For New Technology Network

NTN®

NTN corporation

Bearings for Special Environments

Ultra Final Series

CAT. No. 3023-Ⅲ／E

NTN
Bearings for Special Environments

NTN responds to emerging market needs
with unique technologies for extreme environments.

C O N T E N T S

Recent advances in the process technologies employed in semiconductor fabrication and other industrial sectors have raised expectations for the bearings used in vacuum environments. Today, such bearings are required to be cleaner, more durable and more resistant to corrosion. In response, **NTN** Corporation has developed a bearing technology that employs solid lubricant for ultra-high vacuum environments.
Moreover, **NTN** has continued to expand its product line with bearings designed for corrosive environments. These innovations round out a product line that already features vacuum bearings and ultra-clean bearings designed to accommodate today's increasingly complex production environments.

1. Selecting Bearings for Extreme Environments

The operating environments of today's advanced industries — as typified by the semiconductor fabrication industry — are complex and entail a variety of factors. To simplify the selection of the optimal bearings for complex environments, please refer to **Figure 1**. It illustrates schematically three such environments — vacuum, clean and corrosive — as well as the complex interrelation among these environments. This diagram lists the typical equipment and facilities found in each environment as well as the applicable bearings.

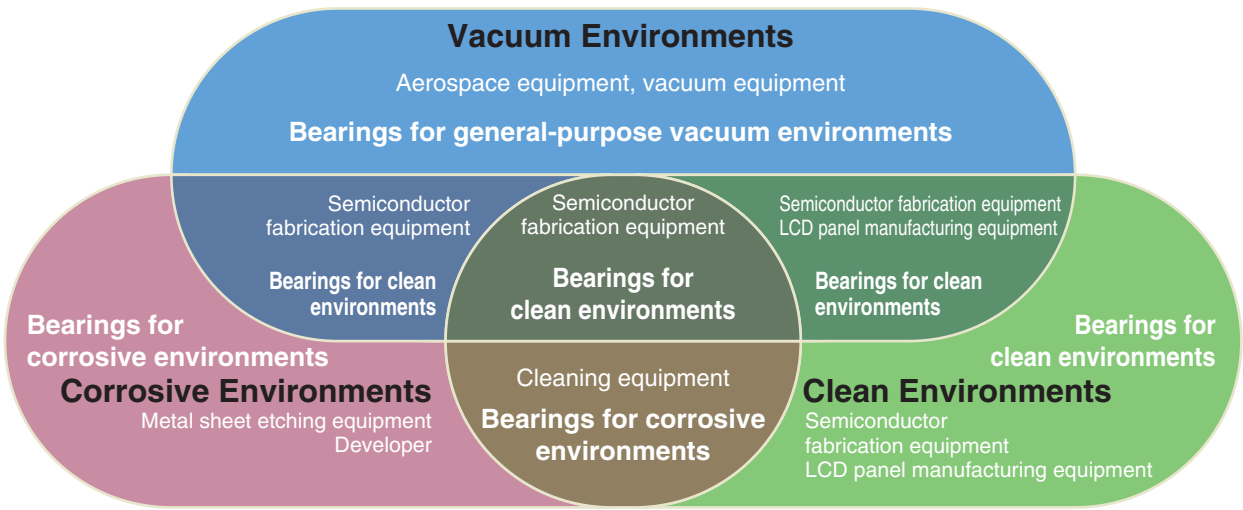


Fig. 1

2. Classifications and Standard Specifications of Bearings for Special Environments

Table 1 summarizes the standard specifications of bearings for special environments.
For custom specifications, please contact **NTN** Engineering.

Table 1. Bearings for Special Environments: Classifications and Standard Specifications

Classification	Operating Environment					Bearing Specification	
	Temperature	Atmosphere	Vacuum	Corrosives	Magnetic field	Inner Ring/Outer Ring	Ball
Vacuum environments	~150˚C	○	○			Martensite stainless steel + MoS_2 coating	Martensite stainless steel + MoS_2 coating
	~300˚C		○			Martensite stainless steel + Pb coating	Martensite stainless steel + Pb coating
	~400˚C		○			Martensite stainless steel	Martensite stainless steel + Ag coating
Clean environments	~ 70˚C	○				Martensite stainless steel	Martensite stainless steel
	~200˚C	○	○				
	~260˚C	○	○			Martensite stainless steel + special PTFE coating	Martensite stainless steel + special PTFE coating
	~300˚C	○	○				Martensite stainless steel + special PTFE coating + special balls
Contaminant-free environments	~ 80˚C	○				Bearing steel or martensite stainless steel	Bearing steel or martensite stainless steel
	~100˚C	○					
	~120˚C	○					
Corrosive environments	~120˚C	○		○		Bearing steel + corrosion resistant coating	Bearing steel
		○		○		Martensite stainless steel	Martensite stainless steel
	~150˚C	○	○	○	○	Ceramic	Ceramic
		○	○	○		Precipitation-hardened stainless steel	
		○		○	○	PPS resin	Ceramic or glass
High temperatures	~500˚C	○				High-speed tool steel	Ceramic
	~800˚C	○				Ceramic	
Cryogenic environments	-273˚C~	○				Martensite stainless steel + special PTFE coating	Martensite stainless steel + special PTFE coating
Non-magnetic environments	~150˚C	○			○	Non-magnetic steel	Ceramic
						Ceramic	
Anti-radioactivity	~120˚C	○				Bearing steel	Bearing steel
Electrically conductive	~120˚C	○				Bearing steel	Bearing steel
	~200˚C	○				Heat-resistant treatment + bearing steel	
Electrically insulated	~120˚C	○				Ceramic	Ceramic
		○				Bearing steel	
		○				Ceramic coating (outer ring)	Bearing steel
		○				PPS resin coating (outer ring)	

Bearing Specifications		Bearing No.	Technical Data Page Ref.
Cage	Grease		
PTFE resin	——	MM－. . . T3	P5, P6
Leaded copper alloy		MN－. . . L9	
Austenite stainless steel		5MG－. . .	
Austenite stainless steel	Low out particle grease	SSN. . . /L635QMP	P8, P9
	Low out particle grease in vacuum environments	SEB. . . . /LX23Q..	P8
Austenite stainless steel + special PTFE coating	——	MT2－SEB. . .	P5, P7, P8, P9 P10
Austenite stainless steel + special PTFE coating		MT2－5PT－SEB. . .	P9
Cold rolled steel plate or austenite stainless steel	General-purpose with solid grease	. . . . /LP03	
	Food-grade with solid grease	. . . . /LP06	
	High-temperature with solid grease	. . . . /LP05	
Cold rolled steel plate	Grease	MXn－. . .	
Austenite stainless steel		F－. . .	
PTFE resin or austenite stainless steel	——	S－. . . 5S－2Fn	
PTFE resin		5S－2N－. . .	P11
——	——	2H－5S－. . .	
		S－. . .	
PTFE resin	——	MT2－F－. . . T3	
PTFE resin	Grease	5S－2Fn－. . .	
		S－. . .	
Cold rolled steel plate	Radioactivity-resistant grease		
Cold rolled steel plate	Electrically conductive grease (EP-2)	. . . /L646	P11
	Electrically conductive fluorine grease (EF-2)	TS3－. . . /LY06	
Cold rolled steel plate	Grease	S－. . .	
		5S－. . .	
		7MC－. . .	
		7MP－. . .	

3. Performance and Technical Data of Various Bearings

3.1 Vacuum bearings

Table 2 Performance of Vacuum Bearings

◎ : Excellent ○ : Good △ : Fair × : Not recommended

Bearing type	Allowable vacuum range Pa	Allowable temperature range °C	Load-carrying capacity	Low-torque performance	Out Particle	Outgassing	Electrical conductivity
MoS_2-coated bearings	10^{-5}～1	～＋150	△	◎	○	○	×
Pb-coated bearings	～10^{-5}	～＋300	○	◎	○	◎	○
Ag-coated bearings	～10^{-5}	～＋400	△	○	○	◎	○
Bearings with vacuum grease (optional)	10^{-5}(vapor pressure) to atmospheric	～＋200	◎	×	×	×	×

Note: Ratings represent relative performance among vacuum bearings.

Test Data

Results of durability evaluation.

Figures 2 through **6** provide sample evaluations of coating-dependent durability.

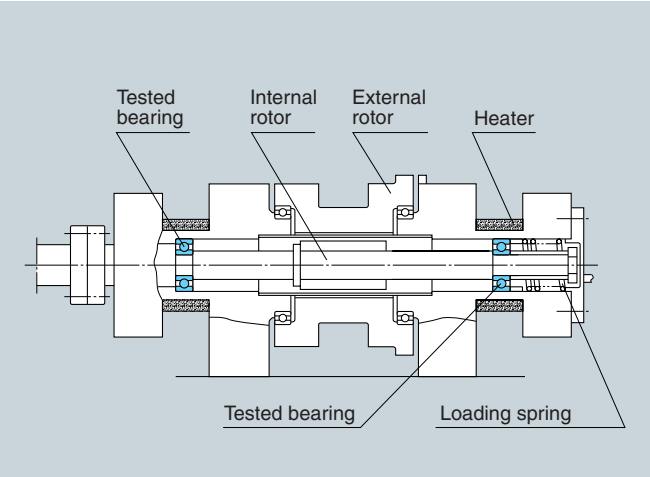


Fig. 2 Durability tester for high-vacuum bearing

● Test conditions

Bearing : Deep groove ball bearings, $\phi 8 \times \phi 22 \times 7$ (Open type)
Axial load : 10N, 30N, 50N
Speed : 2 500min^{-1}
Degree of vacuum : Around 10^{-5} Pa
Temperature : Room temperature
Evaluation criterion : Bearing life is regarded as having expired when the bearing friction torque with two bearings reaches 10^{-2} N・m.

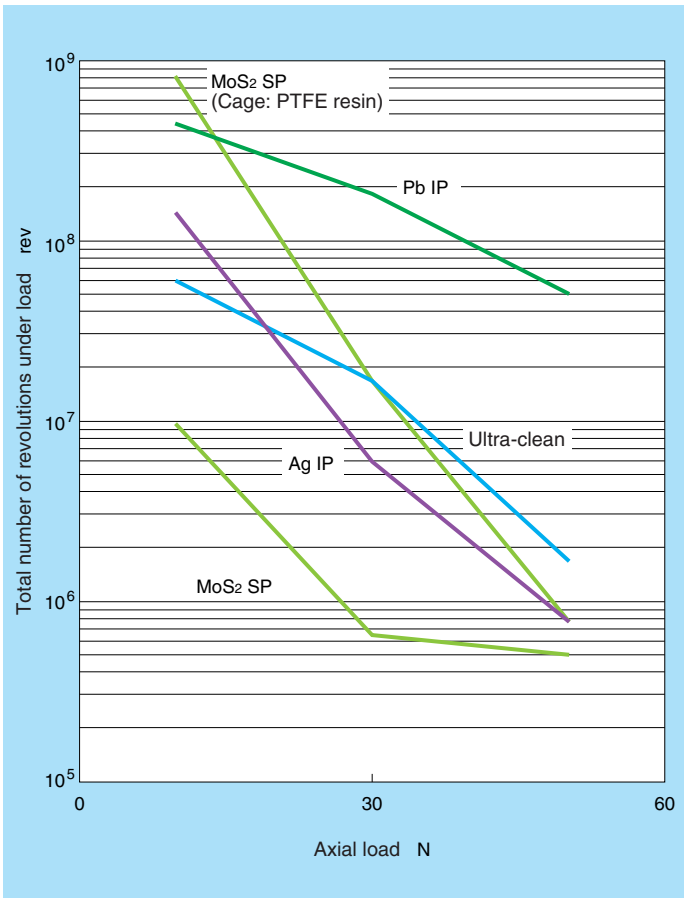


Fig. 3 Load vs. durability in a vacuum

● Test conditions

Bearing	: Angular contact ball bearings, ϕ10×ϕ22×7 (Full complement type)
Axial load	: 10N
Speed	: 2 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

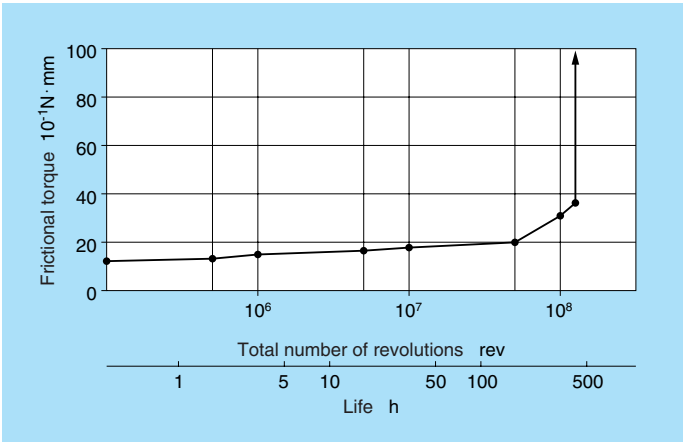


Fig. 4 Evaluation of durability of Ag IP bearing

● Test conditions

Bearing	: Angular contact ball bearings, ϕ10×ϕ22×7 (Cage: Leaded copper alloy))
Axial load	: 10N
Speed	: 7 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

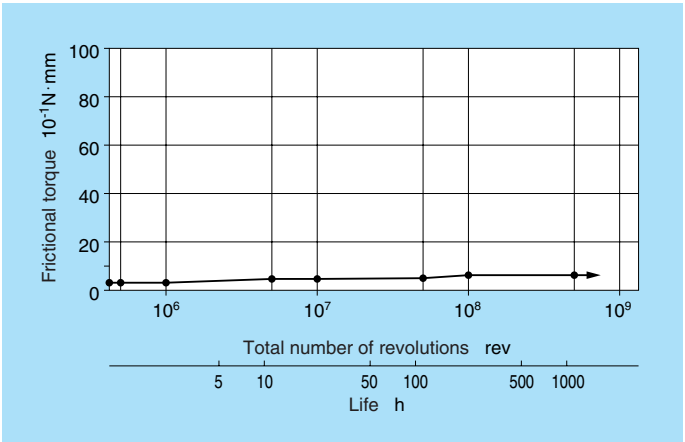


Fig. 5 Evaluation of durability of Pb IP bearing

● Test conditions

Bearing	: Angular contact ball bearings, ϕ10×ϕ22×7 (Cage: PTFE resin)
Axial load	: 10N
Speed	: 7 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

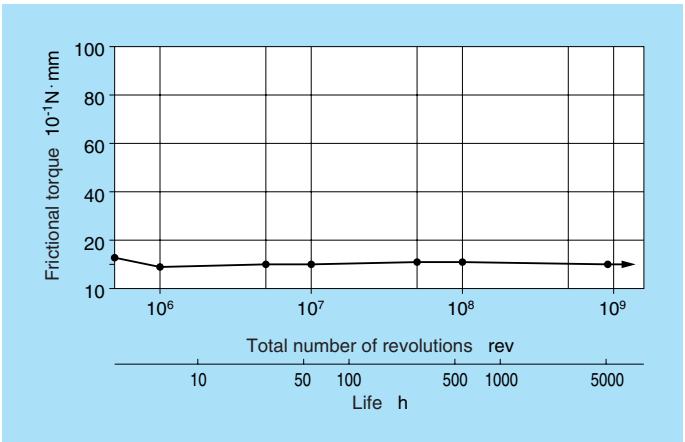


Fig. 6 Evaluation of durability of MoS_2 SP bearing

3.2 Bearings for clean environments

Table 3 Performance of Bearings for Clean Environments

◎ : Excellent ○ : Good △ : Fair × : Not recommended

Bearing type	Allowable vacuum range Pa	Allowable temperature range °C	Load-carrying capacity	Low-torque performance	Out Particle	Outgassing	Corrosion resistance	Maximum d_n value
Bearings with low out particle grease	Atmospheric	+ 70	◎	△	△	—[1)]	△	20×10^4
Bearings with low out particle grease for vacuum environment	10^{-5} to atmospheric	~+200	◎	×	△	△	△	20×10^4
Ultra-clean bearings	10^{-5} to atmospheric	~+260	△	◎	◎	◎	△	1×10^4
Long life ultra-clean bearings	10^{-6} to atmospheric	~+300	△	◎	○	◎	△	1×10^4

Note: Ratings represent relative performance among bearings designed for clean environments.
1) Excluded from evaluation because this type of bearing is used under atmospheric pressure.

Test Data

3.2.1 Evaluation of out particle characteristics

Figures 7 through **13** provide evaluations of the tendency to out particles.

● Test conditions

Bearing : Deep groove ball bearings $\phi8\times\phi22\times7$
Axial load : 10N
Speed : $50min^{-1}$
Minimum particle size measured : 0.3 μm
Temperature : Room temperature

● Test results

· Generation of airborne particles is indicated as the number of particles present in one cubic foot of collected air (number of particles/cf).
· **NTN**'s ultra-clean bearings generate a very low particle count (equivalent to Class 10).

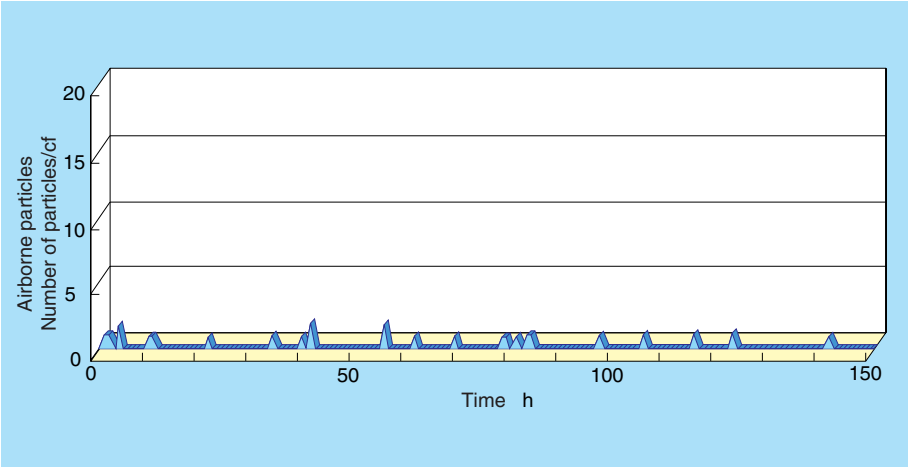


Fig. 7 Measurement of out particle by ultra-clean bearing (at atmospheric pressure)

● Test conditions

Bearing : Deep groove ball bearings $\phi8\times\phi22\times7$
Axial load : 10N (50N)
Speed : $50min^{-1}$
Degree of vacuum : Around 10^{-5} Pa
Minimum particle size measured : 0.38 μm
Temperature : Room temperature (20°C)

● Test results

· The out particle characteristics of ultra-clean bearings are not significantly altered by load or temperature. This type of bearing exhibits low out particle over a wider range of conditions.

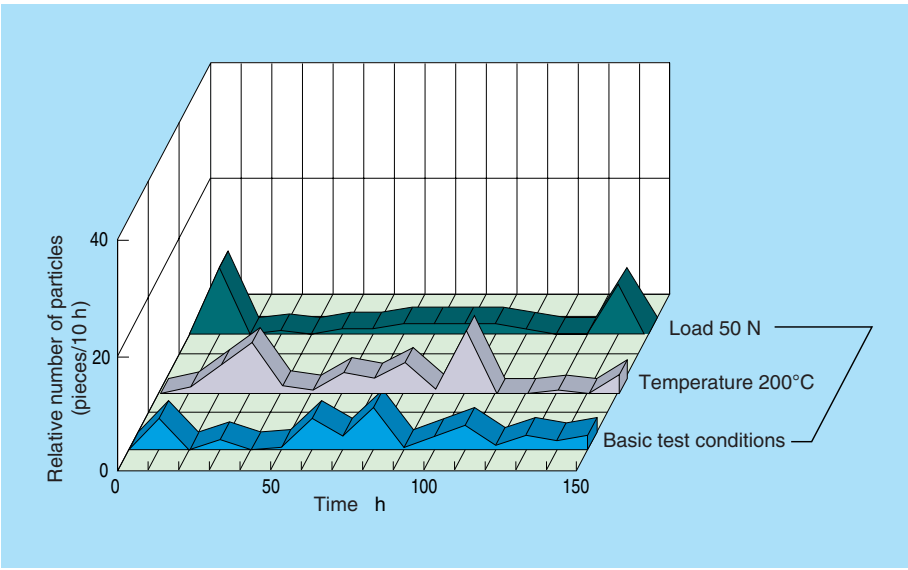


Fig. 8 Measurement of out particle by ultra-clean bearing (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings $\phi 8 \times \phi 22 \times 7$
Axial load : 10N
Speed : 50min^{-1}
Minimum particle size measured : 0.38 μm
Degree of vacuum : Around 10^{-5} Pa

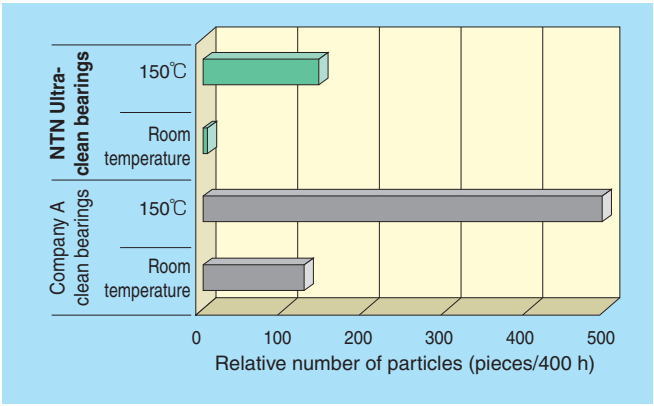


Fig. 9 Measurement of out particle by ultra-clean bearing (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings $\phi 8 \times \phi 22 \times 7$
Axial load : 10N
Minimum particle size measured : 0.1 μm
Temperature : Room temperature

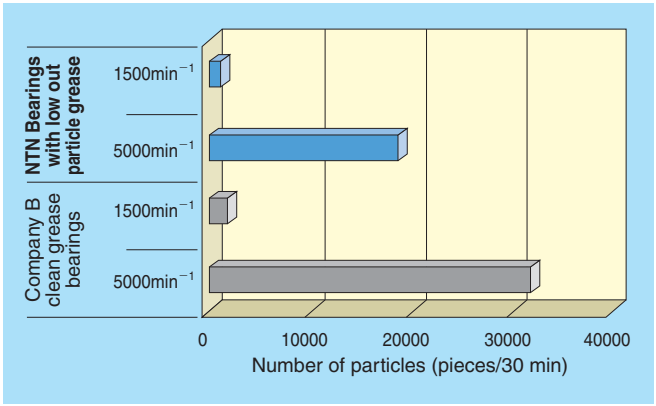


Fig. 10 Measurement of out particles by bearing with low out particle grease (at atmospheric pressure)

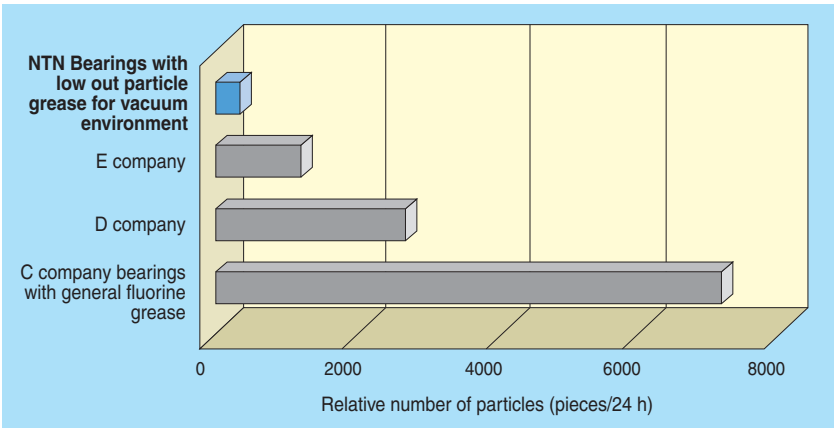


Fig. 11 Measurement of out particles by bearing prelubricated with low out particle vacuum grease (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings $\phi 8 \times \phi 22 \times 7$
Axial load : 30N
Speed : 200min^{-1}
Minimum particle size measured : 0.2 μm
Degree of vacuum : Around 10^{-5} Pa

● Test conditions

Bearing : Deep groove ball bearings $\phi 10 \times \phi 26 \times 8$
Axial load : 15N
Minimum particle size generated : 0.1 μm
Temperature : Room temperature (at atmospheric pressure)

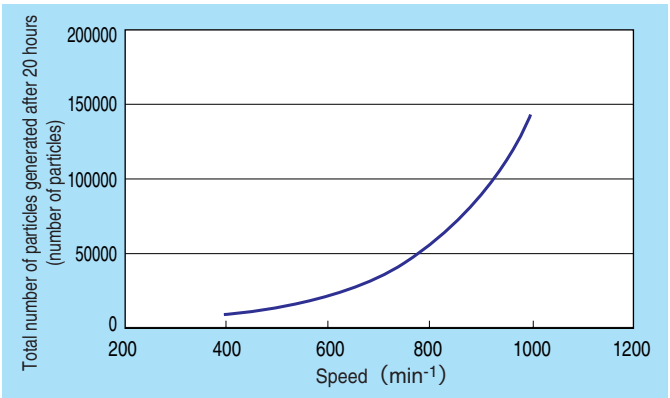


Fig. 12 Relation between bearing speed and number of out particles (bearing with low out particle grease)

● Test conditions

Bearing : Deep groove ball bearings $\phi 10 \times \phi 26 \times 8$
Speed : 400min^{-1}
Minimum particle size generated : 0.1 μm
Temperature : Room temperature (at atmospheric pressure)

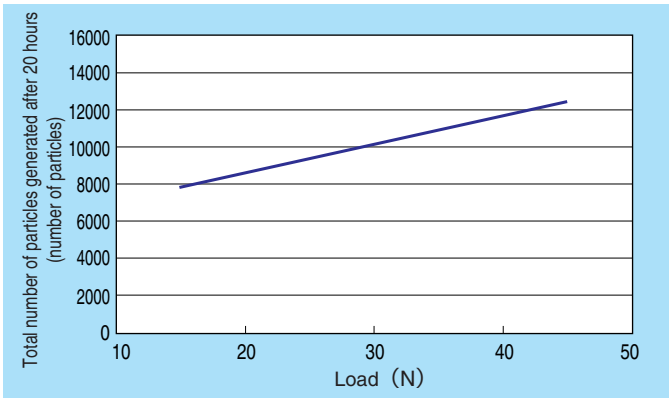


Fig. 13 Relation between axial load and number of out particles (bearing with low out particle grease)

3.2.2 Results of durability evaluation

Figures 14 through **16** provide evaluations of bearing durability.

● Test conditions

Bearing : Deep groove ball bearings $\phi 8 \times \phi 22 \times 7$
Axial load : 10N
Speed : $360 min^{-1}$
Degree of vacuum : Around 10^{-5} Pa
Temperature : Room temperature

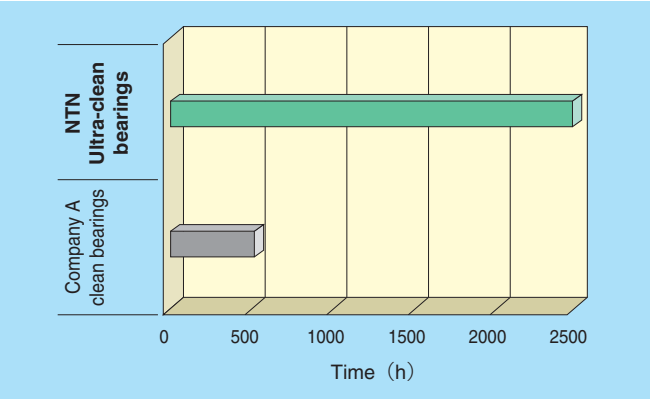


Fig. 14 Evaluation of durability of ultra-clean bearing

● Test conditions

Bearing : Deep groove ball bearings $\phi 20 \times \phi 47 \times 14$
Axial load : 67N
Radial load : 67N
Speed : $10000 min^{-1}$
Temperature : 100˚C

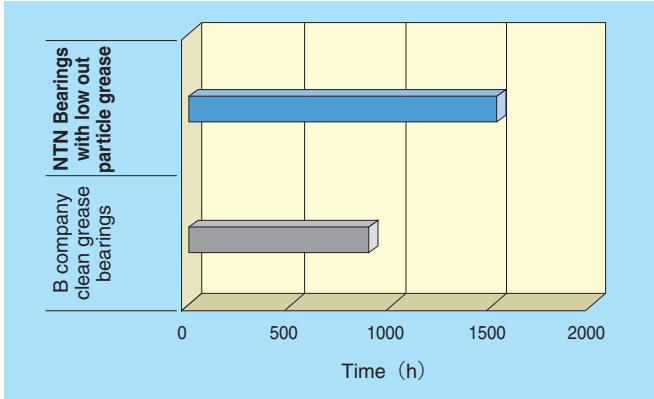


Fig. 16 Evaluation of durability of bearing with low out particle grease

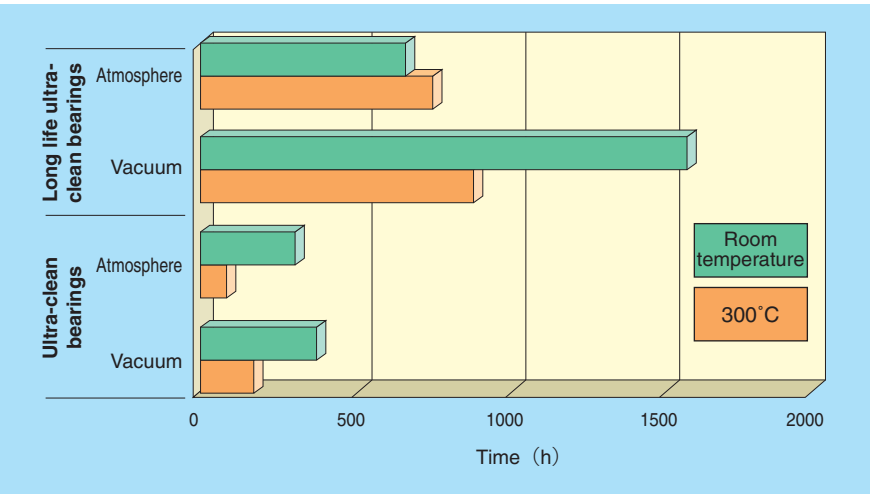


Fig. 15 Evaluation of durability of long-life ultra-clean bearing

● Test conditions

Bearing : Deep groove ball bearings $\phi 8 \times \phi 22 \times 7$
Axial load : 10N
Speed : $2500 min^{-1}$
Atmospheric pressure/vacuum (around 10^{-5} Pa)

3.2.3 Evaluations of outgassing characteristics

Figures 17 and **18** provide evaluations of outgassing characteristics.

● Test conditions

Bearing : Ultra-clean bearing 6 mm dia.×19 mm dia.×6
: Bearing with vacuum grease 6 mm dia.×19 mm dia.×6
: Untreated bearing (PTFE cage) 9.5 mm dia.×22 mm dia.×7.1

Degree of vacuum : Around 10^{-5} Pa

Temperature : Room temperature, 200˚C

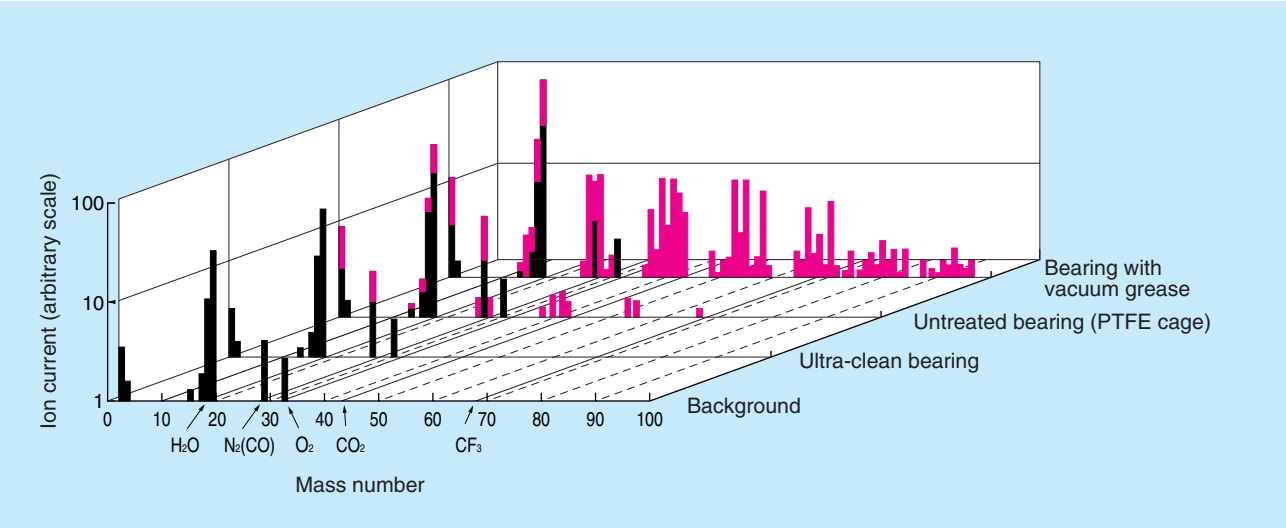


Fig. 17 Example of gasses released immediately after installation of bearing (at room temperature)

- Components that increased after bearing installation are indicated in red, relative to the background measurement of the test equipment.
- The diagram shows that H_2O, N_2 (CO), O_2 and the like are present as background components.
- The ultra-clean bearing exhibited some increase in N_2 (CO) outgassing, but did not show increased outgassing of other components. Additionally, while running, it did not exhibit any increase in outgassing. The **NTN** ultra-clean bearing always exhibits low outgassing.

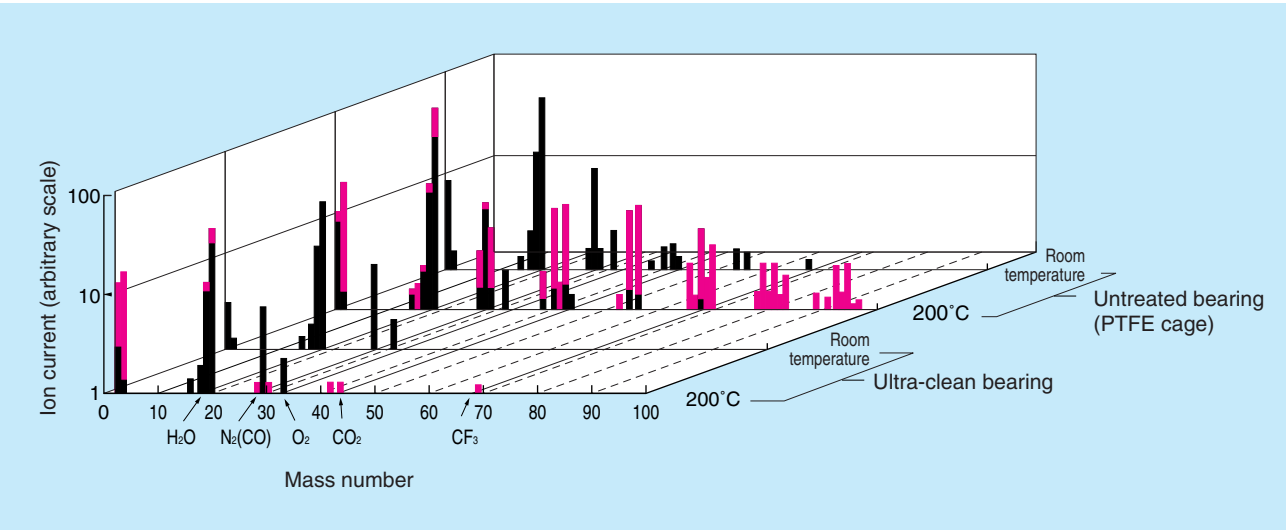


Fig. 18 Comparison of outgassing at room temperature and high temperature

- Components that increased as a result of the temperature increase from room temperature to 200˚C are indicated in red.
- At 200˚C, the amount of gasses released by the ultra-clean bearing somewhat exceed the amount released at room temperature. However, the amount remained small, indicating the low outgassing characteristic of the ultra-clean bearing even in high-temperature applications.

3.3 Bearings for corrosive environments

Table 4 Performance of Bearings for Corrosive Environments

	Applicable temperature range ˚C	Load-carrying capability
PPS resin rolling bearing	Room temperature to 150˚C	Yes

Table 5 Corrosion resistance of bearings for corrosive environments

○ : Good △ : Fair × : Not recommended

	Inner ring & outer ring		Cage		Rolling elements	
	PPS resin	Polyimide resin (optional)	Polyamide resin (optional)	PTFE resin	Ceramic	Glass
10% hydrochloric acid	○	○	×	○	○	△
35% sulfuric acid	○	○	×	○	○	○
35% nitric acid	○	○	×	○	○	○
10% acetic acid	○	△	×	○	○	○
10% potassium hydroxide	○	△	○	○	○	×
10% sodium hydroxide	○	△	○	○	○	×
30% aqueous ammonia	○	△	×	○	○	○

3.4 Electrically conductive bearings

● Test conditions

Bearing : Deep groove ball bearings $\phi 30 \times \phi 42 \times 7$ Speed : 50N

Speed : 150min^{-1} Temperature : Room temperature

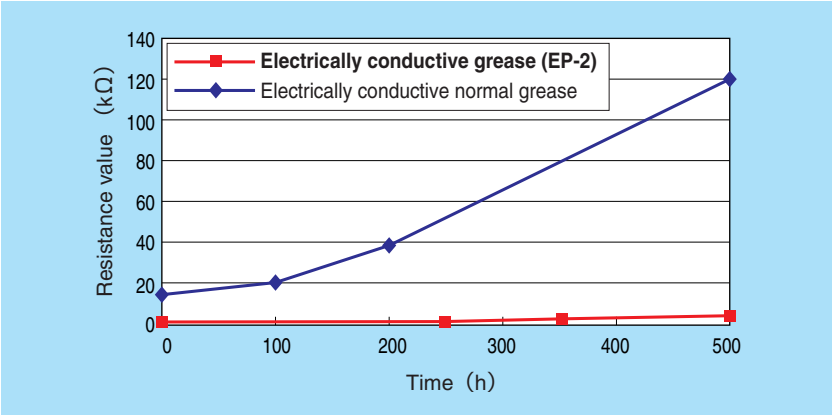


Fig. 19 Durability with electrically conductive grease (EP-2)

4. Material Characteristics

Table 6 Comparison of Characteristics of Ceramic (Si_3N_4) and Bearing Steel (SUJ2)

Characteristics		Ceramic (Si_3N_4)	Bearing Steel (SUJ2)
Hardness	HV	1500	750
Density	g/cm^3	3.2	7.8
Young's modulus	GPa	310	210
Poisson's ratio		0.26	0.3
Coefficient of thermal expansion	×10^{-6}/˚C	3.0	12.5
Thermal conductivity	W/m·k	29	46
Magnetism		Non-magnetic	Ferromagnetic
Corrosion resistance		Good	Poor
Electrical conductivity		Insulator	Conductor

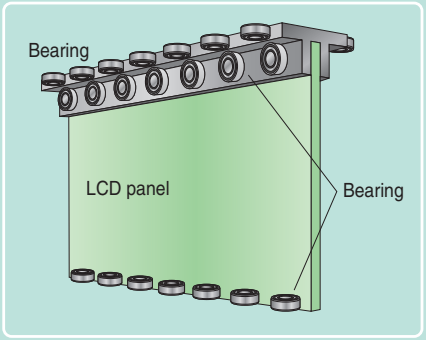
5. Applications

Table 7 summarizes typical applications of **NTN** bearings designed for extreme environments.

Table 7 Typical Applications of Bearings for Extreme Environments

Equipment	Machine/Device	Application	For Vacuum Environments				For Clean Environments				For Corrosive Environments
			Vacuum grease	Ag coating	Pb coating	MoS_2 coating	Ultra-clean	Long-life ultra-clean	Low out particle grease	Low out particle vacuum grease	PPS resin
Aerospace	Manipulators	Actuators	○			○					
	Geosynchronous satellites	Control mechanisms				○					
	Artificial satellites	Antenna deployment mechanisms				○					
Vacuum	Vacuum pumps	Main shafts	○								
	Stepper motors for vacuum environments	Main shafts			○	○	○				
Semiconductor fabrication	Electron beam drawing equipment	Guide rollers					○				
	CVD systems	Transfer mechanisms					○	○		○	
	Sputtering systems	Transfer mechanisms					○	○		○	
	Evaporation systems	Rotary mechanisms		○			○			○	
	Etching systems	Transfer mechanisms					○			○	
	Transfer equipment for clean rooms	Transfer mechanisms					○		○	○	
	Cleaning equipment	Rotating shafts									○
LCD panel manufacturing	Ion implanters	Valve actuator mechanisms								○	
Hard disk manufacturing	Sputtering systems	Transfer/rotary mechanisms					○	○		○	
Electronic device manufacturing	Evaporation systems	Rotary mechanisms		○			○			○	
	Sputtering systems	Transfer mechanisms					○	○		○	
General industrial machinery	Film developers	Guide rollers									○

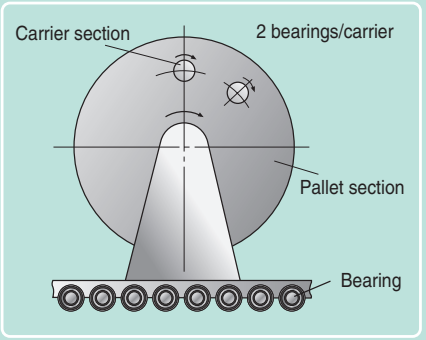
Transfer equipment of LCD panel



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : Special PTFE coating
Material : Inner ring, outer ring, balls
→Martensite stainless steel

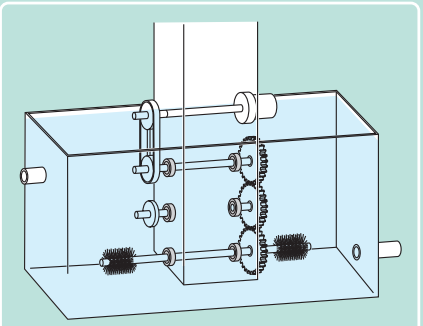
Transfer equipment of HD substrate



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : Special PTFE coating + special balls
Material : Inner ring, outer ring, balls
→Martensite stainless steel

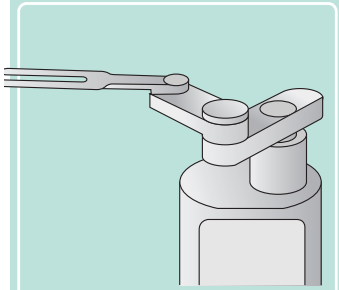
Cleaning equipment within semiconductor fabrication equipment



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : PTFE resin
Material : Inner ring, outer ring→PPS resin
Balls→Ceramic
Cage→PTFE resin

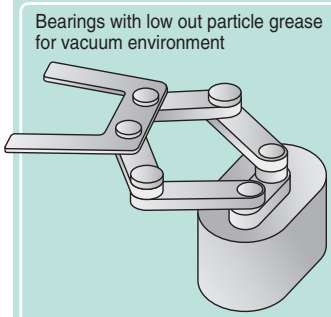
Transfer robot



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : Low out particle grease
Material : Inner ring, outer ring, balls
→Martensite stainless steel

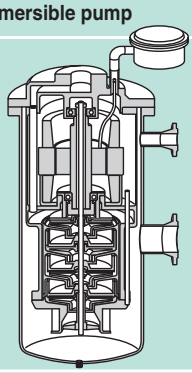
LCD transfer robot



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : Low out particle vacuuum grease
Material : Inner ring, outer ring, balls
→Martensite stainless steel

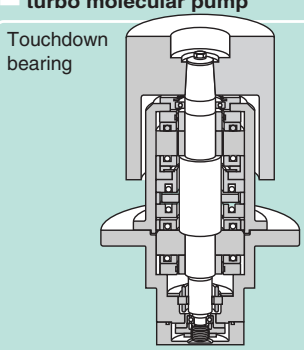
Submersible pump



- **Bearing Specifications**

Type : Deep groove ball bearing
Lubrication : PTFE resin + special PTFE coating
Material : Inner ring, outer ring, balls
→Martensite stainless steel
Cage→PTFE resin

Magnetic bearing spindle for turbo molecular pump

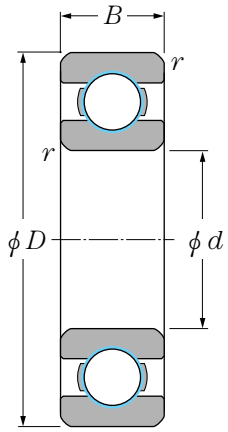


- **Bearing Specifications**

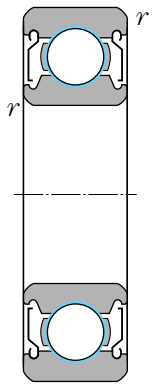
Type : Deep groove ball bearing or angular contact ball bearing
Lubrication : Pb or MoS_2
Material : Inner ring, outer ring, balls
→Martensite stainless steel
Cage→Leaded copper alloy

6. Dimensions

6.1 Vacuum bearings



Open type [2)]



Shielded type

Boundary dimensions (mm)				Bearing numbers	
d	D	B	$r_{s\,min}$ [1)]	Ag coating	MoS_2 coating
4	13	5	0.2	5MG-SEB24J1ZZ1C3/0G	MM-SEB24J1ZZ1C3/0G
5	13	4	0.2	5MG-SEB95AJ1ZZ1C3/0G	MM-SEB95AJ1ZZ1C3/0G
	16	5	0.3	5MG-SEB25J1ZZ1C3/0G	MM-SEB25J1ZZ1C3/0G
6	15	5	0.2	5MG-SEB96J1ZZ1C3/0G	MM-SEB96J1ZZ1C3/0G
	17	6	0.3	5MG-SEB06J1ZZ1C3/0G	MM-SEB06J1ZZ1C3/0G
	19	6	0.3	5MG-SEB26J1ZZ1C3/0G	MM-SEB26J1ZZ1C3/0G
7	19	6	0.3	5MG-SEB07J1ZZ1C3/0G	MM-SEB07J1ZZ1C3/0G
8	19	6	0.3	5MG-SEB98J1ZZ1C3/0G	MM-SEB98J1ZZ1C3/0G
	22	7	0.3	5MG-SEB08J1ZZ1C3/0G	MM-SEB08J1ZZ1C3/0G
10	22	6	0.3	5MG-SEB900J1ZZ1C3/0G	MM-SEB900J1ZZ1C3/0G
	26	8	0.3	5MG-SEB000J1ZZ1C3/0G	MM-SEB000J1ZZ1C3/0G
	35	11	0.6	5MG-SEB300J1ZZ1C3/0G	MM-SEB300J1ZZ1C3/0G
12	24	6	0.3	5MG-SEB901J1ZZ1C3/0G	MM-SEB901J1ZZ1C3/0G
	28	8	0.3	5MG-SEB001J1ZZ1C3/0G	MM-SEB001J1ZZ1C3/0G
	32	10	0.6	5MG-SEB201J1ZZ1C3/0G	MM-SEB201J1ZZ1C3/0G
15	32	9	0.3	5MG-SEB002J1ZZ1C3/0G	MM-SEB002J1ZZ1C3/0G
	35	11	0.6	5MG-SEB202J1ZZ1C3/0G	MM-SEB202J1ZZ1C3/0G
17	30	7	0.3	5MG-SEB903JRIXZZ1C3/0G	MM-SEB903JRIXZZ1C3/0G
	35	10	0.3	5MG-SEB003J1ZZ1C3/0G	MM-SEB003J1ZZ1C3/0G
20	37	9	0.3	5MG-SEB904J1ZZ1C3/0G	MM-SEB904J1ZZ1C3/0G
	42	12	0.6	5MG-SEB004J1ZZ1C3/0G	MM-SEB004J1ZZ1C3/0G
25	42	9	0.3	5MG-SEB905J1ZZ1C3/0G	MM-SEB905J1ZZ1C3/0G
	47	12	0.6	5MG-SEB005J1ZZ1C3/0G	MM-SEB005J1ZZ1C3/0G
30	47	9	0.3	5MG-SEB906J1ZZ1C3/0G	—
	55	13	1	5MG-SEB006J1ZZ1C3/0G	MM-SEB006J1ZZ1C3/0G

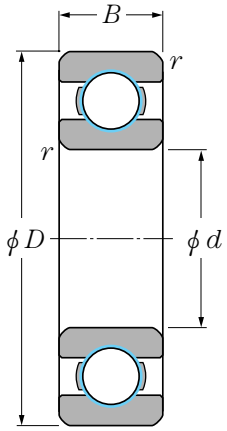
1) Minimum allowable chamfer dimension r.

2) Seal grooves may be provided in some cases.

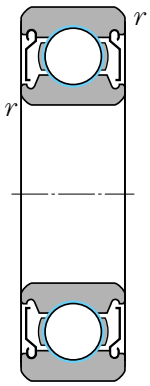
<Example part No:> **5** **MG** – **SEB08** **J1** **C3**

- **5**: Parts code with solid lubricant film
  - Parts ····· Code
  - Inner ring, Outer ring, Balls ··· No code
  - Inner ring, Outer ring ····· 2
  - Balls ····· 5
- **MG**: Code for solid lubricant
  - Molybdenum disulfide ··· MM (MoS_2-coated bearing)
  - Silver ····· MG (Ag-coated bearing)
  - Lead ····· MN (Pb-coated bearing)
- **SEB08**: Basic No.
- **J1**: Cage code
  - Austenite stainless steel ····· J1
  - PTFE resin ····· T3
  - Leaded copper alloy ····· L9
- **C3**: Internal clearance code (C3 clearance)

6.2 Ultra-clean bearings



Open type [2]



Shielded type

Boundary dimensions (mm)				Bearing numbers	Allowable radial load [3]		Basic load ratings	
							dynamic[5]	static
d	D	B	$r_{s\,min}$ [1]		N	kgf	(N)	(N)
4	8	2	0.08	MT2-F-BC4-8C3 [4]	1	0.10	305	140
	9	2.5	0.1	MT2-F-684AX50C3 [4]	1.6	0.16	490	224
	10	3	0.16	MT2-F-BC4-10C3 [4]	1.6	0.16	500	235
	12	4	0.2	MT2-F-604ZZ1C3/0G [4]	2.5	0.26	745	360
	13	5	0.2	MT2-SEB24J1ZZ1C3/0G	3.4	0.35	1 010	490
5	10	3	0.15	MT2-F-BC5-10C3 [4]	1.7	0.17	550	276
	13	4	0.2	MT2-SEB95AJ1ZZ1C3/0G	2.6	0.27	830	430
	14	5	0.2	MT2-F-605ZZ1C3/0G [4]	3.5	0.36	1 020	505
	16	5	0.3	MT2-SEB25J1ZZ1C3/0G	4	0.41	1 350	680
6	12	3	0.15	MT2-F-BC6-12C3 [4]	1.8	0.18	640	365
	15	5	0.2	MT2-SEB96J1ZZ1C3/0G	3.7	0.38	1 040	530
	17	6	0.3	MT2-SEB06J1ZZ1C3/0G	6.1	0.62	1 690	865
	19	6	0.3	MT2-SEB26J1ZZ1C3/0G	13.1	1.34	1 800	885
7	17	5	0.3	MT2-SEB97J1ZZ1C3/0G	3.9	0.40	1 240	715
	19	6	0.3	MT2-SEB07J1ZZ1C3/0G	10.4	1.06	1 720	910
	22	7	0.3	MT2-SEB27J1ZZ1C3/0G	16.9	1.72	2 570	1 400
8	19	6	0.3	MT2-SEB98J1ZZ1C3/0G	5.3	0.54	1 530	865
	22	7	0.3	MT2-SEB08J1ZZ1C3/0G	16.9	1.72	2 570	1 400
	24	8	0.3	MT2-SEB28J1ZZ1C3/0G	24.8	2.53	3 050	1 590
9.525	22.225	7.142	0.3	MT2-F-R6J1ZZ1C3/0G [4]	16.5	1.68	2 560	1 400
10	22	6	0.3	MT2-SEB900J1ZZ1C3/0G	13.4	1.37	2 070	1 270
	26	8	0.3	MT2-SEB000J1ZZ1C3/0G	24	2.45	3 500	1 960
	30	9	0.5	MT2-SEB200J1ZZ1C3/0G	27.8	2.84	3 950	2 390
	35	11	0.6	MT2-SEB300J1ZZ1C3/0G	55.6	5.67	6 300	3 500
12	24	6	0.3	MT2-SEB901J1ZZ1C3/0G	14.1	1.44	2 220	1 460
	28	8	0.3	MT2-SEB001J1ZZ1C3/0G	27.8	2.84	3 950	2 390
	32	10	0.6	MT2-SEB201J1ZZ1C3/0G	37.4	3.82	4 700	2 750
15	28	7	0.3	MT2-SEB902J1ZZ1C3/0G	17.8	1.82	2 810	2 000
	32	9	0.3	MT2-SEB002J1ZZ1C3/0G	31.2	3.18	4 300	2 830
	35	11	0.6	MT2-SEB202J1ZZ1C3/0G	48.8	4.98	5 950	3 600
17	30	7	0.3	MT2-SEB903JR1XZZ1C3/0G	24.8	2.53	3 600	2 580
	35	10	0.3	MT2-SEB003J1ZZ1C3/0G	37.1	3.79	5 250	3 350
	40	12	0.6	MT2-SEB203J1ZZ1C3/0G	62.2	6.35	7 400	4 600
20	37	9	0.3	MT2-SEB904J1ZZ1C3/0G	36.3	3.70	4 900	3 700
	42	12	0.6	MT2-SEB004J1ZZ1C3/0G	48	4.90	7 200	5 050
	47	14	1.0	MT2-SEB204J1ZZ1C3/0G	77.1	7.87	9 900	6 650
25	42	9	0.3	MT2-SEB905J1ZZ1C3/0G	48	4.90	5 400	4 550
	47	12	0.6	MT2-SEB005J1ZZ1C3/0G	63.2	6.45	7 750	5 850
	52	15	1.0	MT2-SEB205J1ZZ1C3/0G	99	10.10	10 800	7 850
30	47	9	0.3	MT2-SEB906J1ZZ1C3/0G	51.5	5.25	5 550	5 000
	55	13	1.0	MT2-SEB006J1ZZ1C3/0G	103.5	10.56	10 200	8 300
	62	16	1.0	MT2-SEB206J1ZZ1C3/0G	129.4	13.20	15 000	11 300

1) Minimum allowable chamfer dimension r.
2) Seal grooves may be provided in some cases.
3) Allowable radial load is the maximum allowable load with only a radial load applied.
4) Maximum allowable temperature is 120˚C (260˚C for others).
5) The basic dynamic load rating is the value for stainless steel bearings.

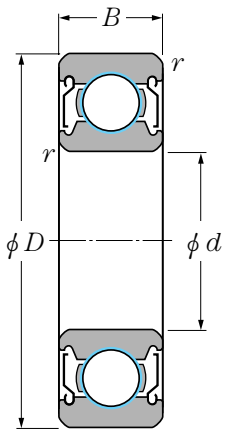
The lead time for products in this table is two weeks.

Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

<Example part No:> **MT2 — SEB08 J1 ZZ1 C3 / 0G**

- MT2 — Solid lubricant code : Special PTFE···MT2 (ultra-clean bearing)
  ···MT2-5PT (long life ultra-clean bearing)
  Grease lubrication···No suffix (indicated at end of part part No.)
- SEB08 — Basic No.
- J1 — Cage code: Austenite stainless steel···J1
- ZZ1 — Shield code : Austenite stainless steel···ZZ1
  : No shield···No code
- C3 — Internal clearance code (C3 clearance)
- 0G — Grease lubricant code
  Solid lubricant···OG
  Low out particlae grease···L635
  Low out particlae fluorine grease·····LX23

6.3 Long life ultra-clean bearings



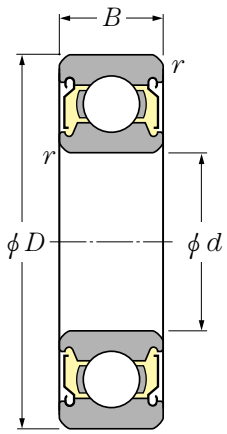
Shielded type

Boundary dimensions (mm)				Bearing numbers	Allowable radial load [2]		Basic load ratings dynamic[3]	static
d	D	B	$r_{s\,min}$ [1]		N	kgf	(N)	(N)
6	19	6	0.3	**MT2-5PT-SEB26J1ZZ1C3/0G**	13.1	1.34	1 800	885
7	22	7	0.3	**MT2-5PT-SEB27J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
8	22	7	0.3	**MT2-5PT-SEB08J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
	24	8	0.3	**MT2-5PT-SEB28J1ZZ1C3/0G**	24.8	2.53	3 050	1 590
10	26	8	0.3	**MT2-5PT-SEB000J1ZZ1C3/0G**	24.0	2.45	3 500	1 960
	30	9	0.6	**MT2-5PT-SEB200J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	35	11	0.6	**MT2-5PT-SEB300J1ZZ1C3/0G**	55.6	5.67	6 300	3 500
12	28	8	0.3	**MT2-5PT-SEB001J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	32	10	0.6	**MT2-5PT-SEB201J1ZZ1C3/0G**	37.4	3.82	4 700	2 750
15	28	7	0.3	**MT2-5PT-SEB902J1ZZ1C3/0G**	17.3	1.77	2 810	2 000
	32	9	0.3	**MT2-5PT-SEB002J1ZZ1C3/0G**	31.2	3.18	4 300	2 830
	35	11	0.6	**MT2-5PT-SEB202J1ZZ1C3/0G**	48.8	4.98	5 950	3 600
17	30	7	0.3	**MT2-5PT-SEB903JR1XZZ1C3/0G**	22.4	2.29	3 600	2 580
	35	10	0.3	**MT2-5PT-SEB003J1ZZ1C3/0G**	37.1	3.79	5 250	3 350
	40	12	0.6	**MT2-5PT-SEB203J1ZZ1C3/0G**	62.2	6.35	7 400	4 600
20	37	9	0.3	**MT2-5PT-SEB904J1ZZ1C3/0G**	31.9	3.26	4 900	3 700
	42	12	0.6	**MT2-5PT-SEB004J1ZZ1C3/0G**	48.0	4.90	7 200	5 050
	47	14	1.0	**MT2-5PT-SEB204J1ZZ1C3/0G**	77.1	7.87	9 900	6 650
25	42	9	0.3	**MT2-5PT-SEB905J1ZZ1C3/0G**	42.6	4.35	5 400	4 550
	47	12	0.6	**MT2-5PT-SEB005J1ZZ1C3/0G**	54.0	5.51	7 750	5 850
	52	15	1.0	**MT2-5PT-SEB205J1ZZ1C3/0G**	99.0	10.01	10 800	7 850
30	47	9	0.3	**MT2-5PT-SEB906J1ZZ1C3/0G**	46.6	4.75	5 550	5 000
	55	13	1.0	**MT2-5PT-SEB006J1ZZ1C3/0G**	90.2	9.20	10 200	8 300

1) Minimum allowable chamfer dimension.
2) Allowable radial load is the maximum allowable load with only a radial load applied.
3) The basic dynamic load rating is the value for stainless steel bearings.
4) Maximum allowable temperature is 300˚C.

The lead time for products in this table is two weeks.
Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

6.4 Bearings with low out particle grease



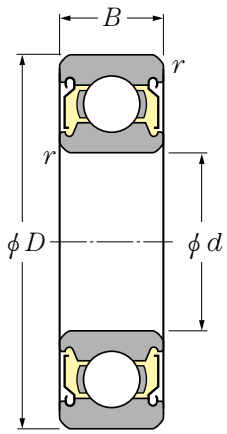
Shielded type

Boundary dimensions (mm)				Bearing numbers	Basic load ratings	
					dynamic[2]	static
d	D	B	$r_{s\,min}$[1]		(N)	(N)
4	12	4	0.2	**F-604ZZ1C3/L635QMP**	745	360
	13	5	0.2	**SEB24J1ZZ1C3/L635QMP**	1 010	490
5	13	4	0.2	**SEB95AJ1ZZ1C3/L635QMP**	830	430
	14	5	0.2	**F-605ZZ1C3/L635QMP**	1 020	505
	16	5	0.3	**SEB25J1ZZ1C3/L635QMP**	1 350	680
6	12	4	0.15	**F-WBC6-12ZZ1C3/L635QMP**	640	365
	15	5	0.2	**SEB96J1ZZ1C3/L635QMP**	1 040	530
	17	6	0.3	**SEB06J1ZZ1C3/L635QMP**	1 690	865
	19	6	0.3	**SEB26J1ZZ1C3/L635QMP**	1 800	885
7	17	5	0.3	**SEB97J1ZZ1C3/L635QMP**	1 240	715
	19	6	0.3	**SEB07J1ZZ1C3/L635QMP**	1 720	910
	22	7	0.3	**SEB27J1ZZ1C3/L635QMP**	2 570	1 400
8	19	6	0.3	**SEB98J1ZZ1C3/L635QMP**	1 530	865
	22	7	0.3	**SEB08J1ZZ1C3/L635QMP**	2 570	1 400
	24	8	0.3	**SEB28J1ZZ1C3/L635QMP**	3 050	1 590
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/L635QMP**	2 560	1 400
10	19	5	0.3	**SSN800ZZ1/L635QMP**	1 630	985
	22	6	0.3	**SSN900ZZ1/L635QMP**	2 070	1 270
	26	8	0.3	**SSN000ZZ1/L635QMP**	3 500	1 960
	30	9	0.5	**SSN200ZZ1/L635QMP**	3 950	2 390
	35	11	0.6	**SEB300J1ZZ1C3/L635QMP**	6 300	3 500
12	24	6	0.3	**SSN901ZZ1/L635QMP**	2 220	1 460
	28	8	0.3	**SSN001ZZ1/L635QMP**	3 950	2 390
	32	10	0.6	**SSN201ZZ1/L635QMP**	5 250	3 050
15	24	5	0.3	**SSN802ZZ1/L635QMP**	1 600	1 260
	28	7	0.3	**SSN902ZZ1/L635QMP**	3 350	2 260
	32	9	0.3	**SSN002ZZ1/L635QMP**	4 300	2 830
	35	11	0.6	**SSN202ZZ1/L635QMP**	5 850	3 750
17	30	7	0.3	**SSN903ZZ1/L635QMP**	3 550	2 560
	35	10	0.3	**SSN003ZZ1/L635QMP**	4 600	3 250
	40	12	0.6	**SSN203ZZ1/L635QMP**	7 350	4 800
20	37	9	0.3	**SSN904ZZ1/L635QMP**	4 900	3 700
	42	12	0.6	**SSN004ZZ1/L635QMP**	7 200	5 050
	47	14	1.0	**SSN204ZZ1/L635QMP**	9 900	6 650
25	42	9	0.3	**SSN905ZZ1/L635QMP**	5 400	4 550
	47	12	0.6	**SSN005ZZ1/L635QMP**	7 750	5 850
	52	15	1.0	**SSN205ZZ1/L635QMP**	10 800	7 850
30	47	9	0.3	**SSN906ZZ1/L635QMP**	5 550	5 000
	55	13	1.0	**SSN006ZZ1/L635QMP**	10 200	8 250
	62	16	1.0	**SSN206ZZ1/L635QMP**	15 000	11 300
35	72	17	1.1	**SSN207ZZ1/L635QMP**	19 800	15 400

1) Minimum allowable chamfer dimension.
2) The basic dynamic load rating is the value for stainless steel bearings.
3) Maximum allowable temperature is 70˚C.

The lead time for products in this table is two weeks.
Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

6.5 Bearings with low out particle grease for vacuum environment



Shielded type

Boundary dimensions (mm)				Bearing numbers	Basic load ratings dynamic[2]	static
d	D	B	$r_{s\,min}$ [1]		(N)	(N)
4	12	4	0.2	**F-604ZZ1C3/LX23Q8** [2]	745	360
	13	5	0.2	**SEB24J1ZZ1C3/LX23Q12**	1 010	490
5	13	4	0.2	**SEB95AJ1ZZ1C3/LX23Q20**	830	430
	14	5	0.2	**F-605ZZ1C3/LX23Q8** [2]	1 020	505
	16	5	0.3	**SEB25J1ZZ1C3/LX23Q24**	1 350	680
6	12	4	0.15	**F-WBC6-12ZZ1C3/LX23Q7** [2]	640	365
	15	5	0.2	**SEB96J1ZZ1C3/LX23Q30**	1 040	530
	17	6	0.3	**SEB06J1ZZ1C3/LX23Q15**	1 690	865
	19	6	0.3	**SEB26J1ZZ1C3/LX23Q31**	1 800	885
7	17	5	0.3	**SEB97J1ZZ1C3/LX23Q6**	1 240	715
	19	6	0.3	**SEB07J1ZZ1C3/LX23Q24**	1 720	910
	22	7	0.3	**SEB27J1ZZ1C3/LX23Q19**	2 570	1 400
8	19	6	0.3	**SEB98J1ZZ1C3/LX23Q22**	1 530	865
	22	7	0.3	**SEB08J1ZZ1C3/LX23Q109**	2 570	1 400
	24	8	0.3	**SEB28J1ZZ1C3/LX23Q5**	3 050	1 590
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/LX23Q18** [2]	2 560	1 400
10	22	6	0.3	**SEB900J1ZZ1C3/LX23Q19**	2 070	1 270
	26	8	0.3	**SEB000J1ZZ1C3/LX23Q67**	3 500	1 960
	30	9	0.6	**SEB200J1ZZ1C3/LX23Q39**	3 950	2 390
	35	11	0.6	**SEB300J1ZZ1C3/LX23Q13**	6 300	3 500
12	24	6	0.3	**SEB901J1ZZ1C3/LX23Q14**	2 220	1 460
	28	8	0.3	**SEB001J1ZZ1C3/LX23Q48**	3 950	2 390
	32	10	0.6	**SEB201J1ZZ1C3/LX23Q59**	4 700	2 750
15	28	7	0.3	**SEB902J1ZZ1C3/LX23Q14**	2 810	2 000
	32	9	0.3	**SEB002J1ZZ1C3/LX23Q33**	4 300	2 830
	35	11	0.6	**SEB202J1ZZ1C3/LX23Q100**	5 950	3 600
17	30	7	0.3	**SEB903JR1XZZ1C3/LX23Q10**	3 600	2 580
	35	10	0.3	**SEB003J1ZZ1C3/LX23Q34**	5 250	3 350
	40	12	0.6	**SEB203J1ZZ1C3/LX23Q91**	7 400	4 600
20	37	9	0.3	**SEB904J1ZZ1C3/LX23Q17**	4 900	3 700
	42	12	0.6	**SEB004J1ZZ1C3/LX23Q41**	7 200	5 050
	47	14	1.0	**SEB204J1ZZ1C3/LX23Q50**	9 900	6 650
25	42	9	0.3	**SEB905J1ZZ1C3/LX23Q18**	5 400	4 550
	47	12	0.6	**SEB005J1ZZ1C3/LX23Q46**	7 750	5 850
	52	15	1.0	**SEB205J1ZZ1C3/LX23Q63**	10 800	7 850
30	47	9	0.3	**SEB906J1ZZ1C3/LX23Q12**	5 550	5 000
	55	13	1.0	**SEB006J1ZZ1C3/LX23Q35**	10 200	8 300
	62	16	1.0	**SEB206J1ZZ1C3/LX23Q65**	15 000	11 300

1) Minimum allowable chamfer dimension.
2) Maximum allowable temperature is 120˚C (200˚C for others).
3) The basic dynamic load rating is the value for stainless steel bearings.

The lead time for products in this table is two weeks.
Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

Handling Precautions

(1) Bearing components have been thoroughly degreased. Do not touch any bearing component with bare hands. Doing so may cause rusting of the bearing. Always wear clean, lint-free gloves when installing a bearing.
(2) Do not rinse a bearing with an organic solvent. Doing so may lead to lubricant leakage or damage to the lubricant film.
(3) Do not unpack a vacuum-packed or heat-packed bearing until immediately before installation. Otherwise, the bearing may rust or become contaminated with dust. If the bearing will not be used for an extended period, store it in a dry, closed container such as a desiccator.