875	0.375	**S316-R14**		130	92	0.9
	1.875	0.5		**S316-R14-2PES**	130	92	0.9
1	2	0.375	**S316-R16**		138	112	0.8
	2	0.5		**S316-R16-2PES**	138	112	0.8

See "Engineering Data - Load Rating" for guidance on recommended loads.

Inch Taper O.D.

Miniature bearings with tapered outer ring

Taper O.D. bearings have a flange on the outer ring, a wider inner ring and an outer ring that is slightly tapered for fitting into soft steel or sheet metal. The outer ring tapers at 0.068 inches per foot. These bearings are supplied in chrome steel.



CHROME STEEL ***Dimensions in inches unless otherwise specified***

Bore	O.D.	Inner Width	Outer Width	Flange O.D.	Flange Width	Shielded Bearing	Max Load (kgf) Dyn	Max Load (kgf) Stat	Rpm (x1000)
0.1875	0.5632	0.625	0.163	0.188	0.042	**F3ZZ**	126	47	43
0.25	0.6257	0.687	0.226	0.25	0.042	**F4ZZ**	142	59	38
0.3125	0.6882	0.750	0.226	0.25	0.042	**F5ZZ**	190	68	35

See "Engineering Data - Load Rating" for guidance on recommended loads.

Relubrication services

Cleaning and relubrication of open, shielded, sealed ball and roller bearings.

We offer a full relubrication service for our own range of bearings and customer supplied bearings. We have many years' experience of degreasing and relubricating bearings with SMB-recommended or customer-specified lubricants. Every day, our customers require bearings with specialised greases and oils designed to handle everything from food safe applications to low torque conditions. We regularly supply bearings with:

cleanroom lubricants
solid polymer lubricants
food safe greases
extreme temperature lubricants
low torque lubricants
molybdenum disulphide coating
tungsten disulphide coating
chemically resistant lubricants
radiation-resistant lubricants
vacuum lubricants
waterproof greases

SAMPLES AT SHORT NOTICE

Manufacturers are rarely interested in small volumes of bearings with non-standard lubricants but we can help. We have a range of degreasing methods to clean all bearing surfaces before using proprietary lubrication equipment to apply your choice of oil, grease or dry lubricant.

Whether you need to re-lubricate a high precision miniature bearing with instrument oil or re-grease a deep groove ball bearing for a vacuum application, we have the equipment to do it.

WE CAN RELUBRICATE BEARINGS WITH NON-REMOVABLE SHIELDS

We can control the lubrication to within a few milligrams so if you require a specific grease fill, we can handle it.

We have been relubricating bearings for over 25 years so our experience with different types of customer-supplied bearings is comprehensive. We have the technical expertise to handle cylindrical and needle roller bearings, plain spherical bearings, thin section bearings and miniature ball bearings from customers worldwide.

We have also developed a system to clean and lubricate bearings without removing the shields so we can process open, shielded and rubber sealed bearings.

WE OFFER EXPERT LUBRICATION ADVICE

We can advise you on the best choice of bearing lubricant for problem applications. If you are involved in testing or R&D, our in-house ultrasonic bearing degreasing and relubrication facility enables us to supply bearing samples at short notice.

If you want to know more about our bearing relubrication capabilities, please ask.

Engineering Data

The following pages give an overview and detailed explanations of the design and selection criteria for the SMB range of radial and thrust ball bearings.

1. Bearing Materials

STEEL

SAE52100 Chrome Steel (no prefix)

- ☺ Higher hardness so longer life ratings
- ☺ Lower cost
- ☺ Good for temperatures of 120°C constant up to 150°C intermittent
- ☹ Poor corrosion resistance so not recommended for low temperature use due to condensation risk

This is the standard steel for most ball bearings. It is harder than stainless steel and gives greater life ratings. It also has superior low noise qualities to standard 440 grade stainless steel. Chrome steel actually has a low chromium content and is not corrosion resistant so not suitable for corrosive environments or for dry (no lubricant) bearings as chrome bearings require an oil coating on the bearing surfaces for protection. Chrome steel can tolerate continuous temperatures of up to 120°C. Above this temperature, it undergoes greater dimensional change and the hardness is affected, reducing load capacity. It can withstand up to 150°C intermittently but above this temperature, bearing life is significantly reduced.

440 Grade Martensitic Stainless Steel (prefix "S")

- ☺ Good corrosion resistance to water and many weak chemicals
- ☺ Good for temperatures from -70°C up to 250°C constant or 300°C intermittent
- ☹ Slightly softer than chrome steel so lower load ratings
- ☹ Will corrode in salt water or salt spray and has poor resistance to acids/alkalis
- ☹ More expensive than chrome steel

More resistant to corrosion due to the greater chromium content and the addition of nickel, 440 grade stainless steel is the most commonly used for corrosion resistant ball bearings. The chromium reacts with oxygen in the air to form a chromium oxide layer, known as the passive film, on the surface of the steel. It is hardened by heat treatment and gives a good combination of strength and corrosion resistance. It is magnetic unlike 300 grade austenitic steel.

The load capacity of AISI440 grade is approximately 20% less than chrome steel so life ratings will be slightly reduced. This grade exhibits good corrosion resistant when exposed to fresh water and some weaker chemicals but will corrode in seawater environments or in contact with many aggressive chemicals. KS440/ACD34/X65Cr13 grade stainless steel with a lower carbon content is used by EZO Japan and has greater corrosion resistance, greater load capacity (approx 10% less than chrome steel) and superior low noise qualities to the standard AISI440C grade. 440 grade stainless steel will also withstand higher temperatures than chrome steel, coping with up to 250°C constant and up to 300°C intermittent with reduced load capacity. Above 300°C, bearing life can be considerably shortened.

AISI316 Austenitic Stainless Steel (prefix "S316")

- ☺ Very good corrosion resistance to water, salt water and many chemicals
- ☺ Good for temperatures up to 500°C as full complement type
- ☺ Suitable for cryogenic applications down to -250°C
- ☺ Negligible response to magnetic fields
- ☹ More expensive than 440 grade due to low production quantities.
- ☹ Suitable for very low load and low speed only
- ☹ Not suitable for low noise applications

316 grade stainless steel bearings are used for greater corrosion resistance to seawater, salt spray and some acids/alkalis. They are suitable for very high temperature applications as the steel is useful in temperatures of up to 500°C. They can also be used in cryogenic applications as the steel retains its toughness down to -250°C. 316 stainless steel bearings are also classed as non-magnetic due to their negligible response to a magnetic field.

316 grade stainless steel cannot be hardened by heat treatment and will only support low loads and low speeds. The load and speed ratings of 316 grade bearings are significantly less than the equivalent 440 grade bearings. 316 grade stainless steel exhibits good corrosion resistance in marine environments when used above the waterline or when temporarily submerged if washed down with clean water. It is less suitable when permanently submerged unless there is a regular high rate flow of water over the bearing. This is because the passive film on the surface of stainless steel relies on the presence of oxygen to regenerate itself. In a low oxygen underwater marine environment (e.g stagnant seawater or under mud/silt) the steel may be prone to pitting or crevice corrosion. 316 stainless steel is less resistant to warm seawater. Pitting corrosion is a risk in seawater over 30°C whereas crevice corrosion can occur in as little as 10-15°C. 316 grade is still much more resistant to corrosion than 440 grade.

Bearings made from 316 grade stainless steel can be used at high temperatures provided a suitable cage material is used or the bearings are full complement. Polyethylene, PEEK or PTFE are often used for retainers in 316 stainless steel bearings.

PLASTICS

Acetal resin/POM-C (prefix "AC")

- ☺ Excellent corrosion resistance to water, salt water and weak chemicals
- ☺ Non magnetic
- 😐 Temperature range -40°C to +110°C
- ☹ Semi-precision and suitable for low load and low speed only

PEEK (prefix "PK")

- ☺ Excellent corrosion resistance to water, salt water and most chemicals
- ☺ Good high temperature performance and suitable for high vacuum applications
- ☺ Non magnetic
- ☺ Wide temperature range -70°C to +250°C
- ☹ Semi-precision and suitable for low load and low speed only although higher loads than other plastics

Polyethylene (PE)

- ☺ Excellent corrosion resistance to water, salt water and many chemicals
- ☺ Non magnetic
- 😐 Temperature range from -40°C to +80°C
- ☹ Suitable for low load and low speed and semi-precision only

PTFE (prefix "PTFE")

- ☺ Excellent corrosion resistance to water, salt water and most chemicals
- ☺ Good high temperature performance
- ☺ Non magnetic
- ☺ Very wide temperature range -190°C to +200°C
- ☹ Semi-precision and suitable for very low load and low speed only

PVDF (prefix “PV”)

- ☺ Excellent corrosion resistance to water, salt water and most chemicals
- ☺ Can withstand higher temperatures than acetal and polypropylene
- ☺ Non magnetic
- ☺ Fairly wide temperature range from -50°C to +150°C
- ☹ Suitable for low load and low speed and semi-precision only

Our standard plastic corrosion resistant bearings have acetal resin (POM-C) rings, nylon (PA66) cages and balls made from 316 stainless steel or glass. They are also suitable for food applications. They will however, corrode in the presence of certain chemicals and PA66 cages will absorb water after long exposure causing loss of tensile strength. A number of alternative materials for rings, cages and balls are available such as polypropylene, PTFE, PEEK or PVDF.

All plastic bearings are semi precision and like 316 stainless steel bearings, should not be used for precision applications. Due to the softer material, they are not suitable for anything other than low loads and low speeds although PEEK has better load bearing capabilities. Corrosion resistance varies between the materials with PTFE, PEEK and PVDF giving the best all round chemical resistance.

Care should be taken to choose the correct material when using plastic bearings at elevated temperatures. Acetal bearings with nylon cages should not be used in temperatures of greater than 100°C and polypropylene should only used up to 100°C but other materials have good high temperature resistance, particularly PTFE (up to 200°C) and PEEK (up to 250°C) although PTFE has lower load ratings. Generally, plastic bearings are not recommended for vacuum applications. PEEK is the exception with very good outgassing characteristics.

CERAMICS

Zirconia (prefix "CCZR")

- ☺ High corrosion resistance to acids and alkalis but may degrade after prolonged exposure to hot water or steam. Studies have also been carried out on low temperature degradation of zirconia in the presence of moisture or water. There is evidence of some surface weakening but the effect on bearing performance is inconclusive and not thought to seriously affect zirconia bearings at low temperatures or room temperature.
- ☺ Wide temperature range from -190°C to 400°C without cage
- ☺ Non magnetic and electrically insulating
- ☺ Higher flexural strength and lower elastic modulus than other ceramics so better for small shock loads and small interference fits
- ☺ Expansion similar to steel so OK for use with steel shaft at high temperature
- ☺ About 70% of the weight of steel
- ☹ Lower speed and load than steel bearings
- ☹ Not suitable for low noise applications

Silicon Nitride (prefix “CCSI”)

- ☺ Very good corrosion resistance to water, salt water, acids and alkalis
- ☺ Very wide temperature range from -210°C to 800°C without cage
- ☺ Non magnetic, electrically insulating and suitable for high vacuum applications
- ☺ About 45% of the weight of steel
- ☹ Lower speed and load than precision steel bearings
- ☹ Not suitable for low noise applications
- ☹ Very low thermal expansion so shaft/housing fits can be a problem in high temperature applications
- ☹ Not recommended for shock loads or interference fits

Full ceramic bearings are much more expensive than steel bearings so are normally used in environments that are too hostile for steel bearings. They have good to excellent corrosion resistance depending on the material and the chemicals encountered and are normally supplied without lubrication. Both zirconia and silicon nitride are non-magnetic and electrically insulating. Full ceramic bearings may have PTFE or PEEK retainers or be supplied as full complement type i.e. without a retainer. Full complement ceramic bearings can be used in very high temperatures.

As ceramics are more brittle than steel, full ceramic bearings, particularly silicon nitride, are not recommended where heavy shock loads are likely due to the risk of cracking. Full ceramic bearings will accept approximately 65% to 75% of the load of a steel bearing due to the greater brittleness. The limiting speed of a full ceramic bearing is only about 25% of the speed of the same steel bearing due to the inferior roundness of the rings and greater risk of sudden failure due to the lower flexural strength compared to steel.

Using silicon nitride bearings with steel shafts or housings in high temperature applications can cause fitting problems due to the large difference in expansion coefficient. Bearing damage can occur if allowance is not made for the the greater expansion of a steel shaft in a silicon nitride inner ring at high temperature. There is much less of a problem with Zirconia as the coefficient of expansion is much more similar to steel. For more information see the section on Shaft/Housing Fit.

Hybrid bearings (prefix "CB" or "SCB")

Silicon nitride is the most popular material for the balls in hybrid bearings as it has only 40% of the density of bearing steel but is much harder, giving greater wear resistance. Hybrid bearings are also capable of higher speeds due to the lower centrifugal force generated by the ceramic balls. However, due to the lower elasticity of the balls, the contact area between the balls and the raceway is smaller which causes a higher contact pressure. This can cause the raceways to wear faster. The speed increase for hybrid bearings is approximately 30-40% with adequate lubrication. Hybrid bearings can also operate better with limited lubrication but running speed should be reduced. They are also less subject to ball skidding under high acceleration with a low load.

MATERIAL TABLES

(a) Chemical composition of bearing steel

	Steel	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Hard-ness
Chrome steel	SAE52100 SUJ2 100Cr6	0.95~ 1.10	0.15~ 0.35	0.50 max	0.025 max	0.025 max	1.30~ 1.60	0.08 max		64 Hrc max
Stainless steel	AISI440C SUS440C X105CrMo17	0.95~ 1.20	1.00 max	1.00 max	0.04 max	0.03 max	16.0~ 18.0	0.75 max		60 Hrc max
	KS440 ACD34 X65Cr13	0.60~ 0.75	1.00 max	1.00 max	0.03 max	0.02 max	11.5~ 13.0	0.3 max		58 Hrc max
	AISI420 SUS420 X20Cr13	0.26~ 0.35	1.00 max	1.50 max	0.04 max	0.03 max	12.0~ 14.0			55 Hrc max
	AISI304 SUS304 X5CrNi1810	0.08 max	0.75 max	2.00 max	0.045 max	0.03 max	18.0~ 20.0		8.0~ 10.5	39 Hrc max
	AISI316 SUS316 X5CrNiMo17-12-2	0.08 max	1.00 max	2.00 max	0.045 max	0.03 max	16.0~ 18.0	2.0~ 3.0	10.0~ 14.0	39 Hrc max

(b) Material of components

Component	Chrome steel bearings	Stainless steel bearings
Inner / Outer rings	SAE52100 / SUJ2 / 100Cr6	AISI440C / SUS440C / X105CrMo17 or KS440 / ACD34 / X65Cr13
Balls	SAE52100 / SUJ2 / 100Cr6	AISI440C / SUS440C / X105CrMo17
Shields	SPCC steel sheet	AISI304 / SUS304 / X5CrNi1810
Retainer	SPCC steel strip	AISI304 / SUS304 / X5CrNi1810 or AISI420 / SUS420 / X20Cr13

2. Retainer

Metal Crown/Ribbon retainer

These standard retainers are manufactured from carbon steel for chrome bearings and AISI304, AISI-316 or AISI420 grade stainless steel for stainless bearings. Ceramic bearings can also be supplied with 316 stainless cages for greater extremes of temperature. The crown cage is mainly used on thinner bearings where space is limited. Steel cages are preferred for arduous operating conditions and high levels of vibration.

☺ Good for low to medium speeds
☺ Wide temperature range depending on grade of steel
☹ Not suitable for very high speeds

Nylon Crown Retainer (PA66)

This is not fibreglass reinforced so not suitable for high speed. It may swell after a few months if constantly used in water or a very damp environment.

☺ Corrosion-resistant
😐 Temperature range -30°C to +100°C
☹ Not suitable for high speeds

PEEK Crown Retainer (PK)

Often used in ceramic bearings, 316 stainless steel bearings and PEEK bearings, this is highly corrosion resistant, has a wide temperature range and is suitable for vacuum use.

☺ Very corrosion-resistant
☺ Low outgassing so suitable for vacuum use
☺ Wide temperature range -70°C to +250°C (lower speed at high temperature)

Polyamide Crown Retainer (TW)

A high speed retainer made from fibreglass reinforced nylon with better sliding characteristics than a steel cage, producing fewer fluctuations in running torque. It can increase maximum speeds by up to 60% and has good low noise properties.

☺ High speed and low noise
😐 Temperature range -30°C to +120°C (lower speed at high temperature)

Polyethylene Crown Retainer (PE)

A low speed, corrosion resistant retainer mainly used in 316 marine grade bearings.

☺ Very corrosion-resistant
😐 Temperature range -40°C to +80°C
☹ Not suitable for high speeds

PTFE Crown Retainer (PT)

Used in ceramic bearings, 316 stainless steel bearings and PTFE bearings.

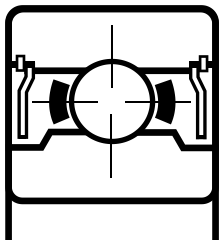
☺ Very corrosion-resistant
☺ Very wide temperature range -190°C to +200°C (low speed at high temperature)
☹ Only suitable for low speed

Full Complement (F/B)

A full complement bearing contains extra balls and has no retainer. It has greater radial load capacity but axial load capacity is very small. These are for low speed use as bearing torque is increased due to ball to ball friction.

☺ Higher radial load capacity
☹ Much lower speed than caged type
☹ Low axial load

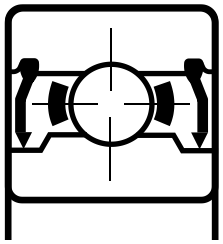
3. Closures



Shields (ZZ)

Most sizes are available with metal shields. Shields are designed to prevent larger particles from entering the bearing and also to keep grease inside the bearing. They may be pressed into the bearing's outer ring (non-removable) or retained by a circlip (removable). As the shields make no contact with the inner ring, they do not increase starting or running torque. Shields on stainless steel bearings are generally made from AISI 304 grade stainless steel.

☺ Prevent contamination by larger particles
☺ Reduce lubricant leakage
☺ Do not increase torque
☺ Very wide temperature range, especially stainless steel
☹ Not very effective in dusty conditions

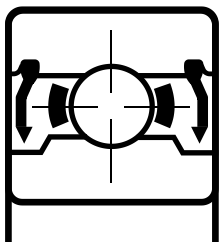


Contact Seals (2RS)

The standard bearing seal consists of nitrile/BUNA-N rubber bonded to a metal washer. High temperature PEEK or PTFE seals (up to 250°C) or Viton seals (up to 230°C) are available on some sizes. The inner lip of the seal rubs against the bearing inner ring to provide an effective seal against smaller particles such as dust and moisture while preventing lubricant leakage. Contact seals produce much higher frictional torque levels than shields and reduce the maximum speed of a bearing. Below -40°C nitrile rubber and viton will stiffen and provide a less effective seal so PEEK or PTFE seals or metal shields should be considered for very low temperatures.

☺ Good protection against contamination
☺ Greatly reduce lubricant leakage
☹ Reduce maximum speed by approx. 40%
☹ Greatly increase bearing torque

- Temp. range –40°C/+110°C for nitrile rubber
- Temp. range –50°C/+110°C for PE
- Temp. range –40°C/+230°C for Viton
- Temp. range –70°C/+250°C for PEEK
- Temp. range –190°C/+250°C for PTFE



Non-contact seals (2RU)

These seals are also made of nitrile rubber bonded to a metal washer but do not rub against the bearing inner ring and therefore do not have the same effect on bearing torque and maximum speed as contact seals. This means they can be used for low torque, high speed applications. They offer superior protection over metal shields but do not provide as effective a seal as the contact type.

☺ Reduced lubricant leakage
☺ No torque increase
☺ Do not affect maximum speed
😐 Offer better protection than shields but not as good as contact seals

- Temp. range –40°C/+110°C for nitrile rubber
- Temp. range –50°C/+110°C for PE
- Temp. range –70°C/+250°C for PEEK
- Temp. range –190°C/+250°C for PTFE

4. Load Rating

Load ratings are expressed in Kgf (kilogramme force) in this catalogue. That is the force exerted by a mass of 1 kilogramme at the Earth's surface. You will often see force expressed in Newtons elsewhere. A Newton is defined as the force that will accelerate a mass of one kilogram at the rate of one meter per second per second (or 1 m/s^2). Since the force of gravity at the Earth's surface is 9.80665 m/s^2, 1 Kgf = 9.80665 Newtons.

Dynamic load rating

The dynamic load rating is that constant stationary radial load which 90% of a group of identical chrome steel bearings, with only the inner ring rotating, can endure for one million revolutions before the first signs of fatigue develop. Yes, one million revolutions sounds a lot but is it really? If you take a bearing running at 10,000 rpm with the maximum dynamic load applied to it, it will last for 100 minutes! These figures are used in the calculation of life ratings but bearings should not be subjected to anywhere near such loads in normal application unless you don't expect them to last very long.

If long life is required, it is preferable to limit the actual load to between 6% and 12% of a bearing's dynamic load rating. Heavier loads can be tolerated but life will be shortened. AISI440C/KS440 stainless steel bearings will support approximately 80% - 85% of the load figures for chrome steel bearings. Load ratings for thrust bearings are based on the constant axial load endured for 1 million revolutions. For life ratings, please contact SMB.

Static load rating

The static rating represents the purely radial load (or axial load for thrust bearings) which will cause a total permanent deformation of the balls or raceway equal to one ten-thousandth of the ball diameter. Static loads approaching this figure may be tolerable for certain applications but not where any smoothness or accuracy is required. Static load ratings for stainless steel bearings are approximately 75 - 85% of the load ratings for chrome steel bearings.

The load capacity of a bearing may be limited by the lubricant. Certain lubricants are only suitable for light loads while others are designed for high load applications. Load ratings are higher for full complement bearings (see Section 2: Retainer). The axial load capacity of a radial ball bearing can be increased by specifying loose radial play.

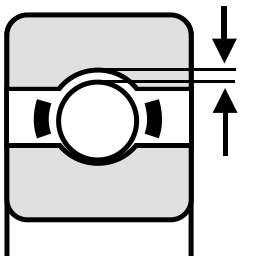
Axial load rating

Heavy duty bearing types such as 6200 or 6300 series may take axial loads of up to 50 percent of the static radial load rating. Thin-section deep groove ball bearings can only support axial loads of between 10 and 30 percent of the bearing's static radial load rating due the shallower raceways. Please note, these figures are based on pure axial load. Additional radial loads or moment (misalignment loads) will have an impact on the axial load capacity. To exceed the total recommended limits for combined loads will have a detrimental effect on bearing life.

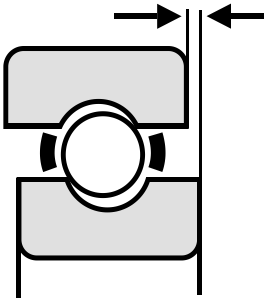
To see the load ratings for our bearings, please refer to the relevant product page.

5. Internal clearance & preloads

Internal clearance is commonly expressed as radial play but can also be measured as axial play and it represents the amount of space between the inner and outer ring raceways and the balls.



Radial play is the clearance measured perpendicular to the bearing axis or more specifically: *average outer ring raceway diameter minus average inner ring raceway diameter minus (2 x ball diameter)*.



Axial play is the clearance measured along the bearing axis. Axial play is approximately 10 times the radial play value.

Radial play is an important consideration when choosing a bearing. The radial play in the bearing before it is fitted can be called the "initial" radial play. "Residual" or "operational" radial play is what is left when the bearing has been fitted. There should normally be a slight residual radial play in the bearing to minimize ball skidding and reduce axial play (end play). Correct selection of the initial radial play can avoid faster bearing wear and reduce unwanted play.

A number of things can alter the radial play during the fitting process. A tight shaft fit where the shaft is slightly larger than the bearing inner ring (often called an interference fit or a press fit) will stretch the inner ring so making it bigger. This reduces radial play by up to 80% of the interference fit. The same thing happens if the outer ring is a tight fit in the housing. This can squash or compress the outer ring also reducing radial play. A difference between the shaft and housing temperatures can also be a problem. If a bearing inner ring gets hotter than the outer ring, it will expand more and reduce radial play. This can be calculated as follows:

Chrome Steel: 0.0000125 x (inner ring temp - outer ring temp °C) x outer ring raceway diameter in mm.

440 Stainless Steel: 0.0000103 x (inner ring temp - outer ring temp °C) x outer ring raceway diameter in mm.

The outer ring raceway diameter is roughly calculated as: **0.2 x (d + 4D)** where d is the bore in mm and D is the outer diameter in mm.

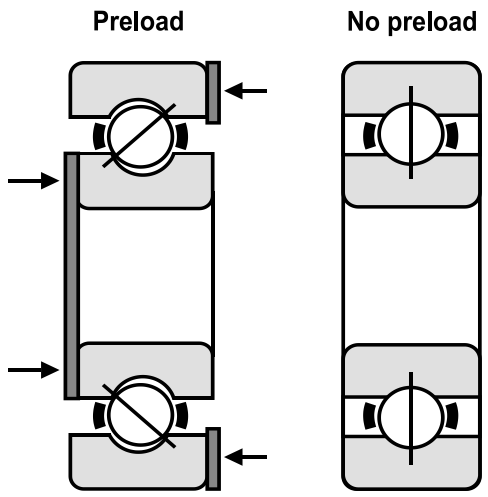
Radial play can also be affected where the shaft or housing is of a different material to the bearing. Different rates of thermal expansion can lead to a reduction in radial play. In such a case, a bearing with a looser radial play may be needed.

In most cases, a standard radial play is suitable and also preferable as these bearings are usually more readily available and cost less. However, there are certain conditions where a non-standard clearance is recommended. A tight radial play is better for greater rigidity and running accuracy if the load is purely radial. This may be worth considering for very low noise, low vibration applications which is why many of our miniature bearings are MC3 radial play. In other applications, a tight radial play may be highly undesirable. If there is a high axial load, a loose radial play is preferable as it increases the bearing's axial load capacity. Also, a loose radial play will better accommodate misalignment between the shaft and housing and cope better with heavy loads or shock loads.

Radial play has nothing to do with the tolerance grade. It is often believed that when there is too much play, a higher precision bearing is required. In this case, the answer is often to use a bearing with a tighter radial play or use a tighter shaft/housing fit or introduce an axial preload to the bearing (see the section on preloads below). Using a higher precision grade will make no difference to the "looseness" of the bearing. You can have an aerospace grade bearing with a loose radial play just as you can have a standard grade bearing with a tight radial play.

Tight radial play	MC1, MC2, C2	Consider for pure radial loads and low noise, low vibration applications. Beware of axial loads, high speed applications, heavy vibration and very low torque applications. Interference fits should not be used.
Standard radial play	MC3, MC4, CN	Acceptable for most applications
Loose radial play	MC5, MC6, C3, C4	Consider for higher axial loads due to greater thrust load capacity. Greater interference fits and shaft misalignment can be tolerated. Better for heavy or shock loads. Not recommended for low noise applications unless tighter radial play not suitable.

PRELOADS



In many low noise, low vibration or high speed applications, zero radial play is desirable. This gives greater rigidity, reduces noise and vibration, gives greater ball alignment and running accuracy and can eliminate ball skidding under high acceleration. This is achieved by applying a preload to the bearing. A preload is an axial load deliberately applied via the inner or outer ring to offset the outer ring against the inner ring and reduce the radial play to zero.

Preload is usually applied by the use of wave or spring washers or springs and normally to the stationary ring which should have a sliding fit to the shaft or housing to allow for axial movement. If the bearings are glued on to the shaft or housing, it may be possible to use weights to keep the bearing preloaded while the adhesive cures. The amount of preload should be as small as possible. Excessive preload can cause the bearing to be too tight leading to very high frictional torque and rapid failure.

GUIDE TO BEARING PRELOADS

Preload category	Preload Amount Miniature & Small Bearing (Cr = Basic Dynamic Load Rating)	Preload Amount Standard Bearing (Cr = Basic Dynamic Load Rating)	Features
Slight preload	0.50% x Cr	0.15% x Cr	Bearing rigidity not required. Emphasis on low torque.
Light preload	1.25% x Cr	0.58% x Cr	Bearing rigidity and low torque both required.
Medium preload	1.75% x Cr	1.28% x Cr	Emphasis on bearing rigidity. Relatively high torque.
Heavy preload	2.50% x Cr	2.64% x Cr	Emphasis on bearing rigidity. High torque.

RADIAL PLAY TABLES

(a) Bore size under 10 mm (x 0.001mm)

Tight		Standard		Loose	
MC1	**MC2**	**MC3**	**MC4**	**MC5**	**MC6**
0 ~ 5	3 ~ 8	5 ~ 10	8 ~ 13	13 ~ 20	20 ~ 28

(b) Bore size from 10 mm (x 0.001mm)

Nominal bore (mm)		Tight	Standard	Loose	Looser
Over	**Including**	**C2**	**CN**	**C3**	**C4**
	10	0 ~ 7	2 ~ 13	8~ 23	14 ~ 29
10	**18**	0 ~ 9	3 ~ 18	11 ~ 25	18 ~ 33
18	**24**	0 ~ 10	5 ~ 20	13 ~ 28	20 ~ 36
24	**30**	1 ~ 11	5 ~ 20	13 ~ 28	23 ~ 41
30	**40**	1 ~ 11	6 ~ 20	15 ~ 33	28 ~ 46
40	**50**	1 ~ 11	6 ~ 23	18 ~ 36	30 ~ 51
50	**65**	1 ~ 15	8 ~ 28	24 ~ 43	38 ~ 61
65	**80**	1 ~ 15	10 ~ 30	25 ~ 51	46 ~ 71
80	**100**	1 ~ 18	12 ~ 36	30 ~ 58	53 ~ 84

6. Maximum Speeds

A number of factors affect speed limitation such as temperature, load, vibration, radial play, retainer, lubricant, ball material and closures. The speeds quoted in our catalogue pages are only approximate and valid for bearings used on a horizontal shaft with a metal cage, standard tolerance grade and radial play, medium loading, rotating inner ring and suitable lubricant (see below).

Vertical shaft applications will require a maximum speed reduction of approximately 20%. Temperature excesses and heavy loadings will also require slower speeds. Bearings fitted with contact seals cannot achieve the same speeds due to increased friction between seal lip and bearing inner ring. The choice of lubricant may also have a significant effect on the speed rating. The maximum rpm at which a lubricant can effectively operate varies from type to type.

Greases also have speed ratings sometimes called "DN" ratings. The calculation for the "DN" of an application is as follows:

Speed in rpm x (bearing ID + bearing OD) ÷ 2

Assume a bearing rotates at 20,000 rpm. The bearing ID is 8mm and the OD is 22mm. The above formula produces a DN of 300,000 so the grease should be rated above this figure. Many modern greases are suitable for high speeds with some rated at 1 million DN or more.

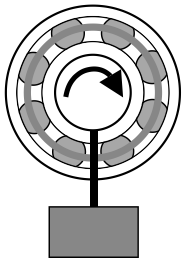
The adjustment factors shown in the following speed reduction table are approximate and are based on bearings with a metal crown or ribbon cage. The maximum speed of a bearing can be increased by the use of a nylon or phenolic cage provided a suitable lubricant is used. The use of ceramic balls will increase maximum bearing speed by up to 40%

SPEED REDUCTION TABLE

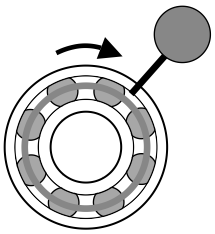
Lubricant	Rotating inner ring		Rotating outer ring	
	Open, ZZ, 2RU	2RS	Open, ZZ, 2RU	2RS
Petroleum oil	Nil reduction	40% reduction	20% reduction	40% reduction
Synthetic oil	Nil reduction	40% reduction	20% reduction	40% reduction
Silicone oil	30% reduction	40% reduction	50% reduction	50% reduction
Standard grease	30% reduction	40% reduction	50% reduction	50% reduction
High speed grease	Nil reduction	40% reduction	20% reduction	40% reduction
Silicone grease	30% reduction	40% reduction	50% reduction	50% reduction

7. Shaft/Housing Fits

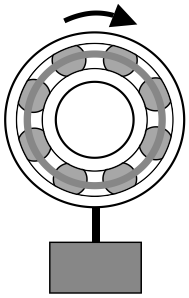
The ideal fit is where the shaft/housing is the same size as the bore/O.D. of the bearing. This is known as a line-to-line fit and gives optimum bearing performance. Looser fits are commonly used and often preferred for ease of assembly or where spring preloading is used (see "Preload" in the Radial Play section). Where heavier radial loads or greater vibration are present, bearing rings under a rotating load may need to be firmly located by an interference fit or other means such as a nut or adhesive. This prevents them from creeping in a circumferential direction which gives rise to increased wear. A bearing ring is subjected to a rotating load when the load is applied to all points of that ring during operation. For a better understanding, see the examples below.



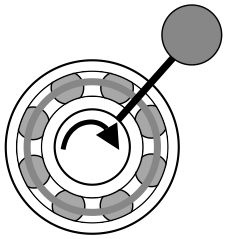
Inner ring rotating load: e.g. a bearing in a vacuum cleaner motor driving the roller brush. The shaft and bearing inner ring are rotating. The load is in a constant direction in relation to the bearing so as the inner ring turns, all parts of it are subjected to the load. The outer ring does not rotate so the load acts on only one point of the outer ring.
This application requires an interference shaft fit and a clearance housing fit.



Another possibility is a static inner ring and rotating outer ring but this time, the load rotates with the outer ring. As above, the load acts on only one point of the outer ring while all parts of the inner ring are subjected to the load.
This application requires an interference shaft fit and a clearance housing fit.



Outer ring rotating load: e.g. a bearing in a pulley wheel. The shaft and inner ring are fixed while the outer ring and housing (the pulley) rotate. The load is in a constant direction in relation to the bearing so as the outer ring turns, all parts of it are subjected to the load. The inner ring does not rotate so the load acts on only one point of the inner ring.
This application requires a clearance shaft fit and an interference housing fit.



This example involves a static outer ring and rotating inner ring, the load rotating with the inner ring. As above, the load acts on only one point of the inner ring while all parts of the outer ring are subjected to the load.
This application requires a clearance shaft fit and an interference housing fit.

This means that usually only one ring is subjected to an interference fit. There may be instances where a fluctuating load direction will require interference fits for both shaft and housing. This may also be true where there is excessive vibration. Make sure that interference fits do not reduce the radial play of the bearing to an unacceptable level or early failure will occur. These fits will stretch the bearing inner ring or compress the outer ring, reducing the bearing's internal space. Excessive interference fits can also cause high stress which may fracture rings.

An interference fit can reduce radial play by up to 80% of the size of the interference fit. Let's use a shaft with a 10mm diameter and a bearing with a 10mm bore as an example. Imagine the shaft diameter is actually 10.007mm and the actual bearing bore is 9.993mm. This gives an interference fit of 0.014mm (i.e. the shaft is 0.014mm larger than the bearing bore). The radial play of the bearing may be reduced by as much as 80% of this figure or approx 0.011mm. If the bearing radial play (before fitting) is less than 0.011mm, the bearing may fail quickly.

The material of the shaft and housing should be taken into consideration so that temperature induced changes in radial play can be calculated. An aluminium housing will expand more than a steel housing so requires a greater interference fit than a steel housing. Greater interference fits are required in thin walled or plastic housings and also on hollow shafts.

Care should also be taken where shaft and housing materials have different expansion coefficients to the bearing material. This may lead to change in radial play and possible damage to the bearing. Silicon nitride has a very low coefficient of expansion so if a silicon nitride bearing is used on a stainless steel shaft at high temperature, there is a risk of the inner ring breaking or cracking particularly as ceramics are more brittle than steel. Much looser fits should be considered to accommodate these differences. There is less of a risk with zirconia as the coefficient is similar to stainless steel but differences in expansion should be taken into account.

To calculate expansion, we need the initial temperature and final temperature, the expansion coefficient and the relevant bearing dimension. Say a 440 stainless steel bearing bore is 30mm at ambient temperature 20°C. The bore size at 250°C can be calculated as follows:

Final temperature 250°C, initial temperature 20°C, temperature increase = **230°C**
Expansion coefficient of 440 grade steel = **0.0000105 per °C**
Bearing bore = **30mm**
230 x **0.0000105** x **30** = **0.072**
Bearing bore at 250°C = **30.072mm**

COEFFICIENTS OF EXPANSION

Bearing Material	Coefficient of expansion
52100 chrome steel	12.5 x 10-6 (0.0000125) per ˚C
440 stainless steel	10.5 x 10-6 (0.0000105) per ˚C
316 stainless steel	16 x 10-6 (0.000016) per ˚C
ZrO2 (zirconia)	10.3 x 10-6 (0.0000103) per ˚C
Si3N4 (silicon nitride)	3.3 x 10-6 (0.0000033) per ˚C

Interference fits can affect rotational accuracy by distorting bearing rings. **The standards of roundness and surface finish which apply to the bearing should also apply to shaft and housing.** This is very important for electric motor and other quiet-running applications. Miniature and thin-section bearings are particularly susceptible to distortion which leads to higher noise and vibration levels. If rotational accuracy is important, a combination of close bearing tolerances and close shaft/housing tolerances should be used to obtain the correct fit with the minimum interference.

8. Tolerances

Tolerances control the dimensional accuracy of a bearing. We use ISO bearing tolerances measured in thousandths of a millimetre (or microns) starting at P0 and moving upwards in precision grade to P6, P5 and then P4. Some manufacturers use AFBMA (ABEC) bearing tolerances which are measured in ten-thousandths of an inch.

It is important to understand that tolerances do not affect radial play although it is sometimes mistakenly thought that improving the tolerances will produce a bearing with less play. Assuming that the shaft and housing are manufactured to the same tolerances as the bearing, higher bearing tolerances will produce better mating between shaft/housing and bearing, lower noise and vibration due to improved roundness. Higher tolerances will produce slightly lower starting and running torque but this is also subject to correct selection of radial play and lubricant.

INNER RING TOLERANCES

Inner Ring and Width x 0.001mm – up to 2.5mm bore **(1) applies to inner ring only**

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-8	10	8	6	6	+0/-40	12	10	_	_
P6	+0/-7	9	7	5	5	+0/-40	12	5	_	_
P5	+0/-5	5	4	4	3	+0/-40	5 (1)	4	7	7
P4	+0/-4	4	3	3	2	+0/-40	2.5 (1)	2.5	3	3

Inner Ring and Width x 0.001mm – over 2.5mm up to 10mm bore **(1) applies to inner ring only**

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-8	10	8	6	6	+0/-120	15	10	_	_
P6	+0/-7	9	7	5	5	+0/-120	15	6	_	_
P5	+0/-5	5	4	4	3	+0/-40	5 (1)	4	7	7
P4	+0/-4	4	3	3	2	+0/-40	2.5 (1)	2.5	3	3

Inner Ring and Width x 0.001mm – over 10mm up to 18mm bore **(1) applies to inner ring only**

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-8	10	8	6	6	+0/120	20	10	_	_
P6	+0/-7	9	7	5	5	+0/120	20	7	_	_
P5	+0/-5	5	4	4	3	+0/-80	5 (1)	4	7	7
P4	+0/-4	4	3	3	2	+0/-80	2.5 (1)	2.5	3	3

INNER RING TOLERANCES (...continued)

Inner Ring and Width x 0.001mm – over 18mm up to 30mm bore (1) applies to inner ring only

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-10	13	10	8	8	+0/120	20	13	_	_
P6	+0/-8	10	8	6	6	+0/120	20	8	_	_
P5	+0/-6	6	5	5	3	+0/120	5 (1)	4	8	8
P4	+0/-5	5	4	4	2.5	+0/120	2.5 (1)	3	4	4

Inner Ring and Width x 0.001mm – over 30mm up to 50mm bore (1) applies to inner ring only

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-12	15	12	9	9	+0/-120	20	15	_	_
P6	+0/-10	13	10	8	8	+0/-120	20	10	_	_
P5	+0/-8	8	6	6	4	+0/-120	5 (1)	5	8	8
P4	+0/-6	6	5	5	3	+0/-120	3 (1)	4	4	4

Inner Ring and Width x 0.001mm – over 50mm up to 80mm bore (1) applies to inner ring only

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-15	19	19	11	11	+0/-150	25	20	_	_
P6	+0/-12	15	15	9	9	+0/-150	25	10	_	_
P5	+0/-9	9	7	7	5	+0/-150	6 (1)	5	8	8
P4	+0/-7	7	5	5	3.5	+0/-150	4 (1)	4	5	5

Inner Ring and Width x 0.001mm – over 80mm up to 120mm bore (1) applies to inner ring only

Grade	Mean bore deviation	Single bore variation			Mean bore variation	Width deviation	Width variation	Radial runout	Face runout with bore	Face runout with raceway
		67,68,69 series	60 series	62,63 series						
P0	+0/-20	25	25	15	15	+0/-200	25	25	_	_
P6	+0/-15	19	19	11	11	+0/-200	25	13	_	_
P5	+0/-10	10	8	8	5	+0/-200	7 (1)	6	9	9
P4	+0/-8	8	6	6	4	+0/-200	4 (1)	5	5	5

OUTER RING TOLERANCES

Outer Ring and Width x 0.001mm – up to 6mm OD

(2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-8	10	8	6	10	6	(2)	15	_	_
P6	+0/-7	9	7	5	9	5	(2)	8	_	_
P5	+0/-5	5	4	4	_	3	5	5	8	8
P4	+0/-4	4	3	3	_	2	2.5	3	4	5

Outer Ring and Width x 0.001mm – over 6mm up to 18mm OD

(2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-8	10	8	6	10	6	(2)	15	_	_
P6	+0/-7	9	7	5	9	5	(2)	8	_	_
P5	+0/-5	5	4	4	_	3	5	5	8	8
P4	+0/-4	4	3	3	_	2	2.5	3	4	5

Outer Ring and Width x 0.001mm – over 18mm up to 30mm OD

(2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-9	12	9	7	12	7	(2)	15	_	_
P6	+0/-8	10	8	6	10	6	(2)	9	_	_
P5	+0/-6	6	5	5	_	3	5	6	8	8
P4	+0/-5	5	4	4	_	2.5	2.5	4	4	5

Outer Ring and Width x 0.001mm – over 30mm up to 50mm OD

(2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-11	14	11	8	16	8	(2)	20	_	_
P6	+0/-9	11	9	7	13	7	(2)	10	_	_
P5	+0/-7	7	5	5	_	4	5	7	8	8
P4	+0/-6	6	5	5	_	3	2.5	5	4	5

OUTER RING TOLERANCES (...continued)

Outer Ring and Width x 0.001mm – over 50mm up to 80mm OD (2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-13	16	13	10	20	10	(2)	25	_	_
P6	+0/-11	14	11	8	16	8	(2)	13	_	_
P5	+0/-9	9	7	7	_	5	6	8	8	10
P4	+0/-7	7	5	5	_	3.5	3	5	4	5

Outer Ring and Width x 0.001mm – over 80mm up to 120mm OD (2) same as inner ring value

Grade	Mean O.D. deviation	Single O.D. variation				Mean O.D. variation	Width variation	Radial runout	Face runout with O.D.	Face runout with raceway
		67,68,69 series	60 series	62,63 series	60,62,63 ZZ/2RS					
P0	+0/-15	19	19	11	26	11	(2)	35	_	_
P6	+0/-13	16	16	10	20	10	(2)	18	_	_
P5	+0/-10	10	8	8	_	5	8	10	9	11
P4	+0/-8	8	6	6	_	4	4	6	5	6

FLANGE TOLERANCES

Flange OD x 0.001mm - outer ring diameter up to 18mm

Grade	Mean O.D. deviation
P0	+125 / -50
P6	+125 / -50
P5	+0 / -25
P4	+0 / -25

Flange OD x 0.001mm - outer ring diameter over 18mm up to 30mm

Grade	Mean O.D. deviation
P0	+330 / -52
P6	+330 / -52
P5	+0 / -52
P4	+0 / -52

FLANGE TOLERANCES (...continued)

Flange OD x 0.001mm - outer ring diameter over 30 up to 50mm

Grade	Mean O.D. deviation
P0	+390 / -62
P6	+390 / -62
P5	+0 / -62
P4	+0 / -62

Flange width x 0.001mm - up to 10mm bore

Grade	Mean Width deviation
P0	+0 / -50
P6	+0 / -50
P5	+0 / -50
P4	+0 / -50

Flange width x 0.001mm - over 10mm up to 18mm bore

Grade	Mean Width deviation
P0	+0 / -120
P6	+0 / -120
P5	+0 / -80
P4	+0 / -80

Flange width x 0.001mm - over 18mm up to 50mm bore

Grade	Mean Width deviation
P0	+0 / -120
P6	+0 / -120
P5	+0 / -120
P4	+0 / -120

THRUST BEARING TOLERANCES

All sizes x 0.001mm

Grade	Mean bore deviation	Mean bore2 deviation	Mean O.D. deviation	Mean O.D. 2 deviation	Mean height deviation
P0	+0 / -8	+0 / -50	+0 / -11	-5 / -20	+0 / -75

9. Frictional Torque

This affects the free-running of the bearing. Spin a bearing containing stiff grease with your finger and not much happens. This indicates high frictional torque. Try a bearing with no lubrication and it will spin freely meaning low frictional torque. The effort required to rotate a bearing depends greatly on the roundness of the bearing, the load applied, the lubrication and the closures. Better roundness and surface finish of the balls and raceways means less effort is needed to rotate the bearing. The greater the load, the greater the deformation of the bearing components leading to increased resistance.

As for lubrication, instrument oils will often produce lower torque levels especially at very low speeds but the difference between these and many low torque greases is actually very small, particularly if a low grease fill is used. A standard low torque grease such as Multemp SRL grease may give an increase of only 20% over an Aeroshell 12 oil. This can drop to under 5% for very low torque greases if a low (e.g 10% to 20%) fill is used. High viscosity lubricants can significantly increase bearing torque due to greater lubricant drag.

Torque levels for a greased bearing are briefly higher to start with as the grease takes a short time to "run in" or be distributed inside the bearing. Contact seals will greatly increase the torque figures. The effort required to rotate a bearing from rest (starting torque) is slightly greater than the effort required to keep it rotating (running torque).

Approximate figures for frictional torque for can be calculated using a simple formula. This is only valid if the bearing has low torque lubrication and is open, shielded or has non-contact seals. It should also be subjected to low speed and low load. For radial ball bearings, the axial load should be less than 20% of the radial load while the load should be purely axial for thrust bearings. Contact us if you need more accurate figures.

The measurements are in Newton millimetres (Nmm). This is a compound unit of torque corresponding to the torque from a force of one newton (approx 0.1 Kgf) applied over a distance arm of one millimetre.

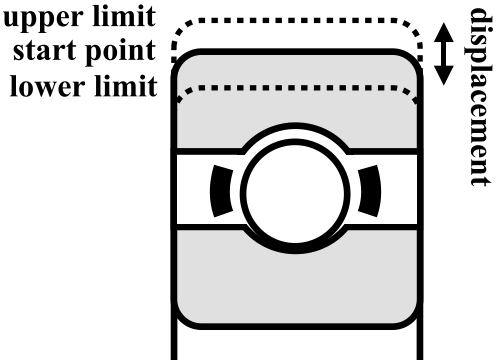
Frictional torque measured in Nmm. 9.80665 Newtons = 1 Kgf

Radial ball bearings:	**0.5 x 0.0015 x radial load in Newtons* x bearing bore (mm)**
Axial ball bearings:	**0.5 x 0.0013 x axial load in Newtons* x bearing bore (mm)**

10. Noise Rating

Bearing rings and balls are not perfectly round and the balls and raceways, even after extensive fine grinding and polishing, are not perfectly smooth. Any surface roughness will cause one ring to move or oscillate radially in relation to other. The amount and speed of this movement contributes to the amount of *bearing vibration and bearing noise*. As a precision manufacturer, EZO, apply a standard noise test to their bearings. Lower noise levels, such as EMQ or EMQ2, require additional testing.

The smoothness or quietness of a bearing can be checked by accelerometers which measure bearing vibration at the outer ring, usually with the inner ring rotating at 1800 rpm. When measuring bearing vibration, we need to take into account both displacement and frequency as these two factors together tell us far more.



The amount of oscillation in a vibrating object is called **displacement**. When a bearing outer ring vibrates, the outer surface will move upwards to the upper limit, then down to the lower limit and then back to the start point. The measurement between upper and lower limit is called peak to peak displacement. The whole oscillation movement from start point through upper and lower limits and back to start point is called a **cycle.** This vibration cycle will repeat as long as the bearing is rotating. We can also measure the number of these cycles in a given time. This gives us the **frequency**. Frequency is most commonly expressed as cycles per second (CPS) or Hertz (Hz) which is the same thing.

Vibration is potentially damaging to a bearing and the equipment it is used in, increasing the rate of fatigue and shortening bearing life. Displacement measurements do not tell us enough. Vibration in a bearing or a machine will usually occur at many different frequencies and they all contribute to fatigue so we need to take all frequencies of vibration into account in our measurements of vibration. We can achieve this by measuring vibration velocity.

Vibration velocity (displacement x frequency) gives us a good indication of the severity of the vibration. If a bearing component is moving a particular distance (displacement) at a particular rate (frequency) it must be moving at a certain speed. The higher the vibration velocity measurement, the noisier the bearing. Vibration velocity is measured on a Bearing Vibration Tester in microns per second or an Anderon Meter in Anderons. One Anderon equals 7.5 microns per second. The readings are separated into three frequency bands: low (50 to 300 Hz); medium (300 to 1800 Hz) and high (1800 to 10000 Hz). Although vibration velocity shows the fatigue potential, *vibration force* can cause deformation to balls and rings and can be very damaging at high frequencies where velocity readings may be quite low. For this reason we also measure vibration acceleration.

Vibration acceleration is an indication of vibratory force (force = mass x acceleration) and since force is damaging at higher frequencies, vibration acceleration is a useful measurement where a bearing will experience vibration frequencies above 2000 Hz. Vibration acceleration is measured in G (9.81 m/s^2) but you will often see these measurements converted to decibels (dB).

A low noise/vibration rating is achieved by paying particular attention to the surface finish of the raceways and balls, the roundness of the rings and balls and correct cage design.

To help reduce noise levels even further, low noise greases are available and the choice is now greater as improved manufacturing techniques mean these greases are more finely filtered and contain fewer, smaller solid particles. These particles generate noise when they pass between the balls and raceway.

External factors such as surrounding vibration can affect bearing noise. Another problem, particularly with smaller and thin-section bearings, is ring distortion caused by poor shaft or housing roundness. Dirt or dust contamination will also increase noise and vibration levels. Poor fitting practice or incorrect handling is sometimes to blame, causing shock loads which, in turn, create scratches or dents in the raceway.

11. Lubricants

Correct lubrication is critical to bearing performance. It provides a thin film between the contact areas in a bearing to reduce friction, dissipate heat and inhibit corrosion on balls and raceways. The lubricant will affect maximum running speed and temperature, torque level, noise level and, ultimately, bearing life. There are a range of options depending on the application.

Mineral or synthetic based lubricants are the most commonly used. There are many different types, designed for general or high speed use, low noise applications, water-resistance or extreme temperatures.
Silicon lubricants have wide temperature ranges and change viscosity less with temperature. They also have good water-resistance and are safe to use with most plastics. They are not suitable for high loads and speeds.
Perfluorinated lubricants are non-flammable, oxygen compatible and highly resistant to many chemicals. Many are suitable for vacuum or clean-room applications while some can withstand temperatures over 300°C.
Dry lubricants are used where standard lubricants may cause contamination such as vacuum environments. Popular materials such as molybdenum disulphide or tungsten disulphide may be burnished or sputtered on to the balls and raceways to give smooth operation and higher running speeds than unlubricated bearings.
Dampening greases prevent rattles and squeaks. They are also used to give a "quality" feel to switches, slides, threads and gears. They can be used in slow rotating bearings in, for example, potentiometers for the same reason.
Food grade lubricants are required for the food and beverage industries to conform with strict hygiene regulations. HI approved lubricants are used were there may be incidental contact with food and H2 grades are used where there is no possibility of contact. These greases are also highly resistant to being washed out by cleaning processes.
Solid polymer lubricants consist of a synthetic polymer impregnated with lubricating oil which fills most of the internal space of the bearing. This type of lubricant is often used in sealed bearings in dusty environments or where lubricant leakage cannot be tolerated such as clean environments and vertical shaft applications. Solid lubricants have excellent water resistance and will withstand regular wash-downs. They will also tolerate high vibration and high centrifugal force.

Lubricant viscosity
Low viscosity oils and greases are used where low lubricant resistance is required such as sensitive instruments. Higher viscosity lubricants may be specified for high load, high speed or vertical shaft applications. Low viscosity oils (or greases with low viscosity base oils) are preferred for high speed applications as they generate less heat. Although greases often provide much greater resistance than oils, many modern low torque greases can produce torque figures that are similar to some oils, particularly where a low grease fill is used.

Oils
Most oils maintain their consistency well over a wide temperature range and are easy to apply. For very low torque applications, a light instrument oil should be specified. Higher running speeds are possible with oil but, as it tends not to stay in place, continuous lubrication must be applied by oil jet, oil bath or oil mist unless speeds are low or rotation is for short periods. An oil-impregnated phenolic retainer or a synthetic retainer made from a material with a very low coefficient of friction such as Torlon do not need continuous external lubrication. These types of retainer are often used in high speed, low torque dental bearings.

Greases
Greases are simply oils mixed with a thickener to so that they stay inside the bearing. Greases are generally more suitable for heavy loads and have the obvious advantage of giving constant lubrication over a long period without maintenance.

Surprisingly, too much grease can be bad for a bearing. A high fill will mean greater rolling resistance (higher torque) which may not be suitable for many applications but heat build-up is more damaging. The free space inside a bearing is important in allowing the heat to radiate away from contact area between balls and raceway. As a result, too much grease can lead to premature failure unless speeds are low. The standard fill is 25% – 35% of the internal space but this may be varied if required. A smaller percentage may be specified for a high speed, low torque application while a much higher fill may be advisable for a low speed, high load application.

For more information on our standard oils and greases, please see the lubricant tables on the following page. We stock many more than are listed here and have access to lubricants from a large number of manufacturers.

STANDARD OILS

Code	Product Manufacturer	Type	Temp range C (F)	Viscosity CS	MIL Spec	Comments
AF2	Aeroshell 12 (Shell)	Diester	-50/+130 (-58/+266)	14/3.5	L-6085A D/Stan 91-49	General purpose aircraft / instrument
AF3	Aeroshell 3 (Shell)	Mineral	-55/+115 (-67/+239)	11/2.3	L-7870	General purpose aircraft / instrument
DC200/ 100	DC200/100 (Dow Corning)	Silicon	-40/+204 (-40/+400)	100/38		Wide temp., high torque, low speed/load. Safe with most plastics
K143	Krytox 143AZ (Du Pont)	Pefluor-inated	-53/+162 (-63/+324)	40/7		High temp., chemically inert, high torque at low temp, plastic / elastomer safe
PDP38	Isoflex PDP38 (Kluber)	Ester	-65/+100 (-85/+212)	12/3.2		General purpose aircraft / instrument

STANDARD GREASES

Code	Product Manufacturer	Base oil	Thickener	Temp range C (F)	MIL Spec	Comments
AG5	Aeroshell 5 (Shell Oil)	Mineral	Microgel	-40/+177 (-40/+350)	G-3545C	High load
AG7	Aeroshell 7 (Shell Oil)	Diester	Microgel	-73/+149 (-100/+300)	G-23827A G287/G354 D/Stan 91-53	Good water-resistance, high load, wide temp. range
AG22	Aeroshell 22 (Shell Oil)	Hydro-carbon	Microgel	-65/+204 (-85/+400)	Mil-PRF81322F XG293/G395 D/Stan 91-52	Good water-resistance, high load/speed, wide temp. range
AG33	Aeroshell 33 (Shell Oil)	Diester	Microgel	-73/+121 (-100/+251)	Mil-PRF23827 XG287/G354 D/Stan 91-53	Good water-resistance, high load, low temp.
AQUA 2	Sapphire AQUA 2 (Rocol)	Mineral	Aluminium Complex	-20/+150 (-4/+302)		Highly water resistant
B325	Beacon 325 (Mobil/Exxon)	Diester	Lithium	-55/+120 (-67/+248)	G-3278A DTD825B	Low torque, quiet running
B601	Braycote 601 (Castrol)	Perfluor	Tetrafluoro-ethylene	-80/+204 (-112/+400)		Chemically inert, instrument & aerospace vacuum grease
B803	Braycote 803 (Castrol)	Perfluor	Tetrafluoro-ethylene	-62/+260 (-80/+500)		Chemically inert, instrument & aerospace vacuum grease
BQ7272	Kluberquiet BQ72-72 (Kluber)	Ester	Polyurea	-45/+180 (-49/+356)		Very low noise, wide temp. range
FL2	Foodlube 2 (Rocol)	Ester Glyceride	Calcium Soap	-50/+160 (-58/+320)		H1 food grade grease Washout resistant
FLEX	Foodlube Extreme (Rocol)	Polyalpha -olefin	Clay	-30/+160 (-22/+320)		H1 food grade grease Highly washout resistant

STANDARD GREASES (...continued)

Code	Product Manufacturer	Base oil	Thickener	Temp range C (F)	MIL Spec	Comments
FLHT2	Foodlube Hi-temp (Rocol)	Silicon	Silica + PTFE	-20/+200 (-4/+392)		High temp., H1 food grade grease. Washout resistant
GHY72	Asonic GHY72 (Kluber)	Ester	Polyurea	-40/+180 (-40/+356)		Low noise
GPL202	Krytox GPL202 (Du Pont)	Fluoro-carbon	PFPE	-63/+132 (-81/+270)		Low temp., chemically inert, plastic/elastomer safe, food grade
GPL203	Krytox GPL203 (Du Pont)	Fluoro-carbon	PFPE	-60/+154 (-76/+310)		Wide temp., chemically inert, plastic/elastomer safe, food grade
GPL204	Krytox GPL204 (Du Pont)	Fluoro-carbon	PFPE	-51/+179 (-60/+355)		Wide temp., chemically inert, plastic/elastomer safe
GPL205	Krytox GPL205 (Du Pont)	Fluoro-carbon	PFPE	-36/+204 (-33/+400)		Low temp., chemically inert, plastic/elastomer safe, food grade
GPL206	Krytox GPL206 (Du Pont)	Fluoro-carbon	PFPE	-36/+260 (-33/+500)		Low temp., chemically inert, plastic/elastomer safe, food grade
GPL207	Krytox GPL207 (Du Pont)	Fluoro-carbon	PFPE	-34/+288 (-29/+550)		High temp., chemically inert, plastic/elastomer safe
KAC	Krytox 240AC (Du Pont)	Fluoro-carbon	PFPE	-34/+288 (-29/+550)	G-27617A	High temp., chemically inert, plastic/elastomer safe, food grade
L55/2	Barrierta L55/2 (Kluber)	Fluoro-carbon	PFPE	-40/+260 (-40/+500)		High temp., chemically inert, plastic/elastomer safe, food grade
LDS18A	LDS18 Spec.A (Kluber)	Synthetic	Lithium	-60/+130 (-76/+266)	G-23827A DTD844B	Low noise, high speed
M44	Molycote 44M (Dow Corning)	Silicon	Lithium	-40/+204 (-40/+400)	G-15719A	High temp., low load
MG28	Grease 28 (Mobil Oil)	Polyalpha -olefin	Clay	-54/+177 (-65/+350)	G-81322	Wide temp. range
N758G	Nyogel 758G (Nye)	Ester	Lithium	-40/+150 (-40/+302)		Electrically conductive
PEM	Polyrex EM (Mobil)	Mineral	Polyurea	-40/+180 (-40/+356)		Good water resistance, wide temp. range, low noise
PS2	Multemp PS2 (Kyodo Yushi)	Diester	Lithium	-55/+130 (-67/+266)		Low torque, low temp.
R374C	Rheolube 374C (Nye)	Polyalpha -olefin	Lithium	-40/+150 (-40/+302)		High speed, non migratory, good for vertical shaft use
SRI-2	Chevron SRI-2 (Caltex)	Mineral	Urea	-30/+175 (-22/+347)	G-3545G	Good water resistance, wide temp range
SRL	Multemp SRL (Kyodo Yushi)	Ester	Lithium	-50/+150 (-58/+302)		Low torque, quiet running, wide temp. range
TR215-2	Tribol GR215-2 (Castrol)	Synthetic	Proprietary	-40/+150 (-40/+302)		Cleanroom grease

Conversion table mm to inch

Inch Fraction	Inch Decimal	Milli-metres	Inch Fraction	Inch Decimal	Milli-metres	Inch Fraction	Inch Decimal	Milli-metres
1/64	0.0156	0.397	–	0.2756	7.0	–	0.6299	16.0
1/32	0.0312	0.794	9/32	0.2813	7.144	41/64	0.6406	16.272
–	0.0394	1.0	19/64	0.2969	7.541	21/32	0.6563	16.669
3/64	0.0469	1.191	5/16	0.3125	7.938	–	0.6693	17.0
–	0.0472	1.2	–	0.315	8.0	43/64	0.6719	17.066
–	0.0591	1.5	21/64	0.3281	8.334	11/16	0.6875	17.463
1/16	0.0625	1.588	11/32	0.3438	8.731	45/64	0.7031	17.859
–	0.0629	1.6	–	0.3543	9.0	–	0.7087	18.0
–	0.0709	1.8	23/64	0.3594	9.128	23/32	0.7188	18.256
5/64	0.0781	1.984	3/8	0.375	9.525	47/64	0.7344	18.653
–	0.0787	2.0	25/64	0.3906	9.922	–	0.748	19.0
–	0.0906	2.3	–	0.3937	10.0	3/4	0.75	19.05
3/32	0.0938	2.381	13/32	0.4063	10.319	49/64	0.7656	19.447
–	0.0984	2.5	27/64	0.4219	10.716	35/32	0.7813	19.844
–	0.1024	2.6	–	0.4331	11.0	–	0.7874	20.0
7/64	0.1094	2.778	7/16	0.4375	11.112	51/64	0.7969	20.241
–	0.1181	3.0	29/64	0.4531	11.509	13/16	0.8125	20.638
1/8	0.125	3.175	15/32	0.4688	11.906	–	0.8268	21.0
–	0.1378	3.5	–	0.4724	12.0	53/64	0.8281	21.034
9/64	0.1406	3.572	31/64	0.4844	12.303	27/32	0.8438	21.431
5/32	0.1562	3.969	1/2	0.50	12.7	55/64	0.8594	21.828
–	0.1575	4.0	–	0.5118	13.0	–	0.8661	22.0
11/64	0.1719	4.366	33/64	0.5156	13.097	7/8	0.875	22.225
–	0.1772	4.5	17/32	0.5313	13.494	57/64	0.8906	22.622
3/16	0.1875	4.762	35/64	0.5469	13.891	–	0.9055	23.0
–	0.1969	5.0	–	0.5512	14.0	29/32	0.9063	23.019
13/64	0.2031	5.159	9/16	0.5625	14.288	59/64	0.9219	23.416
7/32	0.2188	5.556	37/64	0.5781	14.684	15/16	0.9375	23.813
15/64	0.2344	5.953	–	0.5906	15.0	–	0.9449	24.0
–	0.2362	6.0	19/32	0.5938	15.081	61/64	0.9531	24.209
1/4	0.25	6.35	39/64	0.6094	15.478	31/32	0.9688	24.606
17/64	0.2656	6.747	5/8	0.625	15.875	–	0.9843	25.0

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Inside back cover

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