GECO™

Ball Bearings

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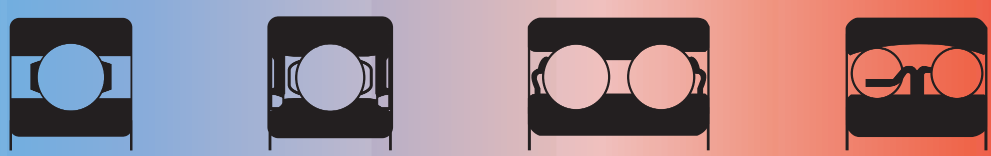

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Technical Information

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Ball Bearings

Pages for refer 028 ~ 054

1. Bearing materials

1.1 Raceway and rolling element materials

1.1.1 High/mid carbon alloy steel
In general,steel varieties which can be hardened not just on the surface but also deep hardened by the so-called "through hardening method" are used for the raceways and rolling elements of bearings. Foremost among these is high carbon chromium bearing steel, which is widely used.

1.1.2 Mid-carbon chromium steel
Mid-carbon chromium steel incorporating silicone and manganese, which gives it hardening properties comparable to high carbon chromium steel.

1.2 Cage materials
Bearing cage materials must have the strength to withstand rotational vibrations and shock loads. These materials must also have a low friction coefficient, be light weight, and be able to withstand bearing operation temperatures.

1.2.1 Pressed cages
For small and medium sized bearings, pressed cages of cold or hot rolled steel with a low carbon content of approx. 0.1% are used. However, depending on the application, austenitic stainless steel is also used.

1.2.2 Plastic cages
Injection molded plastic cages are now widely used: most are made from fiber glass reinforced heat resistant polyamide resin. Plastic cages are light weight, corrosion resistant and have excellent dampening and sliding properties. Heat resistant polyamide resins now enable the production of cages that perform well in applications ranging between -40˚C - 120˚C. However, they are not recommended for use at temperatures exceeding 120˚C.

1.2.3 Steel cages
For temperatures exceeding 120˚C, steel cages are required to use.

Tables 1.1 and 1.2 give the chemical composition for these representative cage materials.

Table 1.1 Chemical composition of steel plate for pressed cages and carbon steel for machined cages.

	Standard	Symbol	Chemical composition(%)						
			C	Si	Mn	P	S	Ni	Cr
Pressed retainers	JIS G 4305	SUS440 C	Max. 0.08	Max. 1.00	Max. 2.00	Max. 0.045	Max. 0.030	8.00~10.50	18.00~20.00

Table 1.2 Chemical composition of high-strength cast brass for machined cages

Standard	Symbol	Chemical composition(%)							Impurities	
		Cu	Zn	Mn	Fe	Al	Sn	Ni	Pb	Si
JIS H 5120	CAC301	55.0~60.0	33.0~42.0	0.1~1.5	0.5~1.5	0.5~1.5	Max. 1.0	Max. 1.0	Max. 0.4	Max. 0.1

2. External bearing sealing devices

External seals have two main functions: to prevent lubricating oil from leaking out, and, to prevent dust,water, and other contaminants from entering the bearing. When selecting a seal, the following factors need to be taken into consideration: the type of lubricant(oil or grease), seal peripheral speed, shaft fitting errors, space limitations, seal friction and resultant heat increase, and cost. Sealing devices for rolling bearings fall into two main classifications: non-contact seals and contact seals.

2.1 Non-contact seals:
Non-contact seals utilize a small clearance between the shaft and the housing cover. Theref ore friction is negligible,making them suitable forhigh speed applications. In order to improve sealing capability, clearance spaces are often filled with lubricant.

2.2 Contact seals:
Contact seals accomplish their sealing action through the contact pressure of a resilient the seal (the lip is often made of synthetic rubber) the sealing surface. Contact seals are generally far superior to noncontact seals in sealing efficieny, although their friction torque and temperature rise coefficients are higher. Furthermore, because the portion of a contact seal rotates while in contact wi the shaft,the allowable seal peripheral speed varie depending on seal type.

3. Bearing tolerances

3.1 Standard of tolerances
Ball bearing "tolerances"or dimensional accuracy and running accuracy, are regulated by ISO and JIS standards (rolling bearing tolerances). For dimensional accuracy, these standards prescribe the tolerances necessary when installing bearings on shafts or in housings.Running accuracy is defined as the allowable limits for bearing runout during operation.

Table 3.1 Comparison of tolerance classifications of national standards

Standard		Tolerance class				
Japanese industrial standard (JIS)	JIS	class 0,6X	class 6	class 5	class 4	class 2
International Organization for Standardization (ISO)	ISO	Normal class Class 6X	Class 6	Class 5	Class 4	Class 2
Deutsches Institut fur Normung(ISO)	DIN	P0	P6	P5	P4	P2
American National Standards Institute (ANSI)	ANSI/ABMA	ABEC-1	ABEC-3	ABEC-5	ABEC-7	ABEC-9

Table 3.2 Bearings types and applicable tolerance

Bearing type	Applicable standard	Applicable tolerance class				Applicable table
Ball bearings	JIS B 1514 ISO 492 (GECO standard)	class 0	class 6	class 5	class 4	Table 3.3
Angular contact ball bearings		class 0	class 6	class 5	class 4	Table 3.3
Self-aligning ball bearings		class 0	class 6	class 5	class 4	Table 3.3

Note: JIS B 1514 and ISO 492 have the same specification level.

Table 3.3 Tolerances for radial ball bearings

Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δdmp										Single radial plane bore diameter variation Vdp									
		class 0		class 6		class 5		class 4 ❶		class 2 ❶		diameter series 9					maxdiameter series 0.1				
												class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2
over	incl.	high	low	high	low	high	low	high	low	high	low	max.					max.				
10	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5
18	30	0	-10	0	-8	0	-6	0	-5	0	-2.5	13	10	6	5	2.5	10	8	5	4	2.5
30	50	0	-12	0	-10	0	-8	0	-6	0	-2.5	15	13	8	6	2.5	12	10	6	5	2.5
50	80	0	-15	0	-12	0	-9	0	-7	0	-4.0	19	15	9	7	4.0	19	15	7	5	4.0
80	120	0	-20	0	-15	0	-10	0	-8	0	-5.0	25	19	10	8	5.0	25	19	8	6	5.0

Nominal bore diameter d mm		Single radial plane bore diameter variation Vdp					Mean single plane bore diameter variation $Vdmp$					Inner ring radial runout Kia					Face runout with bore Sd		
		maxdiameter series 2,3,4																	
		class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 5	class 4	class 2
over	incl.	max.					max.					max.					max.		
10	18	6	5	4	3	2.5	6	5	3	2.0	1.5	10	7	4	2.5	1.5	7.0	3.0	1.5
18	30	8	6	5	4	2.5	8	6	3	2.5	1.5	13	8	4	3.0	2.5	8.0	4.0	1.5
30	50	9	8	6	5	2.5	9	8	4	3.0	1.5	15	10	5	4.0	2.5	8.0	4.0	1.5
50	80	11	9	7	5	4.0	11	9	5	3.5	2.0	20	10	5	4.0	2.5	8.0	5.0	1.5
80	120	15	11	8	6	5.0	15	11	5	4.0	2.5	25	13	6	5.0	2.5	9.0	5.0	2.5

(Unit : μm)

Nominal bore diameter d mm		Inner ring axial runout (with side) Sia ❷			Inner ring width deviation ΔBs										Inner ring width varietion VBs				
					normal						modified ❸								
		class 5	class 4	class 2	class 0,6		class 5,4		class 2		class 0,6		class 5,4		class 0	class 6	class 5	class 4	class 2
over	incl.				high	low	high	low	high	low	high	low	high	low	max.				
10	18	7	3	1.5	0	-120	0	- 80	0	- 80	0	- 250	0	- 250	20	20	5	2.5	1.5
18	30	8	4	2.5	0	-120	0	-120	0	-120	0	-250	0	-250	20	20	5	2.5	1.5
30	50	8	4	2.5	0	-120	0	-120	0	-120	0	-380	0	-250	20	20	5	3.0	1.5
50	80	8	5	2.5	0	-150	0	-150	0	-150	0	-380	0	-250	25	25	6	4.0	1.5
80	120	9	5	2.5	0	-200	0	-200	0	-200	0	-380	0	-380	25	25	7	4.0	2.5

Note: ❶ The dimensional difference Δds of bore diameter to applied for class 4 and 2 is the same as the tolerance of dimentional difference Δdmp of average bore diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and to all the diameter series against Class 2.

❷ To be applied for deep groove ball bearing and angular contact ball bearings.

❸ To be applied for individual raceway rings manufactured for combined bearing use.

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Outer rings (Unit : μm)

Nominal Outside diameter D mm over	incl.	Single plane mean outside diameter deviation $\triangle Dmp$ class 0 high	class 0 low	class 6 high	class 6 low	class 5 high	class 5 low	class 4 ❺ high	class 4 ❺ low	class 2 ❺ high	class 2 ❺ low	Single radial plane outside diameter variation VDp diameter series 9 class 0 max.	class 6	class 5	class 4	class 2	maxdiameter series 0.1 class 0 max.	class 6	class 5	class 4	class 2
6	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5
18	30	0	-9	0	-8	0	-6	0	-5	0	-4.0	12	10	6	5	4.0	9	8	5	4	4.0
30	50	0	-11	0	-9	0	-7	0	-6	0	-4.0	14	11	7	6	4.0	11	9	5	5	4.0
50	80	0	-13	0	-11	0	-9	0	-7	0	-4.0	16	14	9	7	4.0	13	11	7	5	4.0
80	120	0	-15	0	-13	0	-10	0	-8	0	-5.0	19	16	10	8	5.0	19	16	8	6	5.0
120	150	0	-18	0	-15	0	-11	0	-9	0	-5.0	23	19	11	9	5.0	23	19	8	7	5.0
150	180	0	-25	0	-18	0	-13	0	-10	0	-7.0	31	23	13	10	7.0	31	23	10	8	7.0
180	250	0	-30	0	-20	0	-15	0	-11	0	-8.0	38	25	15	11	8.0	38	25	11	8	8.0

Nominal Outside diameter D mm over	incl.	Single radial plane outside diameter variation VDp maxdiameter series 2.3.4 class 0 max.	class 6	class 5	class 4	class 2	Single radial plane outside diameter variation VDp❻ capped bearings diameter series 2,3,4 class 0 max.	0,1,2,3,4 class 6	Mean single plane outside diameter variation $VDmp$ class 0 max.	class 6	class 5	class 4	class 2
6	18	6	5	4	3	2.5	10	9	6	5	3	2.0	1.5
18	30	7	6	5	4	4.0	12	10	7	6	3	2.5	2.0
30	50	8	7	5	5	4.0	16	13	8	7	4	3.0	2.0
50	80	10	8	7	5	4.0	20	16	10	8	5	3.5	2.0
80	120	11	10	8	6	5.0	26	20	11	10	5	4.0	2.5
120	150	14	11	8	7	5.0	30	25	14	11	6	5.0	2.5
150	180	19	14	10	8	7.0	38	30	19	14	7	5.0	3.5
180	250	23	15	11	8	8.0	—	—	23	15	8	6.0	4.0

(Unit : μm)

Nominal Outside diameter D mm over	incl.	Outer ring radial runout Kea class 0 max.	class 6	class 5	class 4	class 2	Outside surface inclination SD class 5 max.	class 4	class 2	Outside ring axial runout Sea❼ class 5 max.	class 4	class 2	Outer ring width deviation $\triangle Cs$ all type	Outer ring width variation Vcs class 0,6	class 5 max.	class 4	class 2
6	18	15	8	5	3	1.5	8	4	1.5	8	5	1.5	Identical to $\triangle Bs$ of inner ring of same bearing	Identical to $\triangle Bs$ and Vbs of inner ring of same bearing	5	2.5	1.5
18	30	15	9	6	4	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
30	50	20	10	7	5	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
50	80	25	13	8	5	4.0	8	4	1.5	10	5	4.0			6	3.0	1.5
80	120	35	18	10	6	5.0	9	5	2.5	11	6	5.0			8	4.0	2.5
120	150	40	20	11	7	5.0	10	5	2.5	13	7	5.0			8	5.0	2.5
150	180	45	23	13	8	5.0	10	5	2.5	14	8	5.0			8	5.0	2.5
180	250	50	25	15	10	7.0	11	7	4.0	15	10	7.0			10	7.0	4.0

Note: ❺ The dimensional difference $\triangle Ds$ of outer diameter to be applied for classes 4 and 2 is the same as the tolerance of dimensional difference $\triangle Dmp$ of average outer diameter. However,the dimensional difference is applied to diameter series 0,1.2.3 and 4 against Class 4, and also to all the diameter series against Cfass 2.

❻ To be applied in case snap rings are not installed on the bearings.

❼ To be applied for Deep Groove Ball Bearings and Angular Contact Ball Bearings.

3.2 Chamfer measurements and tolerance or allowable values of tapered bore

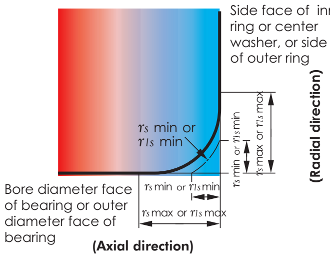


Table 3.4 Allowable critical-value of bearing chamfer

(Unit: μm)

r_s min ❶ or r_s min	Nominal bore ❷ diameter of bearing "d" or nominal outside diameter "D"		r_s max or r_s max	
	over	incl.	Radial direction	Axial direction
0.3	-	40	0.7	1.4
0.3	40	-	0.9	1.6
0.6	-	40	1.1	1.7
0.6	40	-	1.3	2.0
1.0	-	50	1.6	2.5
1.0	50	-	1.9	3.0
1.5	-	120	2.3	3.0
1.5	120	250	2.8	3.5
1.5	250	-	3.5	4.0
2.0	-	120	2.8	4.0
2.0	120	250	3.5	4.5
2.0	250	-	4.0	5.0
2.5	-	120	3.5	5.0
2.5	120	250	4.0	5.5
2.5	250	-	4.5	6.0
3.0	-	120	4.0	5.5
3.0	120	250	4.5	6.5
3.0	250	400	5.0	7.0
3.0	400	-	5.5	7.5
4.0	-	120	5.0	7.0
4.0	120	250	5.5	7.5
4.0	250	400	6.0	8.0
4.0	400	-	6.5	8.5
5.0	-	180	6.5	8.0
5.0	180	-	7.5	9.0
6.0	-	180	7.5	10.0
6.0	180	-	9.0	11.0

4. Bearing fits

4.1 Interference

For rolling bearings, inner and outer rings are fixed on the shaft or in the housing so that relative movement does not occur between fitted surfaces during operation or under load. This relative movement (referred to as "creep") between the fitted surfaces of the bearing and the shaft or housing can occur in a radial direction, an axial direction, or in the direction of rotation. To help prevent this creeping movement, bearing rings and the shaft or housing are installed with one of three interference fits, a "tight fit" (also called shrink fit), "transition fit," or "loose fit" (also called clearance fit), and the degree of interference between their fitted surfaces varies.

The most effective way to fix the fitted surfaces between a bearing's raceway and shaft or housing is to apply a "tight fit." The advantage of this tight fit for thin walled bearings is that it provides uniform load support over the entire ring circumference without any loss of load carrying capacity. However, with a tight fit, ease of installation and disassembly is lost; And when using a non-separable bearing as the floating-side bearing, axial displacement is not possible. For this reason, a tight fit cannot be recommended in all cases.

4.2 The necessity of a proper fit
In some cases, improper fit may lead to damage and shorten bearing life, therefore it is necessary to make a careful analysis in selecting a proper fit. Some of the negative conditions caused by improper fit are listed below.

- Raceway cracking, early peeling and displacement of raceway
- Raceway and shaft or housing abrasion caused by creeping and fretting corrosion
- Seizing caused by loss of internal clearances
- Increased noise and lowered rotational accuracy due to raceway groove deformation

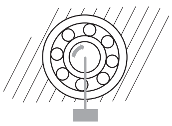
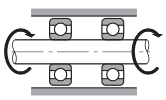
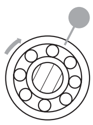
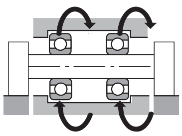
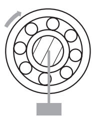
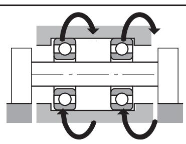
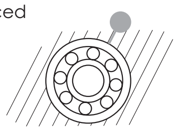
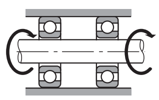
4.3 Fit selection
Selection of a proper fit is dependent upon thorough analysis of bearing operating conditions, including consideration of:

- Shaft and housing material, wall thickness, finished surface accuracy, etc.
- Machinery operating conditions (nature and magnitude of load, rotational speed, temperature, etc.)

4.3.1 "Tight fit," "transition fit," or "loose fit"
For raceways under rotating loads, a tight fit is necessary. (Refer to Table 4.1) "Raceways under rotating loads" refers to raceways receiving loads rotating relative to their radial direction. For raceways under static loads, on the other hand, a loose fit is sufficient.
(Example) Rotating inner ring load the direction of the radial load on the inner ring is rotating relatively.

For non-separable bearings, such as Deep Groove Ball Bearings, it is generally recommended that either the inner ring or outer ring be given a loose fit.

Table 4.1 Radial load for ball bearings

Illustration	Bearing rotation	Ring load	Fit
Static load 	 Inner ring: Rotating Outer ring: Stationary	Rotating inner ring load	Inner ring: Tight fit
Unbalanced load 	 Inner ring: Stationary Outer ring: Rotating	Static outer ring load	Outer ring: Loose fit
Static load 	 Inner ring: Stationary Outer ring: Rotating	Static inner ring load	Inner ring: Loose fit
Unbalanced load 	 Inner ring: Rotating Outer ring: Stationary	Rotating outer ring load	Outer ring: Tight fit

4.3.2 Recommended Fits

The system of limits and fits define the tolerances of the outside diameter of the shaft or the bore diameter of a housing (the shaft or housing to which a metric bearing is installed). Bearing fit is governed by the selection of tolerances for the shaft outside diameter and housing bore diameter. Fig . 3.1 summarizes the interrelations between shaft outside diameter and bearing bore diameter, and between housing bore diameter and shaft outside diameter.Table 3.2 provides the recommended fits for common radial needle roller bearings (machined ring needle roller bearings with inner ring), relative to dimensions and loading conditions. Table 3.3 is a table of the numerical value of fits.

4.3.3 Interference minimum and maximum values

The following points should be considered when it is necessary to calculate the interference for an application:

- In calculating the minimum required amount of interference keep in mind that:
  1) interference is reduced by radial loads
  2) interference is reduced by differences between bearing temperature and ambient temperature
  3) interference is reduced by variation of fitted surfaces
- Maximum interference should be no more than 1:1000 of the shaft diameter or outer diameter. Required interference calculations are shown below.

4.3.3.1 Fitted surface variation and required interference

Interference between fitted surfaces is reduced by roughness and other slight variations of these surfaces which are flattened in the fitting process. The degree of reduced interference depends upon the finish treatment of these surfaces, but in general it is necessary to assume the following interference reductions.

For ground shafts: 1.0 ~ 2.5 μm
For lathed shafts : 5.0 ~ 7.0 μm

4.3.3.2 Maximum interference

When bearing rings are installed with an interference fit, tension or compression stress may occur along their raceways. If interference is too great, this may cause damage to the rings and reduce bearing life . For these reasons , maximum interference should not exceed the previously mentioned ratio of 1:1,000 of the shaft or outside diameter.

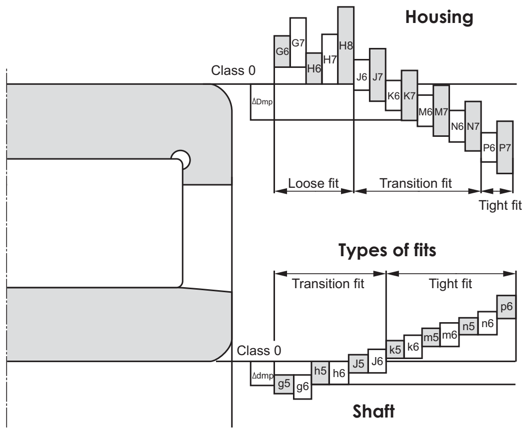


Fig. 4.1

5. Bearings internal clearance

Bearings internal clearance (initial clearance) is the amount of internal clearance a bearing has before being installed on a shaft or in a housing. The internal clearance valves for GECO ball bearing classes are shown in tables 5.1 to 5.5

Table 5.1 Radial internal clearance of ball bearings **(Unit : μm)**

Nominal bore diameter d (mm)		C2		CN		C3		C4		C5	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
6	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140

Table 5.2 Radial internal clearance for self-aligning ball bearings (for bearing with cylindrical bore) **(Unit : μm)**

Nominal bore diameter d (mm)		Bearing with cylindrical bore							
		C2		Normal		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
6	10	2	9	6	17	12	25	19	33
10	14	2	10	6	19	13	26	21	35
14	18	3	12	8	21	15	28	23	37
18	24	4	14	10	23	17	30	25	39
24	30	5	16	11	24	19	35	29	46
30	40	6	18	13	29	23	40	34	53
40	50	6	19	14	31	25	44	37	57
50	65	7	21	16	36	30	50	45	69
65	80	8	24	18	40	35	60	54	83

Table 5.3 Radial internal clearance for self-aligning Ball Bearings (for bearing with tapered bore) (Unit : μm)

Nominal bore diameter d (mm)		Bearing with tapered bore							
		C2		Normal		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
6	10	—	—	—	—	—	—	—	—
10	14	—	—	—	—	—	—	—	—
14	18	—	—	—	—	—	—	—	—
18	24	7	17	13	26	20	33	28	42
24	30	9	20	15	28	23	39	33	50
30	40	12	24	19	35	29	46	40	59
40	50	14	27	22	39	33	52	45	65
50	65	18	32	27	47	41	61	56	80
65	80	23	39	35	57	50	75	69	98

Table 5.4 Radial internal clearance of double row angular contact ball bearings (Unit : μm)

Nominal bore diameter d (mm)		C2		Normal		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
-	10	6	12	8	15	15	22	22	30
10	18	6	12	8	15	15	24	30	40
18	30	6	12	10	20	20	32	40	55
30	50	8	14	14	25	25	40	55	75

Table 5.5 Radial internal clearance of ball bearings (60, 62 and 63 series) for electric motor

(Unit : μm)

Nominal bore diameter d (mm)		Radial internal clearance CM Deep groove ball bearings	
over	incl.	min.	max.
10(incl.)	18	4	11
18	24	5	12
24	30	5	12
30	40	9	17
40	50	9	17
50	65	12	22
65	80	12	22

6. Lubrication

6.1 Lubrication of rolling bearings

The purpose of bearing lubrication is to prevent direct metallic contact between the various rolling and sliding elements. This is accomplished through the formation of a thin oil (or grease) film on the contact surfaces. However, for rolling bearings, lubrication has the following advantages:

(1) Friction and wear reduction
(2) Friction heat dissipation
(3) Prolonged bearing life
(4) Prevention of rust
(5) Protection against harmful elements

In order to achieve the above effects, the most effective lubrication method for the operating conditions must be selected. Also a good quality, reliable lubricant must be selected. In addition, an effectively designed sealing system that prevents the intrusion of damaging elements (dust, water, etc.) into the bearing interior, removes other impurities from the lubricant, and prevents lubricant from leaking to the outside, is also a requirement.

Almost all rolling bearings use either grease or oil lubrication methods, but in some special applicatic solid lubricant such as molybdenum disulfide or graphite may be used.

6.2 Grease lubrication
Grease type lubricants are relatively easy to handle require only the simplest sealing devicesfor these reasons, grease is the most widely used lubricant rolling bearings.

6.2.1 Types and characteristics of grease
Lubricating grease are composed of either a mineral base or a synthetic oil base. To this base a thicks other additives are added. The properties of all greases are mainly determined by the kind of base oil use the combination of thickening agent and various additives.

Standard greases and their characteristics are Table 6.2. As performance characteristics of even same type of grease will vary widely from brand, it is best to check the manufacturers' data when selecting a grease.

6.3 Lubrication methods and characteristics
The lubrication methods come in two general methods: grease or oil, each with their own characteristics. These characteristics are shown in Table 6.1

Table 6.1 Comparison of grease lubrication and oil lubrication characteristics

Method / Concern	Grease lubrication	Oil lubrication
Handling	Very good	Fair
Reliability	Good	Very good
Cooling effect	Poor	Good (circulation necessary)
Seal structure	Good	Fair
Power loss	Good	Good
Environment contamination	Good	Fair
High speed rotation	Poor	Good

6.4 Grease lubrication
Grease type lubricants are relatively easy to handle and require only the simplest sealing devices. For these reasons, grease is the most widely used lubricant for rolling bearings.

6.4.1 Types and characteristics of grease
Lubricating grease are composed of either a mineral ol base or a synthetic oil base. To this base a thickener and other additives are added. The properties of all greases are mainly determined by the kind of base oil used and by the combination of thickening agent and various additives.

Standard greases and their characteristics are listed in Table 6.2 as performance characteristics of even the same type of grease will vary widely from brand to brand, it is best to check the manufacturers' data when selecting a grease.

Also, greases of different brands should not be mixed because of the different additives they contain.

However, if different greases must be mixed, at least greases with the same base oil and thickening agent should be selected. But even when greases of the samel base oil and thickening agent are mixed, the quality of U grease may still change due to the difference in additives. For this reason, changes in consistency and other qualities should be checked before being applied.

Table 6.2 Grease varieties and characteristics

Grease name	Lithium grease			Sodium grease (Fiber grease)	Calcium compound base grease
Thickener	Li soap			Na soap	Ca+Na soap Ca+Li soap
Base oil	Mineral oil	Diester oil	Silicone oil	Mineral oil	Mineral oil
Dropping poin °C	170 ~ 190	170 ~ 190	200 ~ 250	150 ~ 180	150 ~ 180
Operating temperature range °C	-30 ~ +130	-50 ~ +130	-50 ~ +160	-20 ~ +130	-20 ~ +120
Mechanical stability	Excellent	Good	Good	Excellent ~ Good	Excellent ~ Good
Pressure resistance	Good	Good	poor	Good	Excellent ~ Good
Water resistance	Good	Good	Good	Good ~ poor	Good ~ poor
Applications	Widest range of applications. Grease used in all types of rolling bearings.	Excellent low temperature and wear characteristics. Suitable for small sized and miniature bearings.	Suitable for high and low temperatures. Unsuitable for heavy load applications due to low oil film strength.	Some emulsification when water is introduced. Excellent characteristics at relatively high temperatures.	Excellent pressure resistance and mechanical stability. Suitable for bearings receiving shock loads.

Grease name	Aluminum grease	Non-soap base grease Thickener	
Thickener	Al soap	Bentone, silica gel, urea, carbon black, fluorine compounds, etc.	
Base oil	Mineral oil	Mineral oil	Synthetic oil
Dropping poin °C	70 ~ 90	250 or above	250 or above
Operating temperature range °C	-10 ~ +80	-10 ~ +130	-50 ~ +200
Mechanical stability	Good ~ poor	Good	Good
Pressure resistance	Good	Good	Good
Water resistance	Good	Good	Good
Applications	Excellent viscosity characteristics. Suitable for bearings subjected to vibrations.	Can be used in a wide range of low to high temperatures. Shows excellent heat resistance, cold resistance, chemical resistance, and other characteristics when matched with a suitable base oil and thickener. Grease used in all types of roiling bearings.	

6.4.2 Amount of grease

The amount of grease used in any given situation will depend on many factors relating to the size and shaped the housing, space limitations, bearing's rotating speed and type of grease used.

As a general rule, housings and bearings should be only filled from 50% to 80% of their capacities.

Where speeds are high and temperature rises need to be kept to a minimum, a reduced amount of grease should be used. Excessive amounts of grease cause temperature rise which in turn causes the grease to soften and may allow leakage. With excessive grease fills oxidation and deterioration may cause lubricating efficiency to be lowered.

Moreover, the standard bearing space can be found by below formula (6.1)

$V = K \cdot W$ .... Formula (6.1)

where,
V : Quantity of bearing space open type (approx.) cm^3
K : Bearing space factor (Table 6.3)
W : Mass of bearing kg (See bearing tables)

Table 6.3 Bearings space ratio K

Bearing type	Retainer type	K
Ball bearings	Pressed or Machined retainer	35

7. Load rating and life

7.1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly being subjected to repeated compressive stresses which causes flaking of these surfaces to occur. This flaking is due to material fatigue and will eventually cause the bearings to fail. The effective life of a bearing is usually defined in terms of the total number of revolutions a bearing can undergo before flaking of either the raceway surface or the olling element surfaces occurs.

Other causes of bearing failure are often attributed to problems such as seizing, abrasions, cracking, chipping, gnawing, rust, etc. However, these so called "causes" of bearing failure are usually themselves caused by improper installation, insufficient or improper lubrication, faulty sealing or inaccurate bearing selection. Since the above mentioned "causes" of bearing failure can be avoided by taking the proper precautions,and are not simply caused by material fatigue, they are considered separately from the flaking aspect.

7.2 Basic rating life and basic dynamic load rating

A group of seemingly identical bearings when subjected to identical load and operating conditions will exhibit a wide diversity in their durability.

This " life " disparity can be accounted for by the difference in the fatigue of the bearing material itself. This disparity is considered statistically when calculating bearing life, and the basic rating life is defined as follows.

The basic rating life is based on a 90% statistical model which is expressed as the total number of revolutions 90% of the bearings in an identical group of bearings subjected to identical operating conditions will attain or surpass before flaking due to material fatigue occurs. For bearings operating at fixed constant speeds, the basic rating life (90% reliability) is expressed in the total number of hours of operation.

The basic dynamic load rating is an expression of the load capacity of a bearing based on a constant load which the bearing can sustain for one million revolutions (the basic life rating). For radial bearings this rating applies to pure radial loads, and for thrust bearings it refers to pure axial loads. The basic dynamic load ratings given in the bearing tables of this catalog are for bearings constructed of GECO standard bearing materials, using standard manufacturing techniques. Please consult GECO e ngineering for basic load ratings of bearings constructed of special materialsor using special manufacturing techniques.

The relationship between the basic rating life, the basic dynamic load rating and the bearing load is given in formula (7.1).

$L_{10} = (\frac{C}{P})^{P}$..............(7.1)

where,

$P = 3$ ················ For ball bearings

L_{10} : Basic rating life 106 revolutions

C : Basic dynamic rating load, n

(Cr: radial bearings)

P : Equivalent dynamic load, n

(Pr: radial bearings)

The basic rating life can also be expressed in terms of hours of operation (revolution), and is calculated as shown in formula (7.2).

$L_{10h} = 500 f_h{}^{p}$..............(7.2)

$f_h = f_n \frac{C}{P}$ ....(7.3)

$f_n = (\frac{33.3}{n})^{1/p}$..........(7.4)

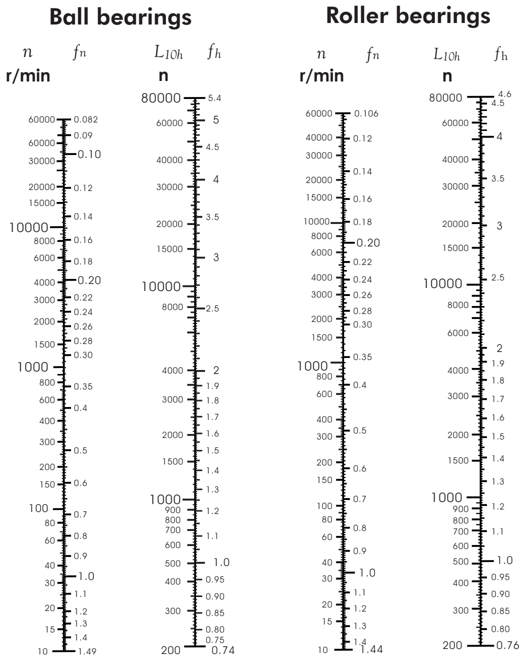


Fig. 7.1 Bearing life rating scale

where,

L_{10} : Basic rating life, h

f_h : Life factor

f_n : Speed factor

n : Rotational speed, r/min

Formula (7.2) can also be expressed as shown in formula (7.5).

$L_{10h} = \frac{10^6}{60n}(\frac{C}{P})^{P}$..............(7.5)

The relationship between rotational speed n and speed factor fn as well as the relation between the basic rating life L10h and the life factor fn is shown in Fig. 7.1. When several bearings are incorporated in machines or equipment as complete units, all the bearings in the unit are considered as a whole when computing bearing life (see formula 7.6). The total bearing life of the unit is a life rating based on the viable lifetime of the unit before even one of the bearings fails due to rolling contact fatigue.

$L = \frac{1}{(\frac{1}{L_1{}^e} + \frac{1}{L_2{}^e} + \ldots \frac{1}{L_n{}^e})^{1/e}}$ ....(7.6)

where,
e = 10/9.......................For ball bearings
L = Total basic rating life or entire unit, h
$L_1, L_2 ... L_n$: Basic rating life or individual bearings, 1, 2,...n, h

When the load conditions vary at regular intervals, the life can be given by formula (7.7).
$L_m = (\Sigma\ \phi_j\ /\ L_j)^{-1}$...............................(7.7)

where,
ϕj : Frequency of individual load conditions
Lj : Life under individual conditions

7.3 Machine applications and requisite life
When selecting a bearing, it is essential that the requisite life of the bearing be established in relation to the operating conditions.The requisite life of the bearing is usually determined by the type of machine in which the bearing will be used, and duration of service and operational reliability requirements. When determining bearing size, the fatigue life of the bearing is an important factor; however, besides bearing life, the strength and rigidity of the shaft and housing must also be taken into consideration.

7.4 Adjusted life rating factor
The basic bearing life rating (90% reliability factor) can be calculated through the formulas mentioned earlier in Section 7.2. However, in some applications a bearing fife factor of over 90% reliability may be required. To meet these requir ements, bearing life can be lengthened by the use of specially improved bearing materials or special construction techniques. Moreover, according to elastohydrodynamic lubrication theory, it is clear that the bearing operating conditions (lubrication, temperature, speed, etc.) all exert an effect on bearing life. All these adjustment factors are taken into consideration when calculating bearing life, the adjusted bearing life can be determined.

$L_{na} = a1 \cdot a2 \cdot a3 \cdot (C/P)^P$...........(7.8)

where,
L_{na} : Adjusted life rating in millions of revolutions (10^6)(adjusted for reliability, material and operating conditions)
$a1$: Reliability adjustment factor
$a2$: Material adjustment factor
$a3$: Operating condition adjustment factor

7.4.1 Life adjustment factor for reliability a_1
The values for the reliability adjustment factor ai (for a reliability factor higher than 90%) can be found in Table 7.1

Table 7.1 Reliability adjustment factor values a_1

Reliability %	L_n	Reliability factor a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

7.4.2 Life adjustment factor for material a_2

The life of a bearing is affected by the material type and quality as well as the manufacturing process.In this regard, the life is adjusted by the use of an a_2 factor.

The basic dynamic load ratings listed in the catalog are based on GECO's standard material and process, therefore, the adjustment factor a_2 =1. When special materials or processes are used the adjustment factor can be larger than 1.

GECO bearings can generally be used up to 120。C.If bearings are operated at a higher temperature, the bearing must be specially heat treated (stabilized) so that inadmissible dimensional change does not occur due to changes in the micro-structure. This special heat treatment might cause the reduction of bearing life because of a hardness change.

7.4.3 Life adjustment factor a_3 for operating conditions

The operating conditions life adjustment factor a_3 is used to adjust for such conditions as lubrication, operating temperature, and other operation factors which have an effect on bearing life.

Generally speaking, when lubricating conditions are satisfactory, the a_3 factor has a value of one; and when lubricating conditions are exceptionally favorable, and all other operating conditions are normal, as can have a value greater than one.

However, when lubricating conditions are particularly unfavorable and the oil film formation on the contact surfaces of the raceway and rolling elements is insufficient, the value of a_3 becomes less than one. This Insufficient oil film formation can be caused, for example, by the lubricating oil viscosity being too low for the operating temperature (below13 mm2/s for ball bearings or by exceptionally low rotational speed (nr/min x dpmm less than 10,000). For bearings used under special operating conditions, please consult GECO engineering.

As the operating temperature of the bearing increases, the hardness of the bearing material decreases . Thus , the bearing life correspondingly decreases. The opera-ting temperature adjustment values are shown in Fig.7.2.

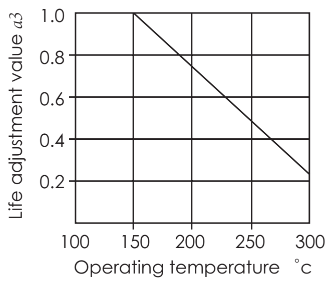


Fig. 7.2 Life adjustment value for operating temperature

7.5 Life of bearing with oscillating motion

The life of a radial bearing with oscillating motion can be calculated according to formula (7.9).

$L_{osc} = \Omega L_{Rot}$ .... (7.9)

where,

L_{osc} : life for oscillating bearing

L_{Rot} : rating life at assumed number of rotations same as oscillation cycles

Ω : oscillation factor (Fig.7.3 indicates the relationship between half oscillation angle β and Ω).

Fig. 7.3 is valid only when the amplitude exceeds a certain degree (critical angle $2\beta c$). The critical angle is determined by the internal design of the bearing, in particular by the number of rolling elements in one row. Critical angle values are given in Table 7.3. When the magnitude of the oscillation is less than the critical angle, the life may be shorter than that calculated to be the value in Fig.7.3 It is safer to calculate life with the factor Ω corresponding to the critical angle. For the critical angle of an individual bearing, please consult GECO Engineering. Where the amplitude of the oscillation 2β is small, it is difficult for a complete lubricant film to form on the contact surfaces of the rings and rolling elements, and fretting corrosion may occur. Therefore it is necessary to exercise extreme care in the selection of bearing type, lubrication and lubricant.

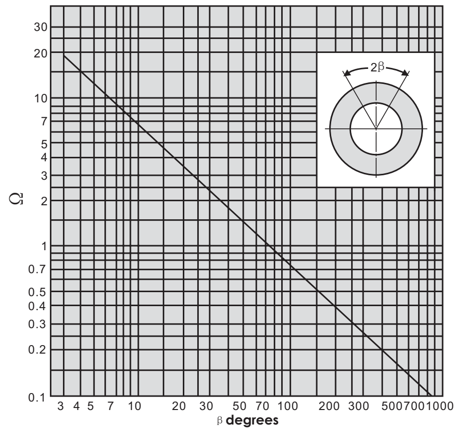


Fig. 7.3 Relationship between half angle β and factor Ω

Table 7.3 Critical angle

Number of rolling elements	Half critical angle βc
10	10°
25	4°
40	2.6°

7.6 Life of bearing with linear motion

With a linear motion bearing such as a linear ball bearing or linear flat roller bearing, the relation among the axial travel distance, bearing load, and load rating is expressed by formulas (7.10).

When the rolling elements are rollers:

$$L = 100 \times \left(\frac{C_r}{P_r}\right)^{\frac{10}{3}} \text{....................(7.10)}$$

where,

L : Load rating km

Cr : Basic dynamic load rating [kgf]

Pr : Bearing load [kgf]

If the cycle and travel distancewithin a particular travel motion remain constant, the rating life of the bearing can be determined by formulas (7.11).

$$L_h = \frac{50\times10^3}{10\cdot S}\left(\frac{C_r}{P_r}\right)^{\frac{10}{3}} \text{................ (7.11)}$$

Where,

Lh : Travel life, h

S : Travel distance per minute, m/min.

$S = 2 \cdot L \cdot N$

L : Stroke length, m

n : Stroke cycle, N{kgf}

Fig. 7.4 summarizes the relation between Cr/Pr **and** L.

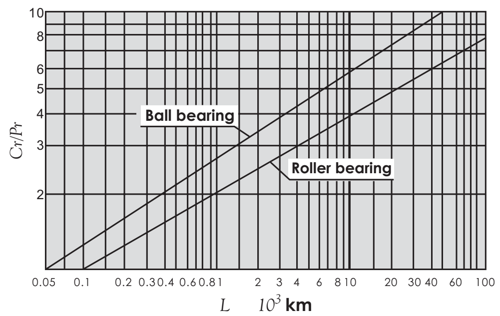


Fig. 7.4 Life of bearing with axial motion

7.7 Basic static load rating
When stationary rolling bearings are subjected to static loads, they suffer from partial permanent deformation of the contact surfaces at the contact point between the rolling elements and the raceway. The amount of deformity increases as the load increases, and if this increase in load exceeds certain limits, the subsequent smooth operation of the bearings is impaired.

It has been found through experience that a permanent deformity of 0.0001 times the diameter of the rolling element, occurring at the most heavily stressed contact point between the raceway and the rolling elements, can be tolerated without any impairment in running efficiency.

The basic rated static load refers to a fixed static load limit at which a specified amount of permanent deformation occurs. It applies to pure radial loads for radial bearings and to pure axial loads for thrust bearings. The maximum applied load values for contact stress occurring at the rolling element and raceway contact points are given below.

For Ball Bearings (except Self-aligning Ball Bearings)	4,200 Mpa
For Self-aligning Ball Bearings	4,600 Mpa

7.8 Allowable static equivalent load
Generally the static equivalent load which can be permitted is limited by the basic static rated load as stated in Section 7.7. However, depending on requirements regarding friction and smooth operation, these limits may be greater or lesser than the basic static rated load.

In the following formula (7.12) and Table 6.4 the safety factor S_o can be determined considering the maximum static equivalent load.

$S_o = C_o / P_o$ ...... (7.12)

where,
S_o : Safety factor
C_o : Basic static rated load, N
(radial bearings: C_{or}, thrust bearings: C_{oa})
$P_o\ max$: Maximum static equivalent load, N
(radial: $P_{or}\ max$, thrust: $C_{oa}\ max$)

Table 7.4 Minimum safety factor values S_o

Operating conditions	Ball bearings	Roller bearings
High rotational accuracy demand	2.0	3.0
Normal rotating accuracy demand (Universal application)	1.0	1.5
Slight rotational accuracy deterioration permitted (Low speed, heavy loading, etc.)	0.5	1.0

Note 1 : For drawn-cup spherical roller bearings, min. S_o value=3.
2 : When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_o max value.

8. Bearing handling

Bearings are precision parts and, in order to preserve their accuracy and reliability, care must be exercised in their handling. In particular, bearing cleanliness must be maintained, sharp impacts avoided, and rust prevented.

8.1 Bearing storage

Most rolling bearings are coated with a rust preventative before being packed and shipped, and they should be stored at room temperature with a relative humidity of less than 60%.

8.2 Installation

When bearings are being installed on shafts or in housings, the bearing rings should never be struck directly with a hammer or a drift, as shown in Fig. 8.1, because damage to the bearing may result. Any force applied to the bearing should always be evenly distributed over the entire bearing ring face.

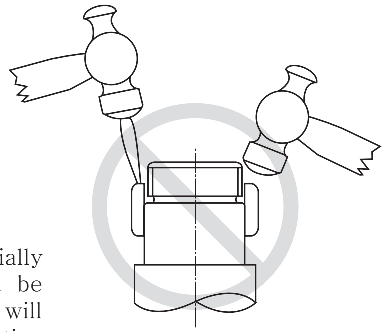


Fig. 8.1

8.2.1 Installation preparations

Bearings should be fitted in a clean, dry work area. Especially for small and miniature bearings, a "clean room" should be provided as any contamination particles in the bearing will greatly affect bearing efficiency. Before installation, all fitting tools, shafts, housings, and related parts should be cleaned and any burrs or cutting chips removed if necessary. Shaft and housing fitting surfaces should also be checked for roughness, dimensional and design accuracy, and to ensure that they are within allowable tolerance limits.
Bearings should not be unwrapped until just prior to installation. Normally, bearings to be usedwith grease lubricant can be installed as is, without removing the rust preventative. However, for bearings which will use oil lubricant, or in cases where mixing the grease and rust preventative would result in loss of lubrication efficiency, the rust preventative should be removed by washing with benzene or petroleum solvent and dried before installation. Bearings should also be washed and dried before installation if the package has been damaged or there are other chances that the bearings have been contaminated. Double shielded bearings and sealed bearings, one way clutches should never be washed.

8.2.2 Installing cylindrical bore bearings

Bearings with relatively small interference fits can be press fit at room temperature by using a sleeve against the inner ring face as shown in Fig. 8.2. Usually, bearings are installed by striking the sleeve with a hammer; however, when installing a large number of bearings, a mechanical or hydraulic press should be used.

When installing non-separable bearings on a shaft and in a housing simultaneously, a pad which distributesth fitting pressure evenly over the inner and outer rings is used as shown in Fig. 8.3. When fitting bearings which have a large inner ring interference fit, or when fitting bearings on shafts that have a large diameter, a considerable amount of force is required to install the bearing at room temperature. Installation can be facilitated by heating and expanding the inner ring beforehand. The required relative temperature difference between the inner ring and the fitting surface depends on the amount of interference and the shaft fitting surface diameter. Fig. 8.4 shows the relation between the bearing inner bore diameter temperature differential and the amount of thermal expansion. In any event, bearings should never be heated above 120°C.

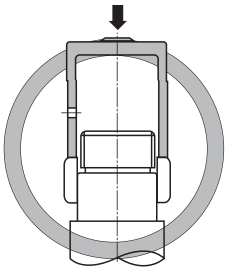


Fig. 8.2 Fitting sleeve pressure against inner ring

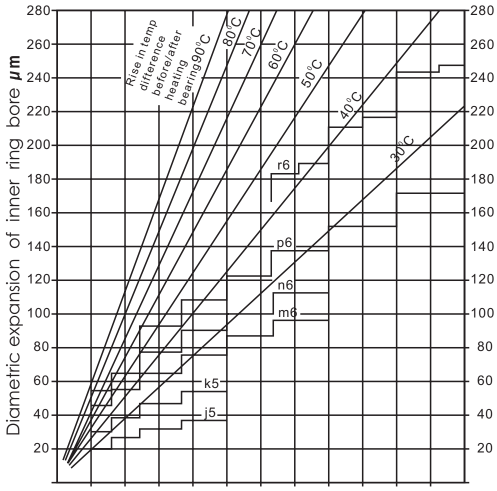


Fig. 8.3 Temperature differential required for shrinkage fit of inner ring

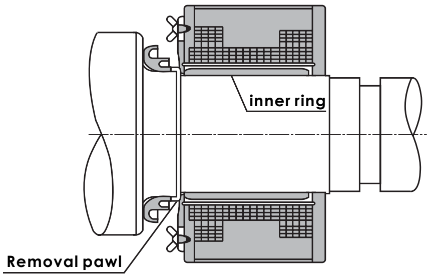


Fig. 8.4 Removal of inner ring using an induction heater

The most commonly used method of heating bearings is to immerse them in hot oil. However, this method should not be used for prelubricated shielded and sealed bearings. To avoid overheating parts of the bearings they should never be brought into direct contact with the heat source, but instead should be suspended inside the heating tank orplacedonawire grid. If bearings are dry-heated with a heating cabinet or hot plate, they can be mounted without drying. An induction heater can be used to quickly heat bearings in a dry state (always demagnetize). When heated bearings are installed on shafts, the inner rings must be held against the shaft abutment until the bearing has been cooled in order to prevent gaps from occurring between the ring and the abutment face.

8.2.3 Installation of outer ring

Even for tight interference fits, the outer rings of small type bearings can be installed by driving them into housings at room temperature. For large type bearings, the housing can be heated before installing the bearing, or the bearing's outer ring can be cooled with dry ice, etc. Before installing. If dry ice or other cooling agent is used, atmospheric moisture will condense on bearing surfaces, and therefore appropriate rust preventative measures are necessary.

8.3 Post installation running test

To insure that the bearing has been properly installed, a running test is performed after installation is completed. The shaft or housing is first rotated by hand and if no problems are observed a low speed, no load power test is performed. If no abnormalities are observed, the load and speed are gradually increased to operating conditions. During the test if any unusual noise, vibration, or temperature rise is observed the test should be stopped and the equipment examined. If necessary, the bearing should be disassembled for inspection. To check bearing running noise, the sound can be amplified and the type of noise ascertained with a listening instrument placed against the housing. A clear, smooth and continuous running sound is normal. A high, metallic or irregular sound indicates some error in function.

Vibration can be accurately checked with a vibration measuring instrument, and the amplitude and frequency characteristics measured against a fixed standard. Usually the bearing temperature can be estimated from the housing surface temperature, However, if the bearing outer ring is accessible through oil inlets, etc., the temperature can be more accurately measured. Under normal conditions, bearing temperature rises with rotation time and then reaches a stable operating temperature after a certain period of time. If the temperature does not level off and continues to rise, or if there is a sudden temperature rise, or if the temperature is unusually high, the bearing should be inspected.

8.4 Bearing disassembly

Bearings are often removed as part of periodic inspection procedures or during the replacement of other parts. However, the shaft and housing are almost always reinstalled, and in more than a few cases the bearings themselves are reused. These bearings, shafts, housings, and other related parts must be designed to prevent damage during disassembly procedures, and the proper disassembly tools must be employed. When removing inner and outer rings which have been installed with interference fits, the dismounting force should be applied to that ring only and not applied to other parts of the bearing, as this may cause internal damage to the bearing's raceway or rolling elements.

8.4.1 Disassembly of bearings with cylindrical bores

For small type bearings, the pullers shown in Fig. 8.5 or the press method shown in Fig. 8.6 can be used for disassembly. When used properly, these methods can improve disassembly efficiency and prevent damage to bearings. To facilitate disassembly procedures, attention should be given to planning the designs of shafts and housings, such as providing extraction grooves on the shaft and housing for puller claws as shown Figs. 8.7 and 8.8. Threaded bolt holes should also be provided in housings to facilitate the pressing out of outer rings as shown in Fig. 8.9.

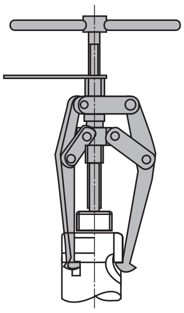


Fig. 8.5 Puller disassembly

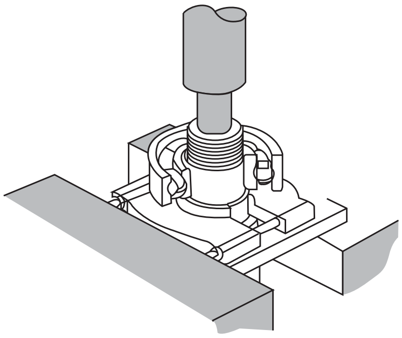


Fig. 8.6 press disassembly

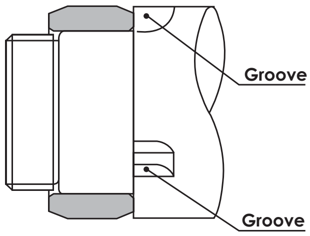


Fig. 8.7 Extracting grooves

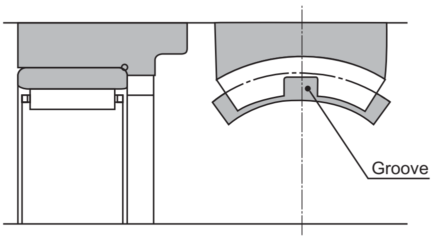


Fig. 8.8 Extraction groove for outer ring disassembly

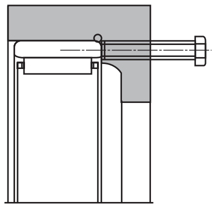


Fig. 8.9 Outer ring disassembly bolt

9. Allowable speed

As bearing speed increases, the temperature of the bearing also increases due to friction heat generated in the bearing interior. If the temperature continues to rise and exceeds certain limits, the efficiency of the lubricant start to fail down drastically, and the bearing can no longercontinue to operate in a stable manner. Therefore, the maximum speed at which it is possible for the bearing to continuously operate without the generation of excessive heat beyond specified limits, is called the allowable speed (r/min). The allowable speed of a bearing depends on the type of bearing, bearing dimensions, type of cage, load, lubricating conditions, and cooling conditions.

The allowable speeds listed in the bearing tables for grease and oil lubrication are for standard GECO bearings under normal operating conditions, correctly installed, using the suitable lubricants with adequate supply and proper maintenance. Moreover, these values are based on normal load conditions (P≤0.09C, Fa/Fr≤0.3). For ball bearings with contact seals (LLU type), the allowable speed is determined by the peripheral lip speed of the seal.

For bearings to be used under heavier than normal load conditions, the allowable speed values listed in the bearing tables must be multiplied by an adjustment factor. The adjustment factors f_L and f_C are given in Figs. 9.1 and 9.2.

Also, when radial bearings are mounted on vertical shafts, lubricant retentions and cage guidance are not favorable compared to horizontal shaft mounting.

Therefore, the allowable speed should be reduced to approximately 80% of the listed speed.

It is possible to operate precision bearings with high speed specification cages at speeds higher than those listed in the bearing tables , if special precautions are taken. These precautions should include the use of forced oil circulation methods such as oil jet or oil mist lubrication.

Under such high speed operating conditions , when special care is taken , the standard allowable speeds given in the bearing tables can be adjusted upward. The maximum speed adjustment values, /B, by which the bearing table speeds can be multiplied, are shown in Table 9.1. However, for any application requiring speeds in excess of the standard allowable speed, please consult GECO Engineering.

Fig.9.1 Value of adjustment factor FL depends on bearing load

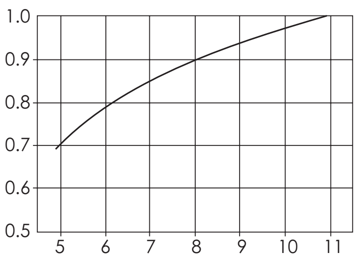


Fig.9.2 Value of adjustment factor Fc depends on combined load

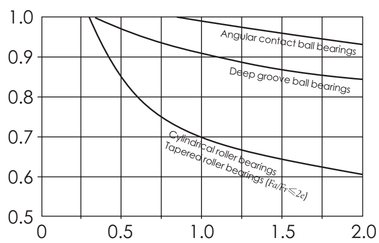


Table 9.1 Adjustment factor, f_B, for allowable number of revolutions

Type of bearing	Adjustment factor f_B
Deep groove ball bearings	3.0
Angular contact ball bearings	2.0

10. Vibration and noise value

GECO also supplies bearings for air conditioners, domestic ceiling fans and electric power tools etc. As a rule, the vibration or noise level of these bearings should be carefully controlled and checked. To be a part of our quality control system, GECO well equipped with two types of testing instrument S0910-1 (For standard application) and BVT1-1A (For precision or quiet applications). Relatively, here it gives out both vibration and noise standard of these bearings for your reference (Please refer to Table 10.1) .

The vibration and noise of GECO bearings are classified in three classes as Z1, Z2 and Z3, it is measured by the instruments of SO910-1. Details please find in the following Table 10.1.

Table 10.1 Specifications of vibration and noise.

Inner bores (mm)	Vibration acceleration (SO910-1)								
	60 Series			62 Series			63 Series		
	Z1⩽	Z2⩽	Z3⩽	Z1⩽	Z2⩽	Z3⩽	Z1⩽	Z2⩽	Z3⩽
4	34	32	28	35	32	30	36	33	31
5	36	34	30	37	34	32	37	35	33
6	36	34	30	37	34	32	37	35	33
7	38	35	31	38	36	34	-	-	-
8	38	35	31	38	36	34	-	-	-
9	40	36	32	40	37	35	-	-	-
10	42	38	33	42	39	35	44	40	37
12	43	39	34	43	39	35	45	40	37
15	44	40	35	44	41	36	46	42	38
17	44	40	35	45	41	36	47	42	38
20	45	41	36	46	42	38	48	43	39
25	46	42	38	47	43	40	49	44	41
30	47	43	39	48	44	41	50	45	42
35	49	45	41	50	46	43	51	47	44
40	51	46	42	52	47	44	54	49	45
45	53	48	45	54	49	46	56	51	47
50	54	50	47	55	51	48	57	53	49
55	56	52	49	57	53	50	59	54	51
60	58	54	51	59	54	51	61	56	53

For special requirement, it is measured by BVT-1 A and GECO bearings are also classified in three classes as V1, V2 and V3. Details please find in the following Table 10.2.

Table 10.2 Specifications of vibration and noise.

Inner bores (mm)	Vibration acceleration BVT-1 (0.001/s) V1≤			V2≤			V3≤		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
4	60	35	32	48	26	22	31	16	15
5	74	48	40	58	36	30	35	21	18
6	74	48	40	58	36	30	35	21	18
7	92	66	54	72	48	40	44	28	24
8	92	66	54	72	48	40	44	28	24
9	92	66	54	72	48	40	44	28	24
10	120	80	70	90	60	50	55	35	30
12	120	80	70	90	60	50	55	35	30
15	150	100	85	110	78	60	65	46	35
17	150	100	85	110	78	60	65	46	35
20	180	125	100	130	100	75	80	60	45
25	180	125	100	130	100	75	80	60	45
30	200	150	130	150	120	100	90	75	60
35	200	150	130	150	120	100	90	75	60
40	240	180	160	180	150	130	110	90	80
45	240	180	160	180	150	130	110	90	80
50	280	200	200	210	160	160	125	100	100
55	280	220	200	210	180	180	125	110	110
60	320	220	240	240	180	200	145	110	130

In our GECO Ball bearings, our series of vibration and noise level, good levels to be classified as following Table 10.3.

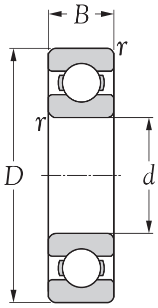
Table 10.3 Specifications of vibration and noise.

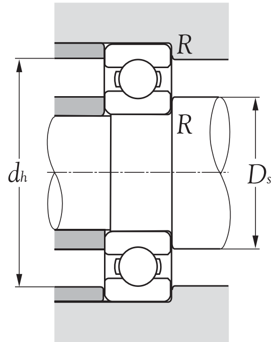
Series	Bores (mm) V1	Z3
60	6 ~ 20	25 ~ 30
62	5 ~ 20	25 ~ 30
63	10 ~ 12	15 ~ 20
618	5 ~ 20	25 ~ 40
619	5 ~ 20	25 ~ 40

The rest of the series which showing in the catalogue pages, below35mm inner bores should be controlled under Z2, Over 40mm inner bores should be controlled under Z1.

BALL BEARINGS

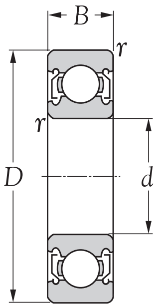
Ball Bearings
series 60



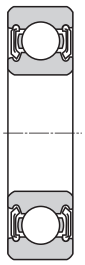


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg(s).
d	D	B	$r_{s\,min}$ [1)]	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
10	26	8	0.3	4,550	1,960	29,000	34,000	**6000**	12.5	23.5	0.3	0.019
12	28	8	0.3	5,100	2,390	26,000	30,000	**6001**	14.5	25.5	0.3	0.021
15	32	9	0.3	5,600	2,840	22,000	26,000	**6002**	17.5	29.5	0.3	0.030
17	35	10	0.3	6,800	3,350	20,000	24,000	**6003**	19.5	32.5	0.3	0.039
20	42	12	0.6	9,400	5,050	18,000	21,000	**6004**	25.0	37.0	0.6	0.069
25	47	12	0.6	10,100	5,850	15,000	18,000	**6005**	30.0	42.0	0.6	0.080
30	55	13	1.0	13,200	8,300	13,000	15,000	**6006**	36.0	49.0	1.0	0.116
35	62	14	1.0	16,000	10,300	12,000	14,000	**6007**	41.0	56.0	1.0	0.155
40	68	15	1.0	16,800	11,500	10,000	12,000	**6008**	46.0	62.0	1.0	0.190
45	75	16	1.0	21,000	15,100	9,200	11,000	**6009**	51.0	69.0	1.0	0.237
50	80	16	1.0	21,800	16,600	8,400	9,800	**6010**	56.0	74.0	1.0	0.261
55	90	18	1.1	28,300	21,200	7,700	9,000	**6011**	62.0	83.0	1.0	0.388
60	95	18	1.1	29,500	23,200	7,000	8,300	**6012**	67.0	88.0	1.0	0.414
65	100	18	1.1	30,500	25,200	6,500	7,700	**6013**	72.0	93.0	1.0	0.421
70	110	20	1.1	38,000	31,000	6,100	7,100	**6014**	77.0	103.0	1.0	0.604
75	115	20	1.1	39,500	33,500	5,700	6,700	**6015**	82.0	108.0	1.0	0.649
80	125	22	1.1	47,500	40,000	5,300	6,200	**6016**	87.0	118.0	1.0	0.854
85	130	22	1.1	49,500	43,000	5,000	5,900	**6017**	92.0	123.0	1.0	0.890
90	140	24	1.5	58,000	49,500	4,700	5,600	**6018**	98.5	131.5	1.5	1.020
95	145	24	1.5	60,500	54,000	4,500	5,300	**6019**	103.5	136.5	1.5	1.080
100	150	24	1.5	60,000	54,000	4,200	5,000	**6020**	108.5	141.5	1.5	1.150

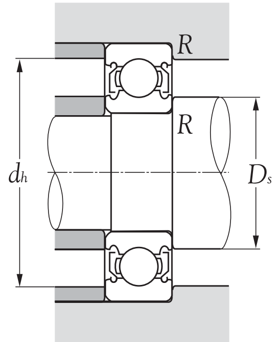
SERIES **60..2RS, 60..ZZ**



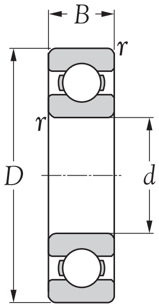
Shielded type
(ZZ)

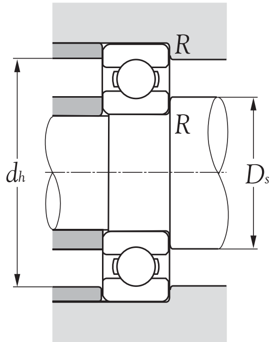


Non-contact
sealed type
(2RS)



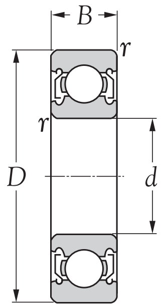
Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers		Abutment and fillet dimensions mm				Mass kg(s).
d	D	B	r_s min[1)]	C_r	C_{or}	grease	oil			D_s min	D_s max	d_h max	R max	(approx.)
10	26	8	0.3	4,550	1,960	29,000	21,000	**6000 2RS**	**6000 ZZ**	12.5	13.5	23.5	0.3	0.019
12	28	8	0.3	5,100	2,390	26,000	18,000	**6001 2RS**	**6001 ZZ**	14.5	16.0	25.5	0.3	0.021
15	32	9	0.3	5,600	2,840	22,000	15,000	**6002 2RS**	**6002 ZZ**	17.5	19.0	29.5	0.3	0.030
17	35	10	0.3	6,800	3,350	20,000	14,000	**6003 2RS**	**6003 ZZ**	19.5	21.0	32.5	0.3	0.039
20	42	12	0.6	9,400	5,050	18,000	11,000	**6004 2RS**	**6004 ZZ**	25.0	26.0	37.0	0.6	0.069
25	47	12	0.6	10,100	5,850	15,000	9,400	**6005 2RS**	**6005 ZZ**	30.0	30.5	42.0	0.6	0.080
30	55	13	1.0	13,200	8,300	13,000	7,700	**6006 2RS**	**6006 ZZ**	36.0	37.0	49.0	1.0	0.116
35	62	14	1.0	16,000	10,300	12,000	6,800	**6007 2RS**	**6007 ZZ**	41.0	42.0	56.0	1.0	0.155
40	68	15	1.0	16,800	11,500	10,000	6,100	**6008 2RS**	**6008 ZZ**	46.0	47.0	62.0	1.0	0.190
45	75	16	1.0	21,000	15,100	9,200	5,400	**6009 2RS**	**6009 ZZ**	51.0	52.5	69.0	1.0	0.237
50	80	16	1.0	21,800	16,600	8,400	5,000	**6010 2RS**	**6010 ZZ**	56.0	57.5	74.0	1.0	0.261
55	90	18	1.1	28,300	21,200	7,700	4,500	**6011 2RS**	**6011 ZZ**	62.0	64.0	83.0	1.0	0.388
60	95	18	1.1	29,500	23,200	7,000	4,100	**6012 2RS**	**6012 ZZ**	67.0	69.0	88.0	1.0	0.414
65	100	18	1.1	30,500	25,200	6,500	3,900	**6013 2RS**	**6013 ZZ**	72.0	73.0	93.0	1.0	0.421
70	110	20	1.1	38,000	31,000	6,100	3,600	**6014 2RS**	**6014 ZZ**	77.0	80.5	103.0	1.0	0.604
75	115	20	1.1	39,500	33,500	5,700	3,300	**6015 2RS**	**6015 ZZ**	82.0	85.5	108.0	1.0	0.649
80	125	22	1.1	47,500	40,000	5,300	3,100	**6016 2RS**	**6016 ZZ**	87.0	91.5	118.0	1.0	0.854
85	130	22	1.1	49,500	43,000	5,000	2,900	**6017 2RS**	**6017 ZZ**	92.0	97.0	123.0	1.0	0.890
90	140	24	1.5	58,000	49,500	4,700	2,800	**6018 2RS**	**6018 ZZ**	98.5	102.0	131.5	1.5	1.020
95	145	24	1.5	60,500	54,000	4,500	2,600	**6019 2RS**	**6019 ZZ**	103.5	109.0	136.5	1.5	1.080
100	150	24	1.5	60,000	54,000	4,200	2,600	**6020 2RS**	**6020 ZZ**	108.5	110.0	141.5	1.5	1.150



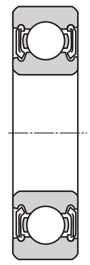


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg(s).
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
10	30	9	0.6	5,100	2,390	25,000	30,000	**6200**	15.0	25.0	0.6	0.032
12	32	10	0.6	6,100	2,750	22,000	26,000	**6201**	17.0	27.0	0.6	0.037
15	35	11	0.6	7,750	3,600	19,000	23,000	**6202**	20.0	30.0	0.6	0.045
17	40	12	0.6	9,600	4,600	18,000	21,000	**6203**	22.0	35.0	0.6	0.066
20	47	14	1.0	12,800	6,650	16,000	18,000	**6204**	26.0	41.0	1.0	0.106
25	52	15	1.0	14,000	7,850	13,000	15,000	**6205**	31.0	46.0	1.0	0.128
30	62	16	1.0	19,500	11,300	11,000	13,000	**6206**	36.0	56.0	1.0	0.199
35	72	17	1.1	25,700	15,300	9,800	11,000	**6207**	42.0	65.0	1.0	0.288
40	80	18	1.1	29,100	17,800	8,700	10,000	**6208**	47.0	73.0	1.0	0.366
45	85	19	1.1	32,500	20,400	7,800	9,200	**6209**	52.0	78.0	1.0	0.398
50	90	20	1.1	35,000	23,200	7,100	8,300	**6210**	57.0	83.0	1.0	0.454
55	100	21	1.5	43,500	29,200	6,400	7,600	**6211**	63.5	91.5	1.5	0.601
60	110	22	1.5	52,500	36,000	6,000	7,000	**6212**	68.5	101.5	1.5	0.783
65	120	23	1.5	57,500	40,000	5,500	6,500	**6213**	73.5	111.5	1.5	0.990
70	125	24	1.5	62,000	44,000	5,100	6,000	**6214**	78.5	116.5	1.5	1.070
75	130	25	1.5	66,000	49,500	4,800	5,600	**6215**	83.5	121.5	1.5	1.180
80	140	26	2.0	72,500	53,000	4,500	5,300	**6216**	90.0	130.0	2.0	1.400
85	150	28	2.0	83,500	64,000	4,200	5,000	**6217**	95.0	140.0	2.0	1.790
90	160	30	2.0	96,000	71,500	4,000	4,700	**6218**	100.0	150.0	2.0	2.150
95	170	32	2.1	109,000	82,000	3,700	4,400	**6219**	107.0	158.0	2.0	2.620
100	180	34	2.1	122,000	93,000	3,500	4,200	**6220**	112.0	168.0	2.0	3.140

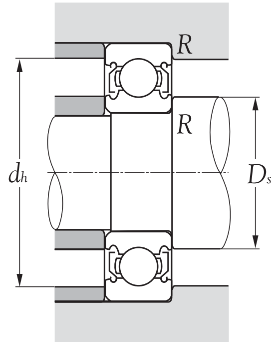
SERIES **62..2RS, 62..ZZ**



Shielded type (ZZ)



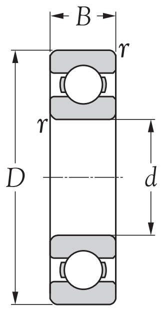
Non-contact sealed type (2RS)

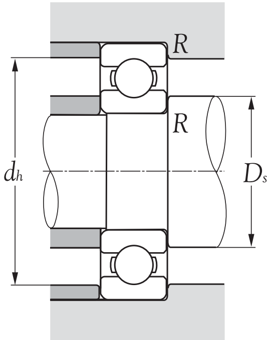


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers		Abutment and fillet dimensions mm				Mass kg(s).
										D_s		d_h	R	
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil			min	max	max	max	(approx.)
10	30	9	0.6	5,100	2,390	25,000	18,000	**6200 2RS**	**6200 ZZ**	15.0	16.0	25.0	0.6	0.032
12	32	10	0.6	6,100	2,750	22,000	16,000	**6201 2RS**	**6201 ZZ**	17.0	17.5	27.0	0.6	0.037
15	35	11	0.6	7,750	3,600	19,000	15,000	**6202 2RS**	**6202 ZZ**	20.0	20.5	30.0	0.6	0.045
17	40	12	0.6	9,600	4,600	18,000	12,000	**6203 2RS**	**6203 ZZ**	22.0	23.0	35.0	0.6	0.066
20	47	14	1.0	12,800	6,650	16,000	10,000	**6204 2RS**	**6204 ZZ**	26.0	28.0	41.0	1.0	0.106
25	52	15	1.0	14,000	7,850	13,000	8,900	**6205 2RS**	**6205 ZZ**	31.0	32.0	46.0	1.0	0.128
30	62	16	1.0	19,500	11,300	11,000	7,300	**6206 2RS**	**6206 ZZ**	36.0	39.0	56.0	1.0	0.199
35	72	17	1.1	25,700	15,300	9,800	6,300	**6207 2RS**	**6207 ZZ**	42.0	45.0	65.0	1.0	0.288
40	80	18	1.1	29,100	17,800	8,700	5,600	**6208 2RS**	**6208 ZZ**	47.0	51.0	73.0	1.0	0.366
45	85	19	1.1	32,500	20,400	7,800	5,200	**6209 2RS**	**6209 ZZ**	52.0	55.5	78.0	1.0	0.398
50	90	20	1.1	35,000	23,200	7,100	4,700	**6210 2RS**	**6210 ZZ**	57.0	60.0	83.0	1.0	0.454
55	100	21	1.5	43,500	29,200	6,400	4,300	**6211 2RS**	**6211 ZZ**	63.5	67.0	91.5	1.5	0.601
60	110	22	1.5	52,500	36,000	6,000	3,800	**6212 2RS**	**6212 ZZ**	68.5	75.0	101.5	1.5	0.783
65	120	23	1.5	57,500	40,000	5,500	3,600	**6213 2RS**	**6213 ZZ**	73.5	80.5	111.5	1.5	0.990
70	125	24	1.5	62,000	44,000	5,100	3,400	**6214 2RS**	**6214 ZZ**	78.5	85.0	116.5	1.5	1.070
75	130	25	1.5	66,000	49,500	4,800	3,200	**6215 2RS**	**6215 ZZ**	83.5	90.5	121.5	1.5	1.180
80	140	26	2.0	72,500	53,000	4,500	3,000	**6216 2RS**	**6216 ZZ**	90.0	95.5	130.0	2.0	1.400
85	150	28	2.0	83,500	64,000	4,200	2,800	**6217 2RS**	**6217 ZZ**	95.0	103.0	140.0	2.0	1.790
90	160	30	2.0	96,000	71,500	4,000	2,600	**6218 2RS**	**6218 ZZ**	100.0	109.0	150.0	2.0	2.150
95	170	32	2.1	109,000	82,000	3,700	2,500	**6219 2RS**	**6219 ZZ**	107.0	116.0	158.0	2.0	2.620
100	180	34	2.1	122,000	93,000	3,500	2,300	**6220 2RS**	**6220 ZZ**	112.0	122.0	168.0	2.0	3.140

Ball Bearings
Series 63

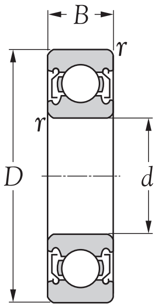
Ball Bearings



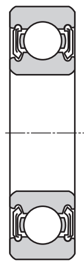


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg(s).
d	D	B	$r_{s\ min}$ [1]	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
10	35	11	0.6	8,200	3,500	23,000	27,000	**6300**	15.0	30.0	0.6	0.053
12	37	12	1.0	9,700	4,200	20,000	24,000	**6301**	18.0	31.0	1.0	0.060
15	42	13	1.0	11,400	5,450	17,000	21,000	**6302**	21.0	36.0	1.0	0.082
17	47	14	1.0	13,500	6,550	16,000	19,000	**6303**	23.0	41.0	1.0	0.115
20	52	15	1.1	15,900	7,900	14,000	17,000	**6304**	27.0	45.0	1.0	0.144
25	62	17	1.1	21,200	10,900	12,000	14,000	**6305**	32.0	55.0	1.0	0.232
30	72	19	1.1	26,700	15,000	10,000	12,000	**6306**	37.0	65.0	1.0	0.360
35	80	21	1.5	33,500	19,100	8,800	10,000	**6307**	43.5	71.5	1.5	0.457
40	90	23	1.5	40,500	24,000	7,800	9,200	**6308**	48.5	81.5	1.5	0.630
45	100	25	1.5	53,000	32,000	7,000	8,200	**6309**	53.5	91.5	1.5	0.814
50	110	27	2.0	62,000	38,500	6,400	7,500	**6310**	60.0	100.0	2.0	1.070
55	120	29	2.0	71,500	45,000	5,800	6,800	**6311**	65.0	110.0	2.0	1.370
60	130	31	2.1	82,000	52,000	5,400	6,300	**6312**	72.0	118.0	2.0	1.730
65	140	33	2.1	92,500	60,000	4,900	5,800	**6313**	77.0	128.0	2.0	2.080
70	150	35	2.1	104,000	68,000	4,600	5,400	**6314**	82.0	138.0	2.0	2.520
75	160	37	2.1	113,000	77,000	4,300	5,000	**6315**	87.0	148.0	2.0	3.020
80	170	39	2.1	123,000	86,500	4,000	4,700	**6316**	92.0	158.0	2.0	3.590
85	180	41	3.0	133,000	97,000	3,800	4,500	**6317**	99.0	166.0	2.5	4.230
90	190	43	3.0	143,000	107,000	3,600	4,200	**6318**	104.0	176.0	2.5	4.910
95	200	45	3.0	153,000	119,000	3,300	3,900	**6319**	109.0	186.0	2.5	5.670
100	215	47	3.0	173,000	141,000	3,200	3,700	**6320**	114.0	201.0	2.5	7.000

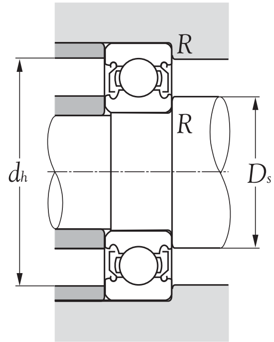
Series 63..2RS, 63..ZZ



Shielded type
(ZZ)



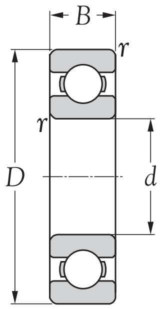
Non-contact
sealed type
(2RS)

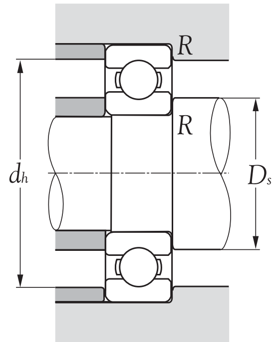


Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm		Bearing numbers		Abutment and fillet dimensions mm				Mass kg(s).
d	D	B	$r_{s\,min}$[1]	C_r	C_{or}	grease	oil			D_s min	D_s max	d_h max	R max	(approx.)
10	35	11	0.6	8,200	3,500	23,000	16,000	6300 2RS	6300 ZZ	15.0	17.0	30.0	0.6	0.053
12	37	12	1.0	9,700	4,200	20,000	15,000	6301 2RS	6301 ZZ	18.0	18.5	31.0	1.0	0.060
15	42	13	1.0	11,400	5,450	17,000	12,000	6302 2RS	6302 ZZ	21.0	23.0	36.0	1.0	0.082
17	47	14	1.0	13,500	6,550	16,000	11,000	6303 2RS	6303 ZZ	23.0	25.0	41.0	1.0	0.115
20	52	15	1.1	15,900	7,900	14,000	10,000	6304 2RS	6304 ZZ	27.0	28.5	45.0	1.0	0.144
25	62	17	1.1	21,200	10,900	12,000	8,100	6305 2RS	6305 ZZ	32.0	35.0	55.0	1.0	0.232
30	72	19	1.1	26,700	15,000	10,000	6,600	6306 2RS	6306 ZZ	37.0	43.0	65.0	1.0	0.360
35	80	21	1.5	33,500	19,100	8,800	6,000	6307 2RS	6307 ZZ	43.5	47.0	71.5	1.5	0.457
40	90	23	1.5	40,500	24,000	7,800	5,300	6308 2RS	6308 ZZ	48.5	54.0	81.5	1.5	0.630
45	100	25	1.5	53,000	32,000	7,000	4,700	6309 2RS	6309 ZZ	53.5	61.5	91.5	1.5	0.814
50	110	27	2.0	62,000	38,500	6,400	4,200	6310 2RS	6310 ZZ	60.0	68.5	100.0	2.0	1.070
55	120	29	2.0	71,500	45,000	5,800	3,900	6311 2RS	6311 ZZ	65.0	74.0	110.0	2.0	1.370
60	130	31	2.1	82,000	52,000	5,400	3,600	6312 2RS	6312 ZZ	72.0	80.5	118.0	2.0	1.730
65	140	33	2.1	92,500	60,000	4,900	3,300	6313 2RS	6313 ZZ	77.0	86.0	128.0	2.0	2.080
70	150	35	2.1	104,000	68,000	4,600	3,100	6314 2RS	6314 ZZ	82.0	92.5	138.0	2.0	2.520
75	160	37	2.1	113,000	77,000	4,300	2,900	6315 2RS	6315 ZZ	87.0	99.0	148.0	2.0	3.020
80	170	39	2.1	123,000	86,500	4,000	2,700	6316 2RS	6316 ZZ	92.0	105.0	158.0	2.0	3.590
85	180	41	3.0	133,000	97,000	3,800	2,600	6317 2RS	6317 ZZ	99.0	112.0	166.0	2.5	4.230
90	190	43	3.0	143,000	107,000	3,600	2,400	6318 2RS	6318 ZZ	104.0	118.0	176.0	2.5	4.910
95	200	45	3.0	153,000	119,000	3,300	2,300	-	6319 ZZ	109.0	125.0	186.0	2.5	5.670
100	215	47	3.0	173,000	141,000	3,200	2,200	-	6320 ZZ	114.0	133.0	201.0	2.5	7.000

BALL BEARINGS
SERIES 160

Ball Bearings

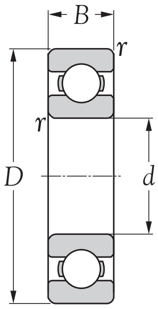


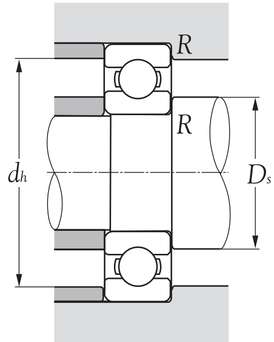


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg(s).
d	D	B	$r_{s\,min}$ 1)	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
12	28	7	0.3	5,100	2,390	26,000	30,000	**16001**	14.5	25.5	0.3	0.019
15	32	8	0.3	5,600	2,840	22,000	26,000	**16002**	17.5	29.5	0.3	0.025
17	35	8	0.3	6,800	3,350	20,000	24,000	**16003**	19.5	32.5	0.3	0.032
20	42	8	0.3	7,900	4,500	18,000	21,000	**16004**	22.5	39.5	0.3	0.051
25	47	8	0.3	8,350	5,100	15,000	18,000	**16005**	27.5	44.5	0.3	0.060
30	55	9	0.3	11,200	7,350	13,000	15,000	**16006**	32.5	52.5	0.3	0.091
35	62	9	0.3	11,700	8,200	12,000	14,000	**16007**	37.5	59.5	0.3	0.110
40	68	9	0.3	12,600	9,650	10,000	12,000	**16008**	42.5	65.5	0.3	0.125
45	75	10	0.6	12,900	10,500	9,200	11,000	**16009**	50.0	70.0	0.6	0.171
50	80	10	0.6	13,200	11,300	8,400	9,800	**16010**	55.0	75.0	0.6	0.180
55	90	11	0.6	18,600	15,300	7,700	9,000	**16011**	60.0	85.0	0.6	0.258
60	95	11	0.6	20,000	17,500	7,000	8,300	**16012**	65.0	90.0	0.6	0.283
65	100	11	0.6	20,500	18,700	6,500	7,700	**16013**	70.0	95.0	0.6	0.307
70	110	13	0.6	24,400	22,600	6,100	7,100	**16014**	75.0	105.0	0.6	0.441
75	115	13	0.6	25,000	24,000	5,700	6,700	**16015**	80.0	110.0	0.6	0.464
80	125	14	0.6	25,400	25,100	5,300	6,200	**16016**	85.0	120.0	0.6	0.597
85	130	14	0.6	25,900	26,200	5,000	5,900	**16017**	90.0	125.0	0.6	0.626
90	140	16	1.0	33,500	33,500	4,700	5,600	**16018**	96.0	134.0	1.0	0.848
95	145	16	1.0	34,500	35,000	4,500	5,300	**16019**	101.0	139.0	1.0	0.885
100	150	16	1.0	35,000	36,500	4,200	5,000	**16020**	106.0	144.0	1.0	0.910
105	160	18	1.0	52,000	50,500	4,000	4,700	**16021**	111.0	154.0	1.0	1.200
110	170	19	1.0	57,500	56,500	3,800	4,500	**16022**	116.0	164.0	1.0	1.460
120	180	19	1.0	63,000	63,500	3,500	4,100	**16024**	126.0	174.0	1.0	1.560

Ball Bearings

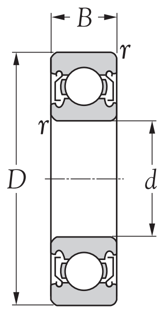
series 68



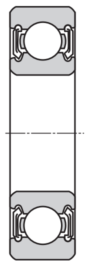


Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg.
d	D	B	$r_{s\ min}$ [1)]	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
10	19	5	0.3	1,830	925	32,000	38,000	**6800**	12	17	0.3	0.005
12	21	5	0.3	1,920	1,040	29,000	35,000	**6801**	14	19	0.3	0.006
15	24	5	0.3	2,080	1,260	26,000	31,000	**6802**	17	22	0.3	0.007
17	26	5	0.3	2,810	1,720	24,000	28,000	**6803**	19	24	0.3	0.008
20	32	7	0.3	4,000	2,470	21,000	25,000	**6804**	22	30	0.3	0.019
25	37	7	0.3	4,300	2,950	18,000	21,000	**6805**	27	35	0.3	0.022
30	42	7	0.3	4,700	3,650	15,000	18,000	**6806**	32	40	0.3	0.026
35	47	7	0.3	4,900	4,050	13,000	16,000	**6807**	37	45	0.3	0.029
40	52	7	0.3	5,100	4,400	12,000	14,000	**6808**	42	50	0.3	0.033
45	58	7	0.3	6,400	5,650	11,000	12,000	**6809**	47	56	0.3	0.040
50	65	7	0.3	6,600	6,100	9,600	11,000	**6810**	52	63	0.3	0.052
55	72	9	0.3	8,800	8,100	8,700	10,000	**6811**	57	70	0.3	0.083
60	78	10	0.3	11,500	10,600	8,000	9,400	**6812**	62	76	0.3	0.106
65	85	10	0.6	11,600	11,000	7,400	8,700	**6813**	69	81	0.6	0.128
70	90	10	0.6	12,100	11,900	6,900	8,100	**6814**	74	86	0.6	0.137
75	95	10	0.6	12,500	12,900	6,400	7,600	**6815**	79	91	0.6	0.145
80	100	10	0.6	12,700	13,300	6,000	7,100	**6816**	84	96	0.6	0.154

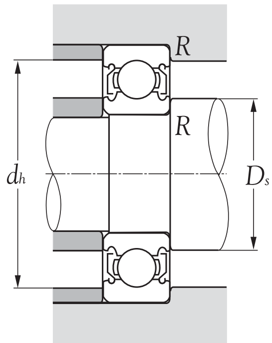
Ball Bearings



Shielded type (ZZ)

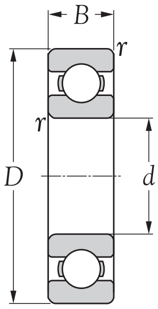


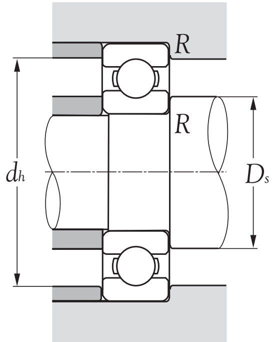
Non-contact sealed type (2RS)



Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers		Abutment and fillet dimensions mm				Mass kg.
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil			D_s min	D_s max	d_h max	R max	(approx.)
10	19	5	0.3	1,830	925	32,000	24,000	**6800 2RS**	**6800 ZZ**	12	12.5	17	0.3	0.005
12	21	5	0.3	1,920	1,040	29,000	20,000	**6801 2RS**	**6801 ZZ**	14	14.5	19	0.3	0.006
15	24	5	0.3	2,080	1,260	26,000	17,000	**6802 2RS**	**6802 ZZ**	17	17.5	22	0.3	0.007
17	26	5	0.3	2,810	1,720	24,000	15,000	**6803 2RS**	**6803 ZZ**	19	19.5	24	0.3	0.008
20	32	7	0.3	4,000	2,470	21,000	13,000	**6804 2RS**	**6804 ZZ**	22	23.0	30	0.3	0.019
25	37	7	0.3	4,300	2,950	18,000	10,000	**6805 2RS**	**6805 ZZ**	27	28.0	35	0.3	0.022
30	42	7	0.3	4,700	3,650	15,000	8,800	**6806 2RS**	**6806 ZZ**	32	33.0	40	0.3	0.026
35	47	7	0.3	4,900	4,050	13,000	7,600	**6807 2RS**	**6807 ZZ**	37	38.0	45	0.3	0.029
40	52	7	0.3	5,100	4,400	12,000	6,700	**6808 2RS**	**6808 ZZ**	42	43.0	50	0.3	0.033
45	58	7	0.3	6,400	5,650	11,000	5,900	**6809 2RS**	**6809 ZZ**	47	48.0	56	0.3	0.040
50	65	7	0.3	6,600	6,100	9,600	5,300	**6810 2RS**	**6810 ZZ**	52	54.0	63	0.3	0.052
55	72	9	0.3	8,800	8,100	8,700	4,800	**6811 2RS**	**6811 ZZ**	57	59.0	70	0.3	0.083
60	78	10	0.3	11,500	10,600	8,000	4,400	**6812 2RS**	**6812 ZZ**	62	64.5	76	0.3	0.106
65	85	10	0.6	11,600	11,000	7,400	4,100	**6813 2RS**	**6813 ZZ**	69	70.0	81	0.6	0.128
70	90	10	0.6	12,100	11,900	6,900	3,800	**6814 2RS**	**6814 ZZ**	74	75.5	86	0.6	0.137
75	95	10	0.6	12,500	12,900	6,400	3,600	**6815 2RS**	**6815 ZZ**	79	80.0	91	0.6	0.145
80	100	10	0.6	12,700	13,300	6,000	3,400	**6816 2RS**	**6816 ZZ**	84	85.0	96	0.6	0.154

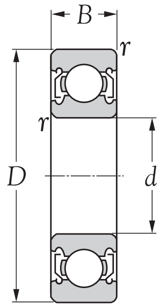
Ball Bearings



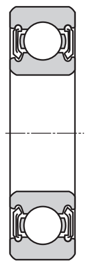


Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg.
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
10	22	6	0.3	2,700	1,270	30,000	36,000	**6900**	12	20	0.3	0.009
12	24	6	0.3	2,890	1,460	27,000	32,000	**6901**	14	22	0.3	0.011
15	28	7	0.3	4,100	2,060	24,000	28,000	**6902**	17	26	0.3	0.016
17	30	7	0.3	4,650	2,580	22,000	26,000	**6903**	19	28	0.3	0.018
20	37	9	0.3	6,400	3,700	19,000	23,000	**6904**	22	35	0.3	0.036
25	42	9	0.3	7,050	4,550	16,000	19,000	**6905**	27	40	0.3	0.042
30	47	9	0.3	7,250	5,000	14,000	17,000	**6906**	32	45	0.3	0.048
35	55	10	0.6	11,200	7,450	12,000	15,000	**6907**	39	51	0.6	0.074
40	62	12	0.6	14,600	10,200	11,000	13,000	**6908**	44	58	0.6	0.110
45	68	12	0.6	15,100	11,200	9,800	12,000	**6909**	49	64	0.6	0.128
50	72	12	0.6	15,600	12,200	8,900	11,000	**6910**	54	68	0.6	0.132
55	80	13	1.0	16,000	13,300	8,200	9,600	**6911**	60	75	1.0	0.180
60	85	13	1.0	16,400	14,300	7,600	8,900	**6912**	65	80	1.0	0.193
65	90	13	1.0	17,400	16,100	7,000	8,200	**6913**	70	85	1.0	0.206
70	100	16	1.0	23,700	21,200	6,500	7,700	**6914**	75	95	1.0	0.334
75	105	16	1.0	24,400	22,600	6,100	7,200	**6915**	80	100	1.0	0.353
80	110	16	1.0	24,900	24,000	5,700	6,700	**6916**	85	105	1.0	0.373

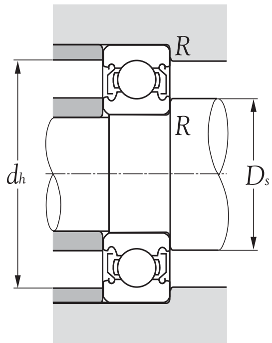
BALL BEARINGS
SERIES 69..2RS, 69..ZZ



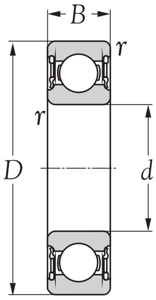
Shielded type
(ZZ)

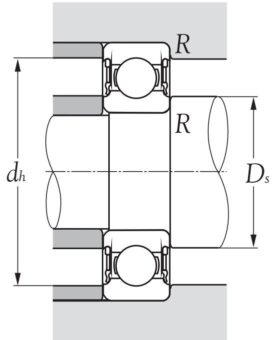


Non-contact
sealed type
(2RS)



Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers		Abutment and fillet dimensions mm				Mass kg.
d	D	B	$r_{s\,min}$ [1)]	C_r	C_{or}	grease	oil			D_s min	D_s max	d_h max	R max	(approx.)
10	22	6	0.3	2,700	1,270	30,000	21,000	**6900 2RS**	**6900 ZZ**	12	13.0	20	0.3	0.009
12	24	6	0.3	2,890	1,460	27,000	19,000	**6901 2RS**	**6901 ZZ**	14	15.0	22	0.3	0.011
15	28	7	0.3	4,100	2,060	24,000	16,000	**6902 2RS**	**6902 ZZ**	17	18.0	26	0.3	0.016
17	30	7	0.3	4,650	2,580	22,000	14,000	**6903 2RS**	**6903 ZZ**	19	20.0	28	0.3	0.018
20	37	9	0.3	6,400	3,700	19,000	12,000	**6904 2RS**	**6904 ZZ**	22	24.0	35	0.3	0.036
25	42	9	0.3	7,050	4,550	16,000	9,800	**6905 2RS**	**6905 ZZ**	27	29.0	40	0.3	0.042
30	47	9	0.3	7,250	5,000	14,000	8,400	**6906 2RS**	**6906 ZZ**	32	34.0	45	0.3	0.048
35	55	10	0.6	11,200	7,450	12,000	7,100	**6907 2RS**	**6907 ZZ**	39	40.0	51	0.6	0.074
40	62	12	0.6	14,600	10,200	11,000	6,300	**6908 2RS**	**6908 ZZ**	44	45.0	58	0.6	0.110
45	68	12	0.6	15,100	11,200	9,800	5,600	**6909 2RS**	**6909 ZZ**	49	51.0	64	0.6	0.128
50	72	12	0,6	15,600	12,200	8,900	5,100	**6910 2RS**	**6910 ZZ**	54	55.5	68	0.6	0.132
55	80	13	1.0	16,000	13,300	8,200	4,600	**6911 2RS**	**6911 ZZ**	60	61.5	75	1.0	0.180
60	85	13	1.0	16,400	14,300	7,600	4,300	**6912 2RS**	**6912 ZZ**	65	66.5	80	1.0	0.193
65	90	13	1.0	17,400	16,100	7,000	4,000	**6913 2RS**	**6913 ZZ**	70	71.5	85	1.0	0.206
70	100	16	1.0	23,700	21,200	6,500	3,700	**6914 2RS**	**6914 ZZ**	75	77.5	95	1.0	0.334
75	105	16	1.0	24,400	22,600	6,100	3,500	**6915 2RS**	**6915 ZZ**	80	82.5	100	1.0	0.353
80	110	16	1.0	24,900	24,000	5,700	3,200	**6916 2RS**	**6916 ZZ**	85	88.0	105	1.0	0.373

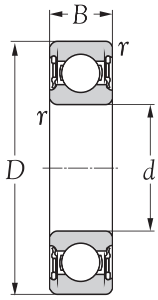


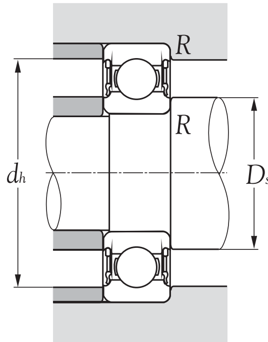


Boundary dimensions mm				Basic load ratings dynamic static N		Speed rating rpm	Bearing numbers	Abutment and fillet dimensions mm				Mass kg.
d	D	B	$r_{s\,min}$[1)]	Co	Cor			Ds min	Ds max	dh max	R max	(approx.)
10	30	14	0.6	5,070	2,360	17,000	**62200 2RS**	14.0	14.5	26.0	0.6	0.040
12	32	14	0.6	6,890	3,100	15,000	**62201 2RS**	16.0	16.0	28.0	0.6	0.045
15	35	14	0.6	7,800	3,750	13,000	**62202 2RS**	19.0	19.0	31.0	0.6	0.054
17	40	16	0.6	9,560	4,750	12,000	**62203 2RS**	21.0	21.0	36.0	0.6	0.083
20	47	18	1.0	12,700	6,550	10,000	**62204 2RS**	25.0	25.5	42.0	1.0	0.130
25	52	18	1.0	14,000	7,800	8,500	**62205 2RS**	30.0	31.0	47.0	1.0	0.150
30	62	20	1.0	19,500	11,200	7,500	**62206 2RS**	35.0	37.0	57.0	1.0	0.240
35	72	23	1.1	25,500	15,300	6,300	**62207 2RS**	41.5	43.5	65.5	1.0	0.370
40	80	23	1.1	30,700	19,000	5,600	**62208 2RS**	46.5	49.5	73.5	1.0	0.440
45	85	23	1.1	33,200	21,600	5,000	**62209 2RS**	51.5	54.0	78.5	1.0	0.480
50	90	23	1.1	35,100	23,200	4,800	**62210 2RS**	56.5	58.0	83.5	1.0	0.520

Ball Bearings
series 623..2RS

Ball
Bearings



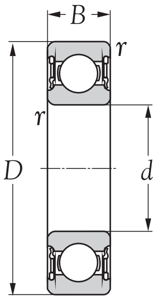


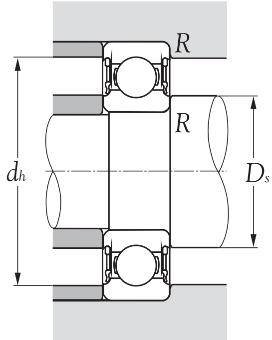
Boundary dimensions mm				Basic load ratings dynamic static N		Speed rating rpm	Bearing numbers	Abutment and fillet dimensions mm				Mass kg(s).
d	D	B	$r_{s\,min}$ [1]	C_o	C_{or}			D_s min	D_s max	d_h max	R max	(approx.)
10	35	17	0.6	8,060	3,400	15,000	**62300 2RS**	14.0	15.0	31.0	0.6	0.06
12	37	17	1.0	9,750	4,150	14,000	**62301 2RS**	17.0	17.0	32.0	1.0	0.07
15	42	17	1.0	11,400	5,400	12,000	**62302 2RS**	20.0	20.5	37.0	1.0	0.11
17	47	19	1.0	13,500	6,550	11,000	**62303 2RS**	22.0	23.5	42.0	1.0	0.15
20	52	21	1.1	15,900	7,800	9,500	**62304 2RS**	26.5	27.0	45.5	1.0	0.20
25	62	24	1.1	22,500	11,600	7,500	**62305 2RS**	31.5	33.5	55.5	1.0	0.32
30	72	27	1.1	28,100	16,000	6,300	**62306 2RS**	36.5	41.5	65.5	1.0	0.48
35	80	31	1.5	33,200	19,000	6,000	**62307 2RS**	43.0	44.0	72.0	1.5	0.66
40	90	33	1.5	41,000	24,000	5,000	**62308 2RS**	48.0	50.5	82.0	1.5	0.89
45	100	36	1.5	52,700	31,500	4,500	**62309 2RS**	53.0	56.5	92.0	1.5	1.15
50	110	40	2.0	61,800	38,000	4,300	**62310 2RS**	59.0	63.0	101.0	2.0	1.55

BALL BEARINGS

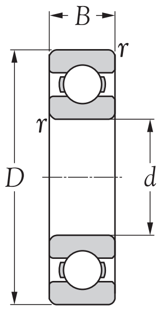
SERIES 630..2RS

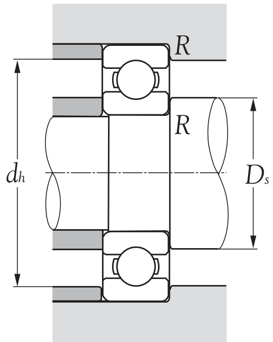
Ball Bearings





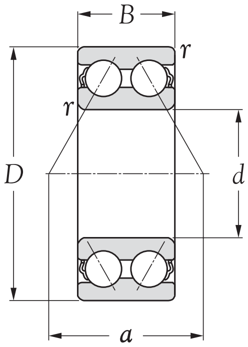
Boundary dimensions mm				Basic load ratings dynamic static N		Speed rating rpm	Bearing numbers	Abutment and fillet dimensions mm				Mass kg.
d	D	B	$r_{s\,min}$ 1)	C_o	C_{or}			D_s min	D_s max	d_h max	R max	(approx.)
10	26	12	0.3	4,620	1,960	19,000	**63000 2RS**	12	12.5	24	0.3	0.025
12	28	12	0.3	5,070	2,360	17,000	**63001 2RS**	14	14.5	26	0.3	0.029
15	32	13	0.3	5,590	2,850	14,000	**63002 2RS**	17	18.0	30	0.3	0.039
17	35	14	0.3	6,050	3,250	13,000	**63003 2RS**	19	20.0	33	0.3	0.052
20	42	16	0.6	9,360	5,000	11,000	**63004 2RS**	24	24.5	38	0.6	0.086
25	47	16	0.6	11,200	6,550	9,500	**63005 2RS**	29	29.0	43	0.6	0.100
30	55	19	1.0	13,300	8,300	8,000	**63006 2RS**	35	35.5	50	1.0	0.160
35	62	20	1.0	15,900	10,200	7,000	**63007 2RS**	40	40.5	57	1.0	0.210
40	68	21	1.0	16,800	11,600	6,300	**63008 2RS**	45	46.0	63	1.0	0.260
45	75	23	1.0	20,800	14,600	5,600	**63009 2RS**	50	51.0	70	1.0	0.340
50	80	23	1.0	21,600	16,000	5,000	**63010 2RS**	55	56.0	75	1.0	0.370

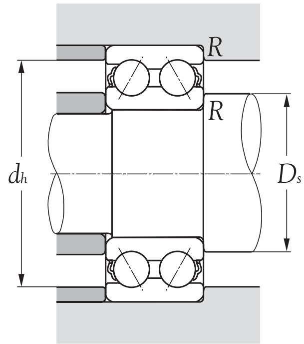




Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm			Mass kg(s).
d	D	B	$r_{s\,min}$ 1)	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	(approx.)
17	62	17	1.1	22,700	10,800	14,000	16,000	**6403**	24.0	55.0	1.0	0.270
20	72	19	1.1	28,500	13,900	12,000	14,000	**6404**	27.0	65.0	1.0	0.400
25	80	21	1.5	34,500	17,500	10,000	12,000	**6405**	33.5	71.5	1.5	0.530
30	90	23	1.5	43,500	23,900	8,800	10,000	**6406**	38.5	81.5	1.5	0.735
35	100	25	1.5	55,000	31,000	7,800	9,100	**6407**	43.5	91.5	1.5	0.952
40	110	27	2.0	63,500	36,500	7,000	8,200	**6408**	50.0	100.0	2.0	1.230
45	120	29	2.0	77,000	45,000	6,300	7,400	**6409**	55.0	110.0	2.0	1.530
50	130	31	2.1	83,000	49,500	5,700	6,700	**6410**	62.0	118.0	2.0	1.880
55	140	33	2.1	89,000	54,000	5,200	6,100	**6411**	67.0	128.0	2.0	2.290
60	150	35	2.1	102,000	64,500	4,800	5,700	**6412**	72.0	138.0	2.0	2.770

Ball Bearings

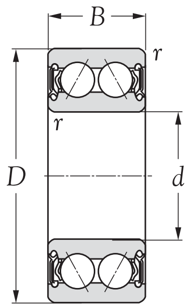




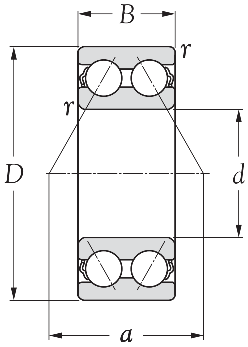
Boundary dimensions mm				Basic load ratings dynamic static N		Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm				Mass kg.
d	D	B	$r_{s\,min}$ 1)	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	a	(approx.)
10	30	14.3	0.6	6950	3800	14000	19000	**3200**	15	25	0.6	17.5	0.049
12	32	15.9	0.6	9150	5050	13000	17000	**3201**	17	27	0.6	19.0	0.057
15	35	15.9	0.6	10000	6050	11000	15000	**3202**	20	30	0.6	21.0	0.064
17	40	17.5	0.6	12800	7900	9900	13000	**3203**	22	35	0.6	24.0	0.096
20	47	20.6	1.0	19000	12100	8800	12000	**3204**	26	41	1.0	28.0	0.153
25	52	20.6	1.0	20600	14300	7300	9800	**3205**	31	46	1.0	31.5	0.175
30	62	23.8	1.0	28600	20400	6300	8400	**3206**	36	56	1.0	36.5	0.286
35	72	27.0	1.1	38000	27800	5500	7400	**3207**	42	65	1.0	42.5	0.436
40	80	30.2	1.1	42500	32500	4900	6600	**3208**	47	73	1.0	47.5	0.590
45	85	30.2	1.1	48000	37000	4400	5900	**3209**	52	78	1.0	50.5	0.640
50	90	30.2	1.1	51000	42000	4000	5300	**3210**	57	83	1.0	54.0	0.689

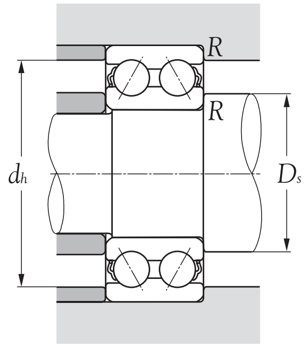
Ball Bearings
series 32..2RS & 32..ZZ

Ball
Bearings



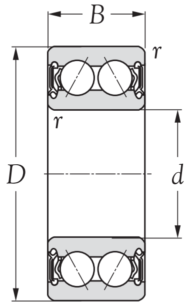
Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm		Bearing numbers		Mass kg.
d	D	B	$r_{s\ min}$ 1)	C_r	C_{or}	grease	oil			(approx.)
10	30	14.3	0.6	7150	3900	16000	22000	**3200 2RS**	**3200 ZZ**	0.045
12	32	15.9	0.6	10600	5850	15000	20000	**3201 2RS**	**3201 ZZ**	0.050
15	35	15.9	0.6	11700	6950	12000	17000	**3202 2RS**	**3202 ZZ**	0.068
17	40	17.5	0.6	14800	9000	10000	15000	**3203 2RS**	**3203 ZZ**	0.090
20	47	20.6	1.0	19500	12200	9000	13000	**3204 2RS**	**3204 ZZ**	0.140
25	52	20.6	1.0	21200	14600	8000	11000	**3205 2RS**	**3205 ZZ**	0.160
30	62	23.8	1.0	29600	21200	7000	9500	**3206 2RS**	**3206 ZZ**	0.260
35	72	27.0	1.1	37700	27500	6000	8000	**3207 2RS**	**3207 ZZ**	0.400
40	80	30.2	1.1	44900	34000	5600	7500	**3208 2RS**	**3208 ZZ**	0.530
45	85	30.2	1.1	48800	39000	5000	6700	**3209 2RS**	**3209 ZZ**	0.570



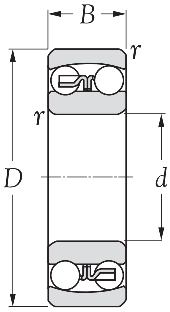


Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm		Bearing numbers	Abutment and fillet dimensions mm				Mass
d	D	B	$r_{s\,min}$ 1)	C_r	C_{or}	grease	oil		D_s min	d_h max	R max	a	(approx.)
15	42	19.0	1.0	17200	10100	9900	13000	**3302**	21.0	36.0	1.0	26.0	0.132
17	47	22.2	1.0	20400	12100	9000	12000	**3303**	23.0	41.0	1.0	28.5	0.181
20	52	22.2	1.1	20600	12700	8000	11000	**3304**	27.0	45.0	1.0	30.5	0.217
25	62	25.4	1.1	30500	20500	6700	8900	**3305**	32.0	55.0	1.0	36.5	0.362
30	72	30.2	1.1	39500	27500	5700	7600	**3306**	37.0	65.0	1.0	43.0	0.553
35	80	34.9	1.5	49500	35000	5000	6600	**3307**	43.5	71.5	1.5	48.5	0.766
40	90	36.5	1.5	60500	44000	4400	5900	**3308**	48.5	81.5	1.5	53.5	1.010
45	100	39.7	1.5	72500	54000	4000	5300	**3309**	53.5	91.5	1.5	60.0	1.340
50	110	44.4	2.0	85500	64500	3600	4800	**3310**	60.0	100.0	2.0	65.5	1.810

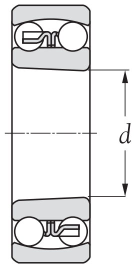
Ball
Bearings



Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm		Bearing numbers		Mass kg(s).
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil			(approx.)
15	42	19.0	1.0	17,200	10,100	9,900	13,000	**3302 2RS**	**3302 ZZ**	0.132
17	47	22.2	1.0	20,400	12,100	9,000	12,000	**3303 2RS**	**3303 ZZ**	0.181
20	52	22.2	1.1	22,500	14,600	8,500	12,000	**3304 2RS**	**3304 ZZ**	0.200
25	62	25.4	1.1	30,700	20,400	7,500	10,000	**3305 2RS**	**3305 ZZ**	0.320
30	72	30.2	1.1	41,600	29,000	6,300	8,500	**3306 2RS**	**3306 ZZ**	0.480
45	100	39.7	1.5	72,800	53,000	4,500	6,000	**3309 2RS**	**3309 ZZ**	1.150



Cylindrical bore

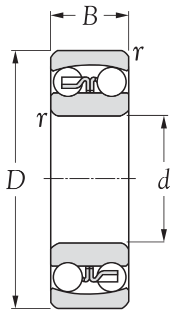


Tapered bore
taper 1:12

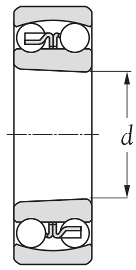
Boundary dimensions mm				Basic load ratings N		Limiting speeds rpm		Bearing numbers		Mass kg(s). (approx.)	
				dynamic	static					cylindrical bore	tapered bore
d	D	B	$r_{s\ min}$[1]	C_r	C_{or}	grease	oil				
10	30	9	0.6	5,500	1,190	21,000	24,000	**1200 E**	**-**	0.033	-
12	32	10	0.6	5,600	1,270	18,000	22,000	**1201 E**	**-**	0.040	-
15	35	11	0.6	7,450	1,750	16,000	19,000	**1202 E**	**-**	0.049	-
17	40	12	0.6	7,900	2,010	14,000	17,000	**1203 E**	**-**	0.072	-
20	47	14	1.0	9,900	2,610	13,000	15,000	**1204**	**1204 K**	0.116	0.114
25	52	15	1.0	12,100	3,300	11,000	13,000	**1205**	**1205 K**	0.138	0.135
30	62	16	1.0	15,600	4,650	9,200	11,000	**1206**	**1206 K**	0.217	0.213
35	72	17	1.1	15,800	5,100	8,000	9,400	**1207**	**1207 K**	0.317	0.312
40	80	18	1.1	19,300	6,550	7,100	8,400	**1208**	**1208 K**	0.414	0.407
45	85	19	1.1	21,900	7,350	6,400	7,500	**1209**	**1209 K**	0.457	0.448
50	90	20	1.1	22,700	8,100	5,800	6,800	**1210**	**1210 K**	0.515	0.504
55	100	21	1.5	26,800	10,000	5,300	6,200	**1211**	**1211 K**	0.692	0.679
60	110	22	1.5	30,000	11,500	4,900	5,800	**1212**	**1212 K**	0.879	0.864
65	120	23	1.5	31,000	12,500	4,500	5,300	**1213**	**1213 K**	1.130	1.110
70	125	24	1.5	34,500	13,800	4,200	4,900	**1214**	**-**	1.240	-
75	130	25	1.5	39,000	15,700	3,900	4,600	**1215**	**1215 K**	1.330	1.310
80	140	26	2.0	40,000	17,000	3,700	4,300	**1216**	**1216 K**	1.650	1.620

BALL BEARINGS
SERIES 13,13..K

Ball
Bearings



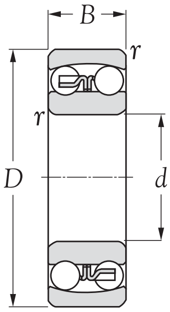
Cylindrical bore



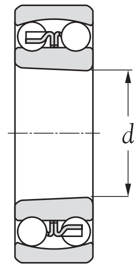
Tapered bore
taper 1:12

Boundary dimensions mm				Basic load ratings N		Limiting speeds rpm		Bearing numbers		Mass kg(s). (approx.)	
				dynamic	static					cylindrical bore	tapered bore
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil				
10	35	11	0.6	7,250	1,620	18,000	21,000	**1300 E**	**-**	0.058	-
12	37	12	1.0	9,450	2,160	16,000	18,000	**1301 E**	**-**	0.066	-
15	42	13	1.0	9,550	2,300	13,000	16,000	**1302 E**	**-**	0.092	-
17	47	14	1.0	12,500	3,200	12,000	14,000	**1303 E**	**-**	0.128	-
20	52	15	1.1	12,400	3,350	11,000	13,000	**1304**	**1304 K**	0.160	0.158
25	62	17	1.1	18,000	5,000	9,100	11,000	**1305**	**1305 K**	0.255	0.251
30	72	19	1.1	21,300	6,300	7,700	9,100	**1306**	**1306 K**	0.383	0.377
35	80	21	1.5	25,100	7,850	6,800	8,000	**1307**	**1307 K**	0.500	0.492
40	90	23	1.5	29,600	9,700	6,000	7,000	**1308**	**1308 K**	0.709	0.698
45	100	25	1.5	38,000	12,700	5,400	6,300	**1309**	**1309 K**	0.953	0.938
50	110	27	2.0	43,500	14,100	4,900	5,800	**1310**	**1310 K**	1.200	1.180
55	120	29	2.0	51,500	17,900	4,500	5,200	**1311**	**1311 K**	1.580	1.560
60	130	31	2.1	57,000	20,800	4,100	4,800	**1312**	**1312 K**	1.960	1.930

Ball Bearings



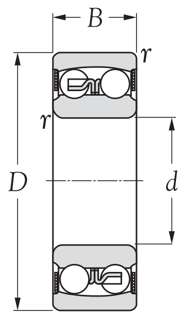
Cylindrical bore



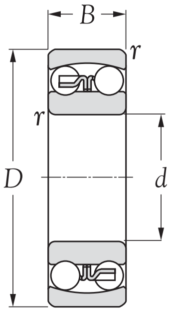
Tapered bore
taper 1:12

Boundary dimensions mm				Basic load ratings N		Limiting speeds rpm		Bearing numbers		Mass kg(s). (approx.)	
				dynamic	static					cylindrical bore	tapered bore
d	*D*	*B*	$r_{s\ min}$[1)]	C_r	C_{or}	grease	oil				
10	30	14	0.6	7,300	1,590	19,000	23,000	**2200 E**	**-**	0.047	-
12	32	14	0.6	7,600	1,730	17,000	20,000	**2201 E**	**-**	0.051	-
15	35	14	0.6	7,700	1,850	15,000	18,000	**2202**	**-**	0.060	-
17	40	16	0.6	9,800	2,410	13,000	16,000	**2203**	**-**	0.088	-
20	47	18	1.0	12,600	3,300	12,000	14,000	**2204**	**2204 K**	0.140	0.137
25	52	18	1.0	12,300	3,450	10,000	12,000	**2205**	**2205 K**	0.157	0.153
30	62	20	1.0	15,200	4,500	8,600	10,000	**2206**	**2206 K**	0.256	0.250
35	72	23	1.1	21,500	6,600	7,500	8,800	**2207**	**2207 K**	0.392	0.382
40	80	23	1.1	22,300	7,350	6,700	7,900	**2208**	**2208 K**	0.493	0.482
45	85	23	1.1	23,200	8,150	6,000	7,100	**2209**	**2209 K**	0.540	0.528
50	90	23	1.1	23,200	8,450	5,500	6,400	**2210**	**2210 K**	0.583	0.569
55	100	25	1.5	26,500	9,900	5,000	5,800	**2211**	**2211 K**	0.787	0.769
60	110	28	1.5	34,000	12,600	4,600	5,400	**2212**	**2212 K**	1.080	1.060

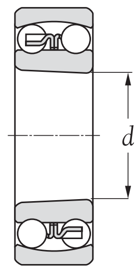
Ball
Bearings



Boundary dimensions mm				Basic load ratings N dynamic	static	Speed rating rpm	Bearing numbers	Mass kg(s).
d	D	B	rs min[1)]	Cr	Cor	grease		(approx.)
10	30	14	0.6	5,530	1,180	17,000	**2200 E 2RS**	0.048
12	32	14	0.6	6,240	1,430	16,000	**2201 E 2RS**	0.053
15	35	14	0.6	7,410	1,760	14,000	**2202 2RS**	0.058
17	40	16	0.6	8,840	2,200	12,000	**2203 2RS**	0.089
20	47	18	1.0	12,700	3,400	10,000	**2204 2RS**	0.140
25	52	18	1.0	14,300	4,000	9,000	**2205 2RS**	0.160
30	62	20	1.0	15,600	4,650	7,500	**2206 2RS**	0.260
35	72	23	1.1	19,000	6,000	6,300	**2207 2RS**	0.410
40	80	23	1.1	19,900	6,950	5,600	**2208 2RS**	0.500
45	85	23	1.1	22,900	7,800	5,300	**2209 2RS**	0.530
50	90	23	1.1	22,900	8,150	4,800	**2210 2RS**	0.570
55	100	25	1.5	27,600	10,600	4,300	**2211 2RS**	0.790
60	110	28	1.5	31,200	12,200	3,800	**2212 2RS**	1.050



Cylindrical bore

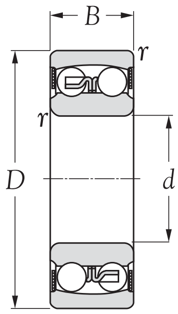


Tapered bore
taper 1:12

Boundary dimensions mm				Basic load ratings N		Limiting speeds rpm		Bearing numbers		Mass kg(s). (approx.)	
				dynamic	static					cylindrical bore	tapered bore
d	D	B	$r_{s\,min}$[1)]	C_r	C_{or}	grease	oil				
10	35	17	0.6	10,100	2,150	17,000	20,000	**2300 E**	**-**	0.083	-
12	37	17	1.0	11,800	2,710	15,000	17,000	**2301 E**	**-**	0.091	-
15	42	17	1.0	12,000	2,900	13,000	15,000	**2302**	**-**	0.114	-
17	47	19	1.0	14,400	3,550	11,000	14,000	**2303**	**-**	0.156	-
20	52	21	1.1	18,100	4,700	10,000	12,000	**2304**	**2304 K**	0.206	0.201
25	62	24	1.1	24,400	6,600	8,500	10,000	**2305**	**2305 K**	0.334	0.326
30	72	27	1.1	31,500	8,750	7,200	8,500	**2306**	**2306 K**	0.496	0.485
35	80	31	1.5	39,500	11,300	6,300	7,400	**2307**	**2307 K**	0.671	0.653
40	90	33	1.5	45,000	13,500	5,600	6,600	**2308**	**2308 K**	0.918	0.895
45	100	36	1.5	54,000	16,700	5,000	5,900	**2309**	**2309 K**	1.230	1.200
50	110	40	2.0	64,500	20,200	4,600	5,400	**2310**	**2310 K**	1.630	1.590
55	120	43	2.0	75,500	24,000	4,200	4,900	**2311**	**2311 K**	2.100	2.050
60	130	46	2.1	87,000	28,200	3,800	4,500	**2312**	**2312 K**	2.590	2.520

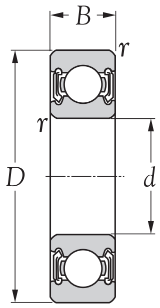
BALL BEARINGS
SERIES 23..2RS

Ball
Bearings

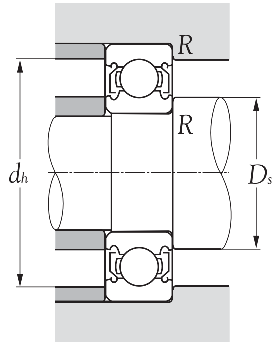


Boundary dimensions mm				Basic load ratings N dynamic	static	Speed rating rpm	Bearing numbers	Mass kg(s).
d	D	B	$r_{s\,min}$ [1]	C_r	C_{or}	grease		(approx.)
15	42	17	1.0	10,800	2,600	12,000	**2302 2RS**	0.11
17	47	19	1.0	12,700	3,400	11,000	**2303 2RS**	0.16
20	52	21	1.1	14,300	4,000	9,500	**2304 2RS**	0.21
25	62	24	1.1	19,000	5,400	7,500	**2305 2RS**	0.34
30	72	27	1.1	22,500	6,800	6,700	**2306 2RS**	0.51
35	80	31	1.5	26,500	8,500	5,600	**2307 2RS**	0.70
40	90	33	1.5	33,800	11,200	5,000	**2308 2RS**	0.96
45	100	36	1.5	39,000	13,400	4,500	**2309 2RS**	1.30
50	110	40	2.0	43,600	14,000	4,000	**2310 2RS**	1.65

Stainless Steel Ball Bearings
series SS 60.. 2RS & SS 60.. ZZ

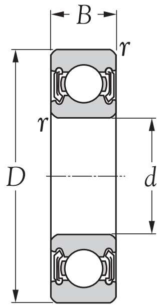


Non-contact
sealed type (2RS)

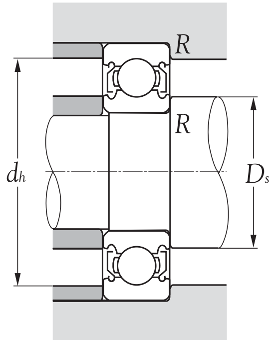


Boundary dimensions mm				Basic load ratings N		Limiting speeds rpm	Bearing numbers		Mass kg. (approx.)
d	D	B	$r_{s\,min}$ [1]	C_r (dynamic)	C_{or} (static)				
10	26	8	0.3	4,550	1,960	19,000	SS 6000 2RS	SS 6000 ZZ	0.020
12	28	8	0.3	5,100	2,360	18,000	SS 6001 2RS	SS 6001 ZZ	0.023
15	32	9	0.3	5,600	2,850	16,000	SS 6002 2RS	SS 6002 ZZ	0.031
17	35	10	0.3	6,000	3,250	14,000	SS 6003 2RS	SS 6003 ZZ	0.040
20	42	12	0.6	9,300	5,000	12,000	SS 6004 2RS	SS 6004 ZZ	0.067
25	47	12	0.6	10,000	5,850	10,000	SS 6005 2RS	SS 6005 ZZ	0.084
30	55	13	0.6	12,700	8,000	8,000	SS 6006 2RS	SS 6006 ZZ	0.120
35	62	14	0.6	16,000	10,200	7,500	SS 6007 2RS	SS 6007 ZZ	0.163
40	68	15	1.0	17,800	11,600	6,300	SS 6008 2RS	SS 6008 ZZ	0.190
45	75	16	1.0	20,000	14,300	6,000	SS 6009 2RS	SS 6009 ZZ	0.244
50	80	16	1.0	20,800	15,600	5,600	SS 6010 2RS	SS 6010 ZZ	0.271
55	90	18	1.1	29,600	21,200	4,500	SS 6011 2RS	SS 6011 ZZ	0.390
60	95	18	1.1	30,700	23,200	4,300	SS 6012 2RS	SS 6012 ZZ	0.420
65	100	18	1.1	31,900	25,000	4,000	SS 6013 2RS	SS 6013 ZZ	0.440

Stainless Steel Ball Bearings
series SS 62.. 2RS & SS 62.. ZZ



Non-contact
sealed type (2RS)



Boundary dimensions mm				Basic load ratings N dynamic	static	Limiting speeds rpm	Bearing numbers		Mass kg. (approx.)
d	D	B	$r_{s\,min}$[1]	C_r	C_{or}				
10	30	9	0.6	6,000	2,600	17,000	**SS 6200 2RS**	**SS 6200 ZZ**	0.034
12	32	10	0.6	6,950	3,100	16,000	**SS 6201 2RS**	**SS 6201 ZZ**	0.040
15	35	11	0.6	7,800	3,750	14,000	**SS 6202 2RS**	**SS 6202 ZZ**	0.045
17	40	12	0.6	9,500	4,750	12,000	**SS 6203 2RS**	**SS 6203 ZZ**	0.067
20	47	14	1.0	12,700	6,550	10,000	**SS 6204 2RS**	**SS 6204 ZZ**	0.109
25	52	15	1.0	14,000	7,800	9,000	**SS 6205 2RS**	**SS 6205 ZZ**	0.133
30	62	16	1.0	19,300	11,200	7,500	**SS 6206 2RS**	**SS 6206 ZZ**	0.211
35	72	17	1.1	25,500	15,300	6,300	**SS 6207 2RS**	**SS 6207 ZZ**	0.303
40	80	18	1.1	29,000	18,000	5,600	**SS 6208 2RS**	**SS 6208 ZZ**	0.384
45	85	19	1.1	31,000	20,400	5,300	**SS 6209 2RS**	**SS 6209 ZZ**	0.441
50	90	20	1.1	37,100	23,200	4,800	**SS 6210 2RS**	**SS 6210 ZZ**	0.460

GECO TM

POWERTEK