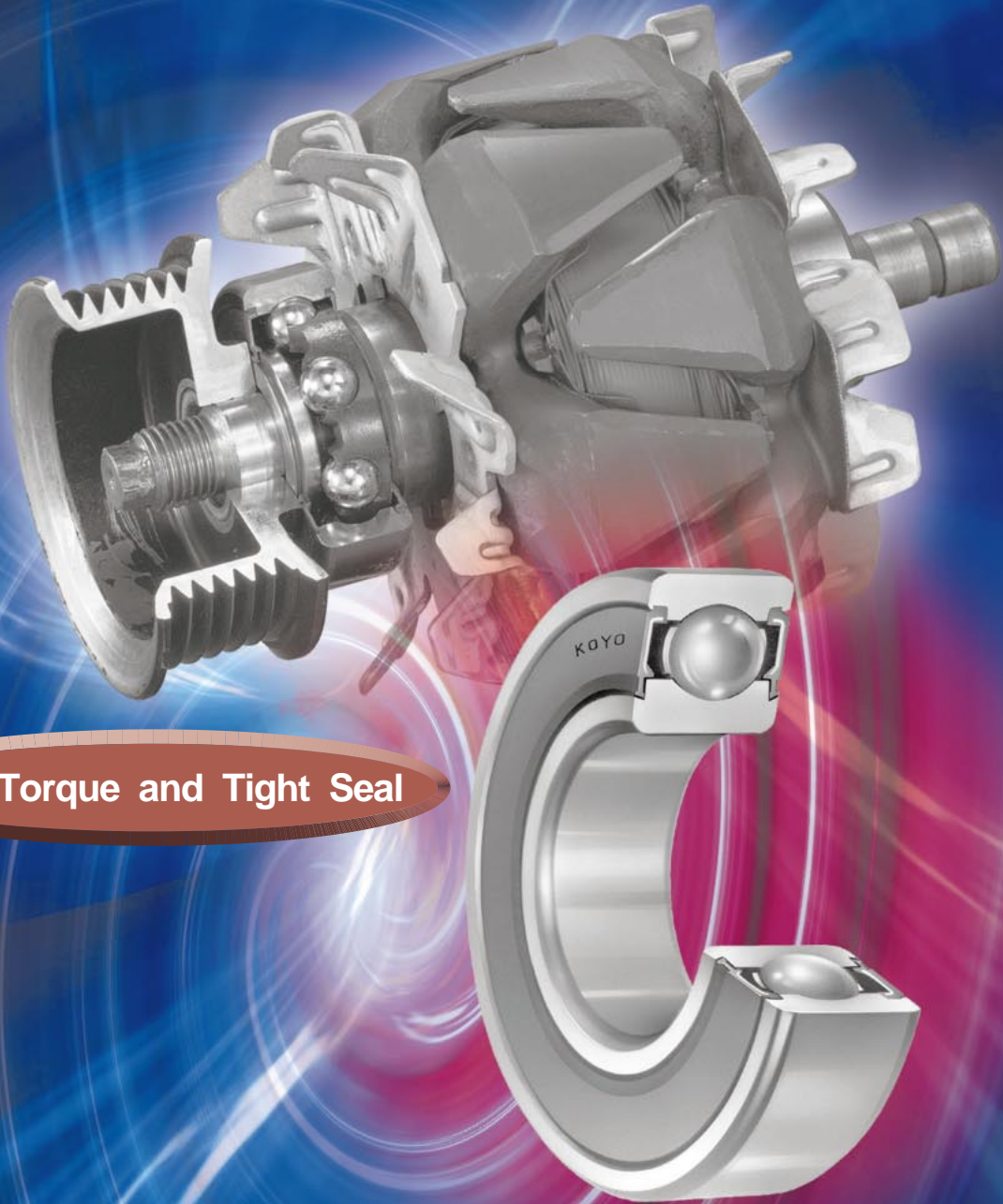


Koyo®

RD TYPE SEALED BALL BEARING



Low Torque and Tight Seal



ISO 9001/QS-9000
Certificate No. 927265

KOYO SEIKO CO., LTD.

CAT. NO. 251E

RD Type Sealed Ball Bearing



Koyo produces shielded ball bearings and sealed ball bearings of non-contact type (Z and RU types) and contact type (RS and RK types). In general, non-contact type products are used in applications requiring low torque, and contact type products in applications requiring tight sealing.

As conventional products do not fully meet either of these requirements, there has long been an urgent need for a new type of ball bearing.

With torque as low as that of a non-contact type product, yet whose seal is nearly as tight as that of a contact-type product: Such ball bearings should be highly water and dustproof, with only a slight temperature rise during high-speed operation.

The newly developed RD type sealed ball bearings satisfy precisely these conflicting demands; Koyo's efforts in R&D, based on a new concept, made this breakthrough possible.

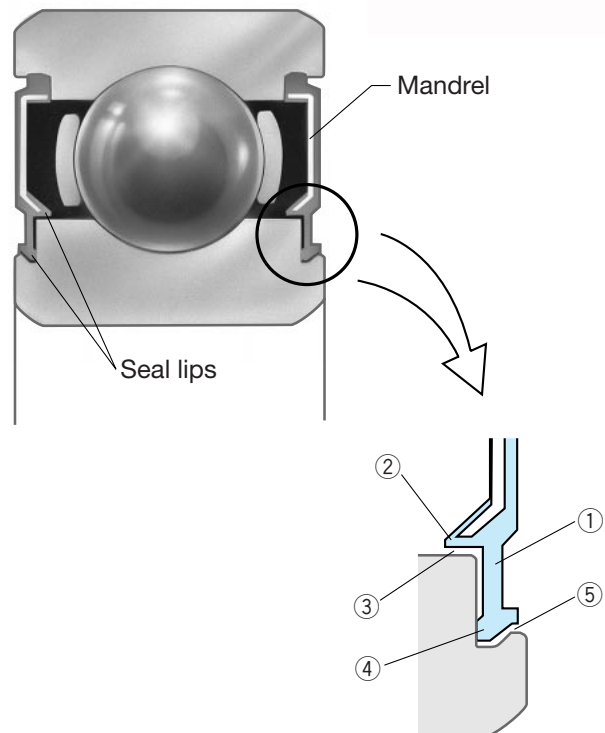
Structure and Features

Structure

1. The seal, made of synthetic rubber, is reinforced by a mandrel.
2. Seal lips and the inner ring form a Z-shaped labyrinth with a tapering groove on the inner ring shoulder. The tip of the seal outer lip ④ touches the inner ring lightly.

Features

1. The increased flexibility of the seal outer lip ①, designed to optimal length and thinness, reduces friction torque.
2. The seal inner lip ② prevents the leakage of grease by directing it toward the bearing interior.
3. Clearances ③ and ⑤ between inner ring and seal lips form a labyrinth, improving seal tightness.
4. The protuberance ④ at the tip of the outer lip improves seal tightness and stabilizes friction torque.
5. Foreign materials are prevented from entering the bearing interior by centrifugal force resulting from revolution; the angled inner ring and seal outer lip ⑤ facilitate help keep cut foreign materials.

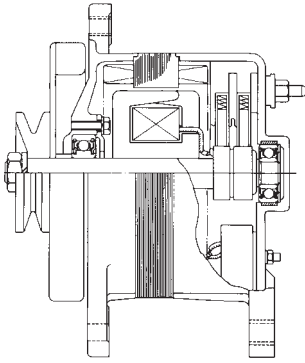


High-speed Operation RD Type Sealed Ball Bearing

Typical Applications

● Automotive alternator

While ZZ type shielded ball bearings and 2RU type sealed ball bearings have conventionally been used in automotive alternators, Koyo has developed new RD type sealed ball bearings for this application. Strict field tests conducted by auto manufacturers have proved that the new products are superior to conventional ZZ and 2RU non-contact type products in dust and waterproof construction, the prevention of grease leakage and other respects, while showing the same level of starting torque and temperature rise as do conventional products.



● Fan heater

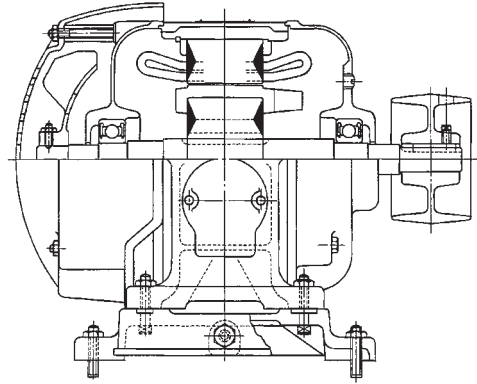
Fan motors, usually installed outdoors, must be dust and waterproof, and function at low torque to save energy. In conventional fan motors, Z type shielded ball bearings have been used together with such sealing devices as slinger rubber caps. With RD type bearings, however, these sealing devices can be replaced by simpler ones.

■ Dust proof testing chamber

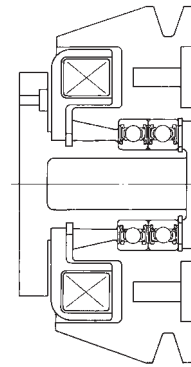


● Other applications

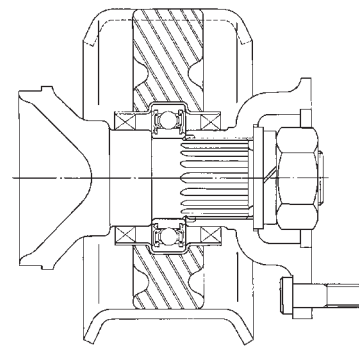
▶ Various motors



▶ Electromagnetic clutch



▶ Propeller shaft center



▶ Transmission

▶ Tension pulley

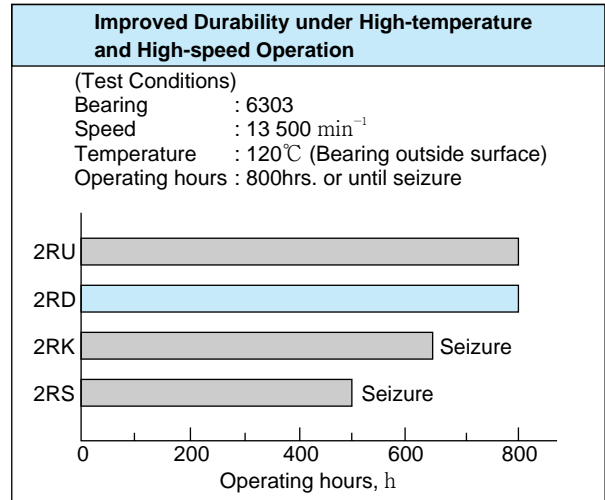
▶ Reduction motor, etc.

Koyo's RD type sealed ball bearing was developed to meet the demand for bearings that provide both low torque and tight seal. For this product, optimal design has been realized thanks to our long technical experience and basic studies.

This section shows examples of the results of basic studies and performance tests.

These results, as well as performance records, prove that the quality of RD type sealed ball bearings is superior in the following respects:

- ▶ Prevention of grease leakage: Superior to other products over the entire operating speed range
- ▶ Friction torque (durability) and temperature rise: Nearly equal to RU and ZZ non-contact type sealed bearings
- ▶ Protection against dust and water: Nearly equal to RS and RK contact-type sealed bearings



Some results of basic studies

Improvement in grease leakage prevention and dust protection

Optimum design as to seal lip length and clearance

Seal lip length, l_o

Seal lip clearance, t_o

Seal lip length, l_s

Seal lip clearance, t_s

$L = l_o + l_s$
 $T = \frac{1}{2}(t_o + t_s)$

○ Volume of grease leakage
● Dust-free time

Correlation coefficient $R=0.86$

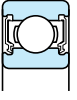
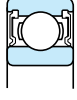
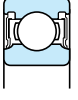
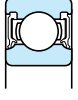
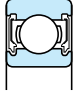
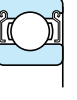
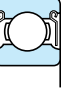
Some results of performance tests

(Test conditions)
 Bearing : 6303
 Grease : Synthetic and mineral base oil
 Consistency No. 2 (Volume : 40% of space)
 Radial load : 50 N
 Dustproof test : Conducted in aluminum powder atmosphere
 Waterproof test : Mist atmosphere

Slight grease leakage

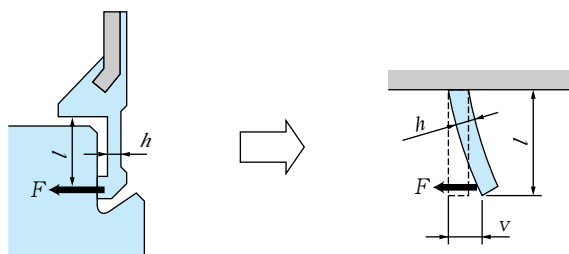
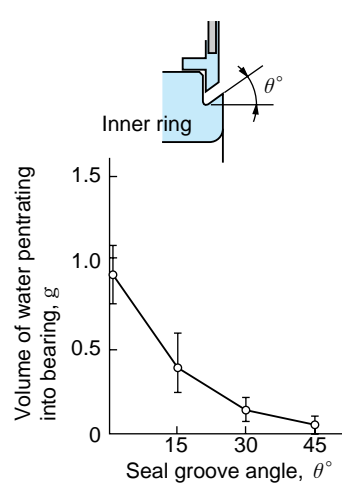
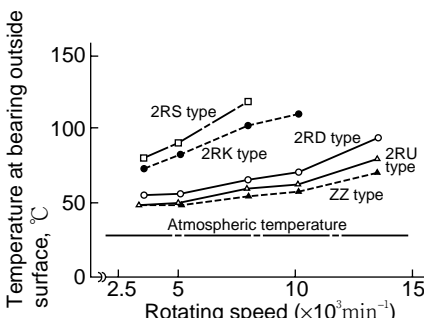
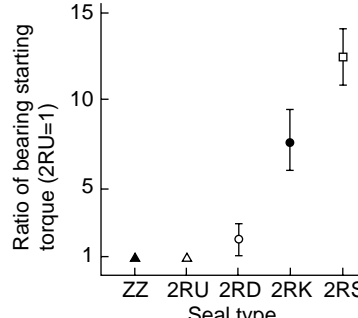
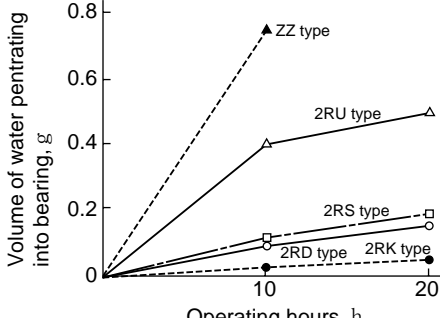
Superior protection against dust

(Reference) Comparison of Various Sealed and Shielded Ball Bearings

Type	Sealed ball bearings				Shielded ball bearings
	Light-contact type	Contact type		Non-contact type	Non-contact type
	2RD	2RS	2RK	2RU	ZZ
Charac-teristics	 (a)	 (b) ¹⁾  (c)	 (d)	 (e)	 (f) ²⁾  (g)
Friction torque	Low	High	High	Low	Low
Grease retention	Very good	Very good	Very good	Better than ZZ type	Good
Protection against dust	Very good	Better than 2RU type	Very good	Better than ZZ type	Good
Protection against water	Good	Good	Very good	Better than ZZ type	Not very good
Limiting speed ³⁾ (maximum)	$d_m n = 450\,000$	$d_m n = 300\,000$	$d_m n = 300\,000$	$d_m n = 500\,000$	$d_m n = 500\,000$
Operating tem- ⁴⁾ perature range	-30~110°C	-30~100°C	-30~100°C	-30~110°C	-30~110°C

Notes)

- 1), 2) : These seal and shield designs are for relatively small bearings.
- 3), 4) : Limiting speed and operating temperature ranges shown here are those of standard types. If you need bearings with higher speeds or wider operating temperature ranges, please contact a Koyo office.

Reduction of friction torque		Improvement of protection against water
<p>■ Optimum design as to seal lip thickness and length</p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> $F = \frac{E\nu}{4} \left(\frac{h}{l} \right)^3 b$ <p> <i>F</i> : Force resulting from rubber elasticity (N) <i>E</i> : Young's modulus for rubber (N/mm²) <i>ν</i> : Interference (mm) <i>l</i> : Seal outer lip length (mm) <i>h</i> : Seal outer lip thickness (mm) <i>b</i> : Microwidth in circumferential direction (mm) </p> </div>		<p>■ Optimum design as to groove angle</p>  <p style="text-align: center;">Volume of water penetrating into bearing, g</p> <p style="text-align: center;">Seal groove angle, θ°</p>
<p>Slight temperature rise</p>  <p style="text-align: center;">Temperature at bearing outside surface, °C</p> <p style="text-align: center;">Rotating speed (×10³ min⁻¹)</p>	<p>Low starting torque</p>  <p style="text-align: center;">Ratio of bearing starting torque (2RU=1)</p> <p style="text-align: center;">Seal type</p>	<p>Superior protection against water</p>  <p style="text-align: center;">Volume of water penetrating into bearing, g</p> <p style="text-align: center;">Operating hours, h</p>

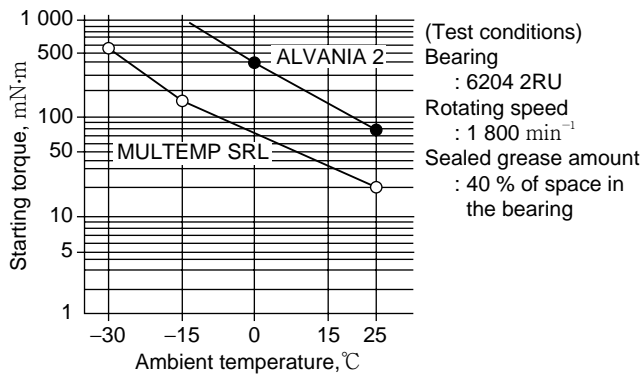
Features of MULTEMP SRL Grease

KOYO RD Type Sealed Ball Bearings have MULTEMP SRL grease sealed in. This grease features a wide operating temperature range, low friction torque, and long service life.

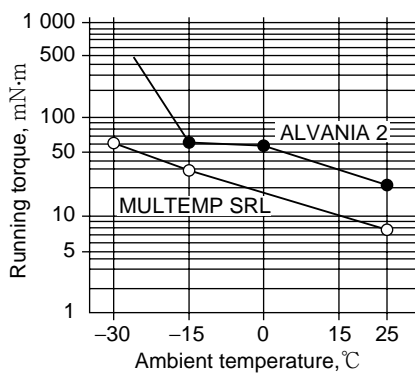
We summarize here the excellent features of MULTEMP SRL grease, along with its properties.

• Torque

(1) Starting Torque



(2) Running Torque



Starting torque and running torque are lower with MULTEMP SRL grease than with ALVANIA 2 grease.

Bearing Radial Internal Clearance

KOYO RD Type Sealed Ball Bearings have a standard radial internal clearance of class C3.

The class C3 clearance is as specified below:

Radial internal clearance of KOYO RD Type Sealed Ball Bearings

Nominal bore diameter <i>d</i> , mm		Clearance, μm C3	
over	up to	min.	max.
10	18	11	25
18	24	13	28
24	30	13	28
30	40	15	33
40	50	18	36
50	65	23	43

Nominal bore diameter <i>d</i> , mm		Measurement load N	Amount of clearance correction, μm
over	up to		C3
2.5	18	24.5	4
18	50	49	6
50	280	147	9

[Remark] For measured clearance, the increase of radial internal clearance caused by the measurement load should be added to the values in the above table for correction. Amount for correction are as shown right.

• Lubricating Service Life

(1) Performance test results

(Ambient temperature: 125°C)

Grease	Average service life, h		
	0	1 000	2 000
MULTEMP SRL	[Bar chart showing service life up to 2000h]		
ALVANIA 2	[Bar chart showing service life up to ~1000h]		

(Test conditions)
 Bearing: 6306ZZ
 Rotating speed : 3 500 min⁻¹
 20 h ON,
 4 h OFF
 Radial load: 120 N
 Axial load: 180 N

(2) Performance test results

(Ambient temperature: 150°C)

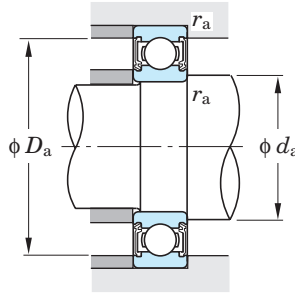
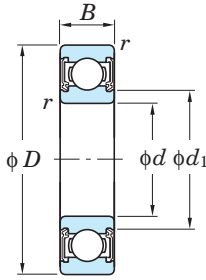
Grease	Average service life, h	
	0	1 000
MULTEMP SRL	[Bar chart showing service life up to 1000h]	
ALVANIA 2	[Bar chart showing service life up to ~500h]	

(Test conditions)
 Bearing: 6305ZZ
 Rotating speed : 4 500 min⁻¹
 Radial load: 20 N
 Axial load: 200 N

MULTEMP SRL grease has a longer service life than ALVANIA 2 grease.

• MULTEMP SRL Grease Average Properties

			MULTEMP SRL
Thickener			Lithium soap
Base oil	Type		Synthetic oil (diester oil)
	Kinematic viscosity (mm ² /s)	at 40°C	26.0
		at 100°C	5.1
Penetration index (25°C, 60 mixing operations)			250
Dropping point, °C			190
Operating temperature range, °C			-40~130



Dynamic Equivalent Radial Load

$$P_r = XF_r + YF_a$$

$\frac{f_0 \cdot F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static Equivalent Radial Load

$$P_{or} = 0.6F_r + 0.5F_a$$

However; $P_{or} = F_r$ when $P_{or} < F_r$.

Boundary dimensions (mm)					Bearing No.	Basic load ratings (kN)		factor f_0
d	D	B	r min.	d ₁		C _r	C _{or}	
12	32	10	0.6	16.6	6201 2RD C3	6.80	3.05	12.3
15	35	11	0.6	19.7	6202 2RD C3	7.65	3.75	13.2
17	40	12	0.6	22.1	6203 2RD C3	9.55	4.80	13.2
	47	14	1	24.3	6303 2RD C3	13.6	6.65	12.4
20	47	14	1	26.9	6204 2RD C3	12.8	6.65	13.2
	52	15	1.1	27.4	6304 2RD C3	15.9	7.85	12.3
25	52	15	1	31.6	6205 2RD C3	14.0	7.85	13.9
	62	17	1.1	34.2	6305 2RD C3	20.6	11.3	13.2
30	62	16	1	37.6	6206 2RD C3	19.5	11.3	13.9
	72	19	1.1	40.3	6306 2RD C3	26.7	15.0	13.3
35	72	17	1.1	43.9	6207 2RD C3	25.7	15.4	13.9
	80	21	1.5	46.4	6307 2RD C3	33.4	19.3	13.2
40	80	18	1.1	49.1	6208 2RD C3	29.1	17.8	14.0
	90	23	1.5	51.8	6308 2RD C3	40.7	24.0	13.2
45	85	19	1.1	52.6	6209 2RD C3	32.7	20.3	14.0
	100	25	1.5	57.6	6309 2RD C3	48.9	29.5	13.3
50	90	20	1.1	59.0	6210 2RD C3	35.1	23.3	14.4
	110	27	2	64.8	6310 2RD C3	62.0	38.3	13.2
55	100	21	1.5	66.4	6211 2RD C3	43.4	29.4	14.4
60	110	22	1.5	72.5	6212 2RD C3	52.4	36.2	14.4

Bearing No.	Limiting speed (min ⁻¹) Grease lub.	Mounting dimensions (mm)				(Refer.) Mass (kg)
		d _a min.	d _a max.	D _a max.	r _a max.	
6201 2RD C3	20 000	16	16.5	28	0.6	0.037
6202 2RD C3	18 000	19	19.5	31	0.6	0.045
6203 2RD C3	15 000	21	22	36	0.6	0.065
6303 2RD C3	14 000	22	24.3	42	1	0.115
6204 2RD C3	14 000	25	26.5	42	1	0.106
6304 2RD C3	13 000	26.5	27	45.5	1	0.144
6205 2RD C3	12 000	30	31.5	47	1	0.128
6305 2RD C3	9 900	31.5	34	55.5	1	0.232
6206 2RD C3	9 900	35	37.5	57	1	0.199
6306 2RD C3	8 600	36.5	40	65.5	1	0.346
6207 2RD C3	8 300	41.5	43.5	65.5	1	0.288
6307 2RD C3	7 700	43	46	72	1.5	0.457
6208 2RD C3	7 500	46.5	49	73.5	1	0.366
6308 2RD C3	6 900	48	51.5	82	1.5	0.633
6209 2RD C3	6 900	51.5	53.5	78.5	1	0.407
6309 2RD C3	6 100	53	59.5	92	1.5	0.833
6210 2RD C3	6 400	56.5	59	83.5	1	0.463
6310 2RD C3	5 500	59	66.5	101	2	1.07
6211 2RD C3	5 700	63	66	92	1.5	0.607
6212 2RD C3	5 100	68	72.5	102	1.5	0.783



RD TYPE SEALED BALL BEARING

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