



SPACEA™

Bearings, Ball Screws and NSK Linear Guides, for Special Environments



SPACEA™

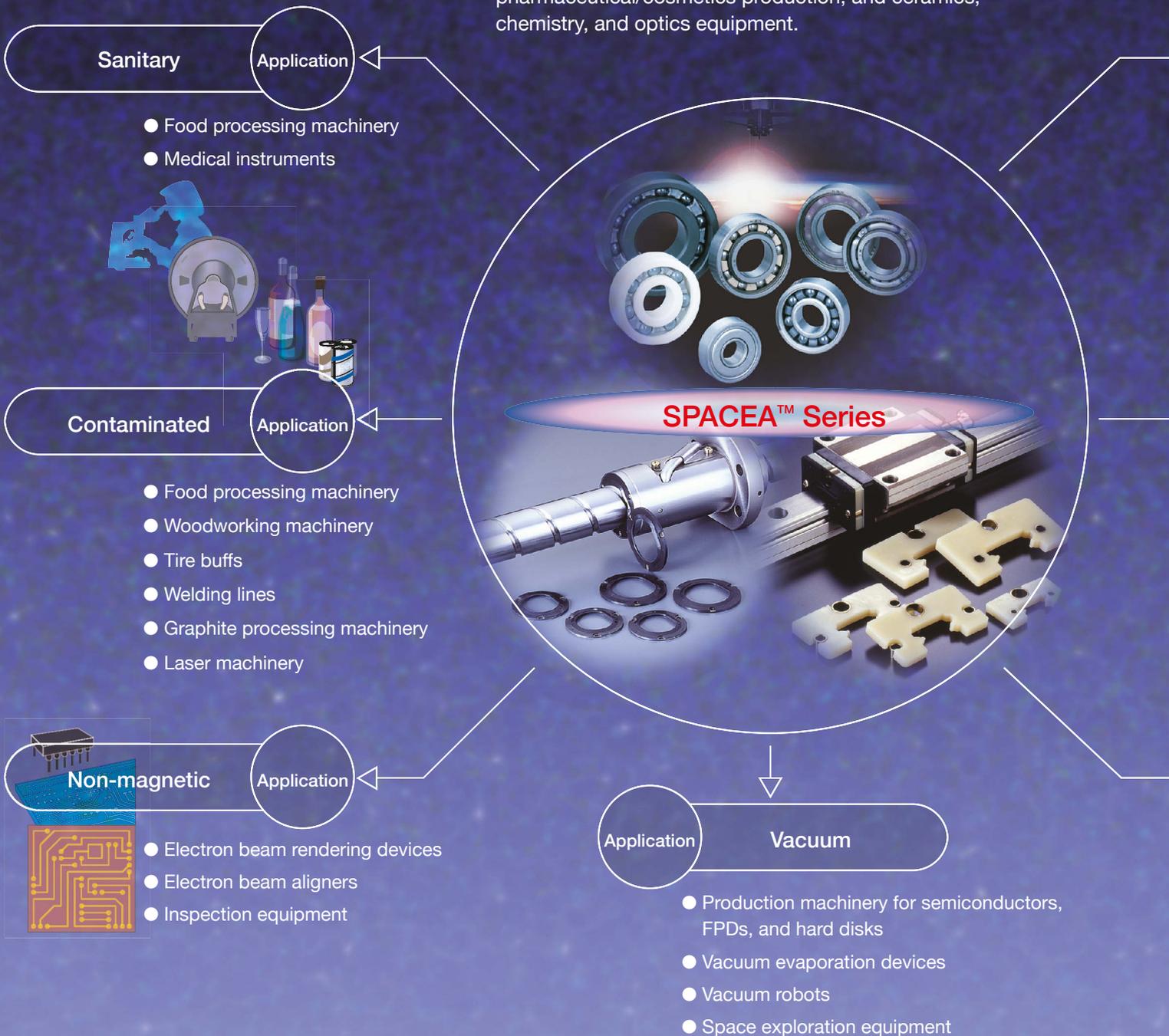
Bearings, Ball Screws, and NSK Linear Guides for Special Environments

The SPACEA™ Series—responding to extreme, special environments

NSK's SPACEA™ Series adapts the vacuum lubrication, material, and thin-film technologies for advanced applications. Our wide array of bearings, ball screws, and NSK Linear Guide™ products offer high functionality and unmatched quality in special environments. As such, the SPACEA Series stands up to tough operation requirements in vacuum, corrosive, cleanroom, high-temperature, non-magnetic, and contaminated environments.

SPACEA™

The SPACEA Series is optimized for a variety of advanced applications, including semiconductor, flat panel display, and hard disk production; food processing machinery; pharmaceutical/cosmetics production; and ceramics, chemistry, and optics equipment.



Solutions that excel in diverse operating conditions and a broad range of applications.



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Bearings

Ball Screws/NSK Linear Guides

Appendices

Application

Corrosive

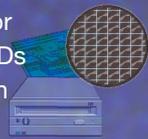
- Cleaning equipment for semiconductors, FPDs, PDPs, and hard disks
- Food processing machinery
- Conveyors
- Chemical plants
- Plating facilities
- Etching equipment



Application

Cleanroom

- Transporters in clean rooms
- Production machinery for semiconductors and FPDs panels, and conveyors in machinery
- Hard disk production machinery
- Solar cell production machinery



Application

High-temperature

- Kilns
- High-temperature conveyors
- Semiconductor production machinery
- Kiln cars



NSK Global Network

NSK's global network is key to our ability to develop innovative products that incorporate the latest technologies.

Our network connects each sales branch, distribution center, production facility, and technology center and enables us to gather the latest information from each location.

Data is instantly accessible to every part of the network, resulting in products of the highest quality.

Our global system also receives and processes orders, ships products, and provides technical support.

By leveraging our resources, NSK quickly responds to diverse challenges, no matter how complex.

NSK's global network means excellent products and superior customer service.

NSK's communication system links the major markets of the world in Europe, Asia, Japan, and the Americas. We use this highly developed system to share information on changes and trends in each market in real time. As a result, we can react quickly to meet changing customer needs, supplying optimized, high-quality products. Our global network makes NSK a truly global company. We are able to transcend borders and other restrictions to meet the needs of our customers around the globe.



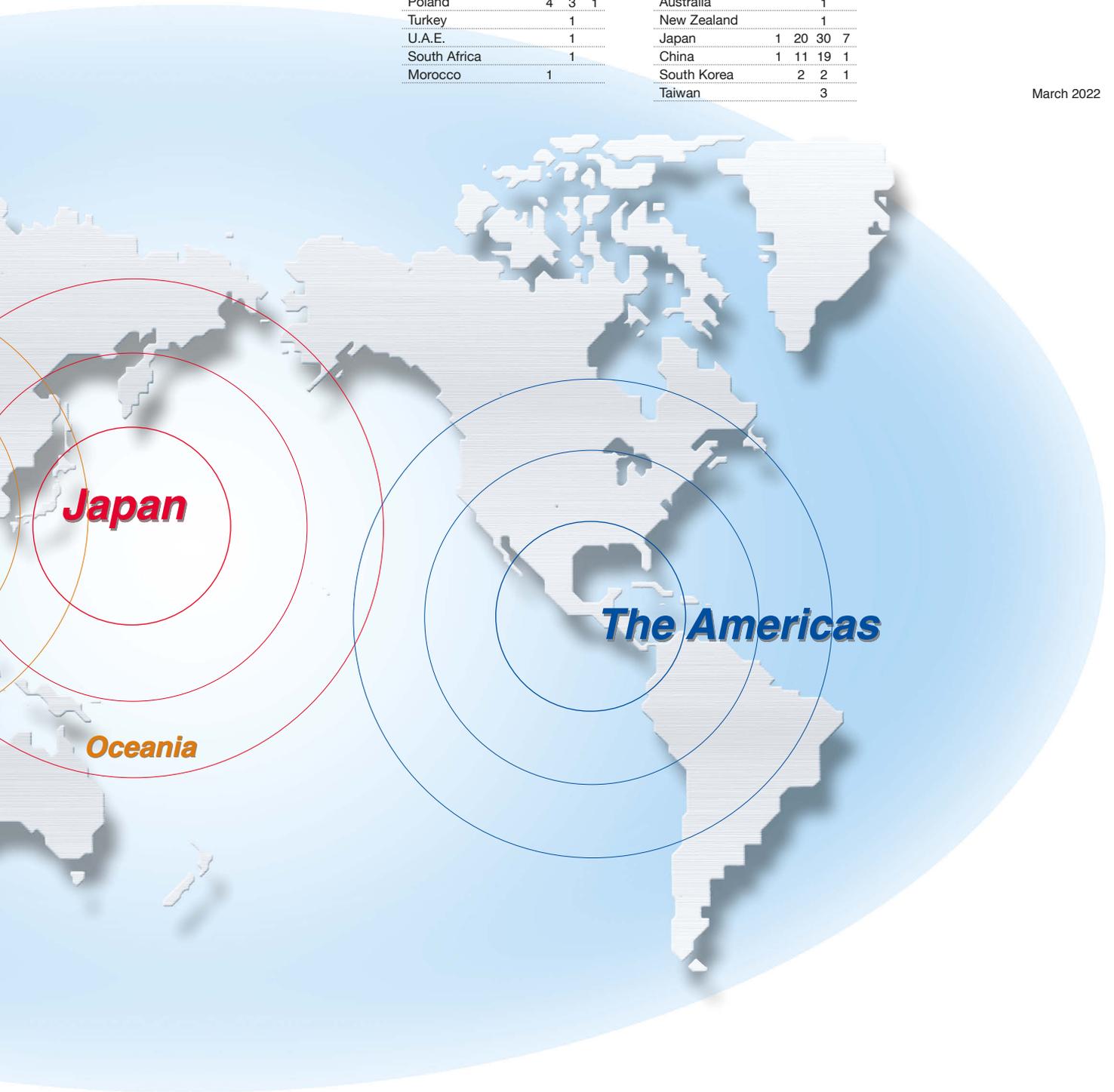
● Headquarters.....6
■ Plants.....66
■ Sales offices.....106
□ Technical offices.....22

EUROPE/AFRICA	●	■	■	□
U.K.	1	4	2	1
Germany	2	4	2	
Denmark				1
France	1			
Italy	1			
Holland	1			
Spain	1			
Poland	4	3	1	
Turkey	1			
U.A.E.	1			
South Africa	1			
Morocco	1			

ASIA/OCEANIA	●	■	■	□
Singapore	1		1	
Indonesia	3	2		
Thailand	2	5	1	
Malaysia	2	3		
Philippines	1			
Vietnam	2			
India	1	5	7	2
Australia				1
New Zealand				1
Japan	1	20	30	7
China	1	11	19	1
South Korea	2	2	1	
Taiwan				3

THE AMERICAS	●	■	■	□
U.S.A.	1	7	7	4
Canada				2
Mexico		2	1	
Brazil	1	1	1	
Peru				1
Argentina				1

March 2022



Japan

Oceania

The Americas

NSK Research and Development

Extensive commitment to research and development through a network of four bases in the United States, Europe, and Asia, with Japan as the core.

NSK's R&D centers concentrate on enhancements in our core technologies of tribology, materials numerical simulation and mechatronics. These form the basis for development of NSK's current and future product lineups. We strive to improve our fundamental technologies while preparing for future changes.

NSK Technology Development Center Fujisawa
(Japan)



European Technology Centre
(England)



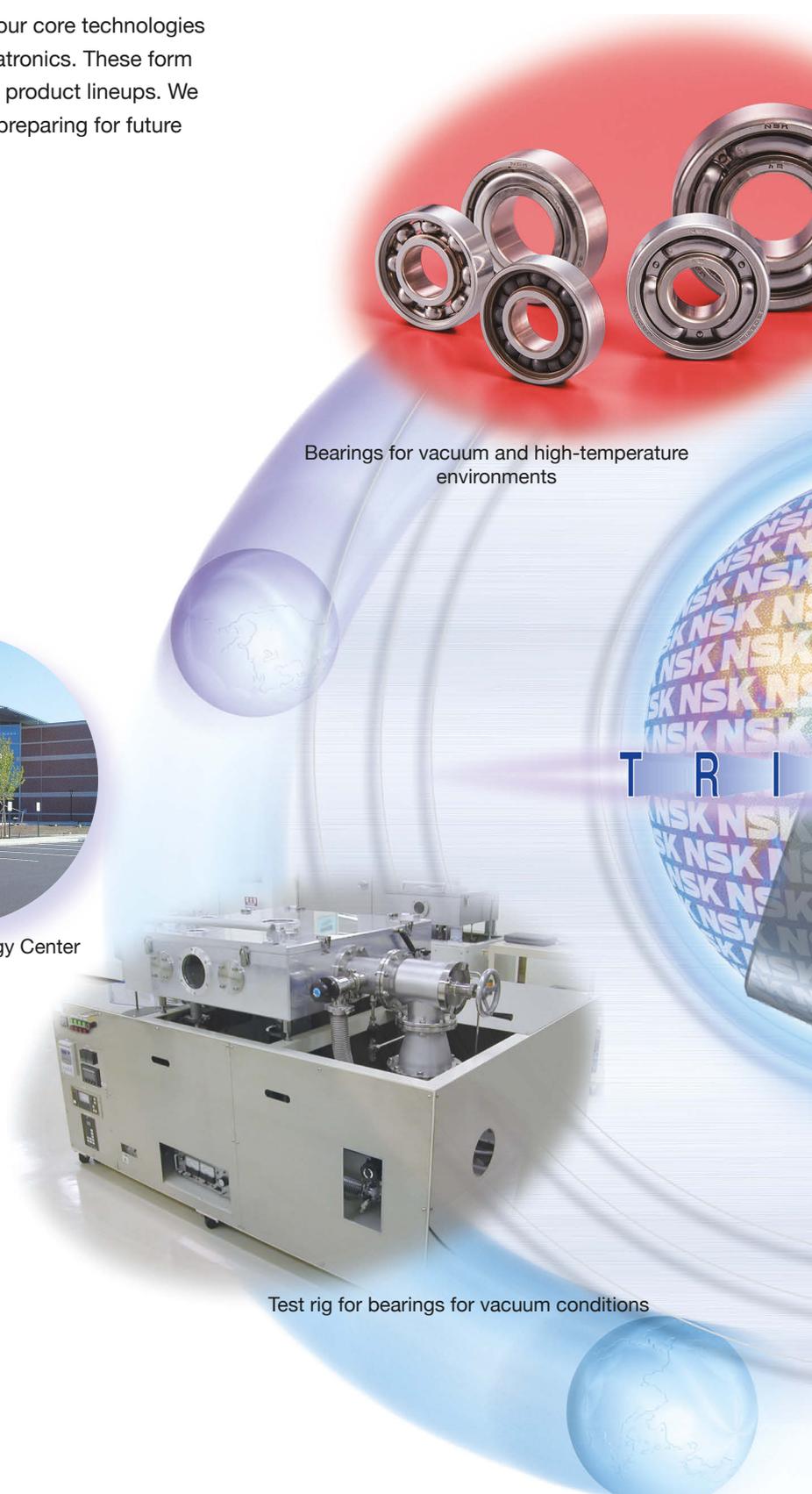
American Technology Center
(USA)



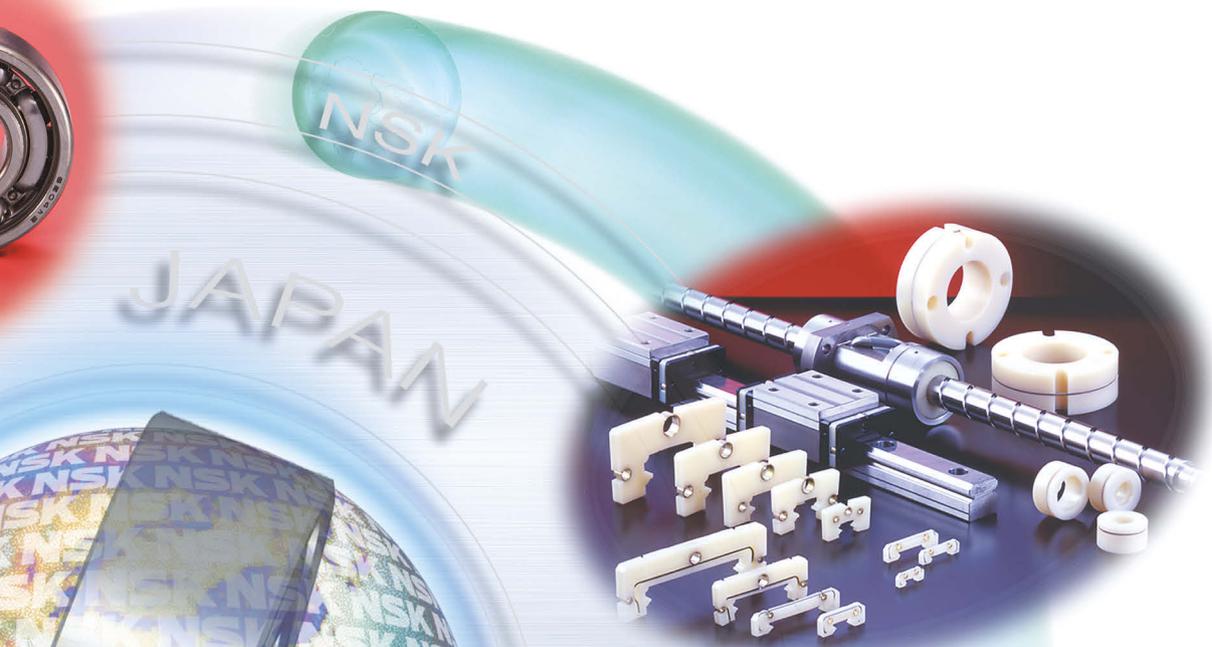
China Technology Center
(China)



Bearings for vacuum and high-temperature environments



Test rig for bearings for vacuum conditions



B O L O G Y

Lubrication Unit "NSK K1™"

SPACEA™ Series bearings, ball screws, and NSK Linear Guides are technology-driven products that continue to evolve, supported by advanced technologies developed in the NSK R&D centers. Lubrication, materials, and evaluation technologies are integrated to create new SPACEA™ products.

● **Lubrication technology**

- Cleanroom and vacuum lubricant DFO
- Cleanroom greases: LG2, LGU
- Special solid lubricant
- Solid lubricant for vacuum/high temperature

● **Materials technology**

- Highly corrosion-resistant, long-life stainless steel: ES1
- Highly corrosion-resistant, high hardness stainless steel: ESZ
- Fiber-reinforced, highly corrosion-resistant fluororesin materials
- Highly corrosion-resistant ceramic materials

● **Evaluation technology**

- In-vacuo rotation/linear tester
- Clean environment rotation/linear tester
- Corrosive environment bearing endurance tester
- Dust-contaminated environment linear tester



Bearings for corrosive environments

SPACEA Series Bearings: Functionality and Quality Tailored for Special Environments

Through a diverse lineup committed to functionality and quality, SPACEA Series bearings suit a wide range of conditions, requirements, and environments.

Please see Pages A5–A8 for recommended bearings for specific applications.



● SPACEA™ Bearings ●

A	Inventory	A3–A4
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	9. Aqua-Bearing™	A43–A44
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A SPACEA™ Series Bearings

Lineup

NSK's SPACEA™ Series bearings for special environments are optimized for operating environments that are too severe for ordinary bearings, such as production machinery for semiconductors, flat panel displays (FPDs), hard disks; food processing machinery; and equipment for pharmaceutical, cosmetics, ceramics, chemistry, and optics.

Sanitary environments

● For food processing machinery

- Food grade grease-packed bearings
- Molded-Oil™ bearings with food grade lubricant



Food grade grease-packed bearings

Vacuum environments

● Cleanroom

- FG9 fluorine grease-packed bearings
- DFO bearings

● High-temperature

- YS bearings with spacer joints
- SJ bearings



YS bearings with spacer joints

Corrosive environments

● Wet environments

- Stainless steel bearings
- Molded-Oil™ bearings
- Hybrid bearings
- Corrosion-resistant coated bearings

● Alkali and weak acid environments

- ESZ bearings

● Strong acid and reactive gas environments

- Aqua-Bearing™
- All-ceramic bearings



Stainless steel bearings



Aqua-Bearing™

SPACEA™

SPACEA™ Series

Cleanroom environments

- **At atmospheric pressure, room temperature**
 - LG2 grease-packed bearings
 - LGU grease-packed bearings
- **At atmospheric pressure, vacuum**
 - FG9 fluorine grease-packed bearings
 - DFO bearings



Clean grease-packed bearings



SJ bearings

High-temperature environments

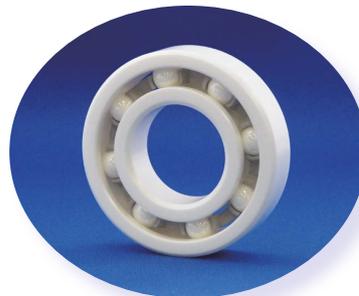
- **At atmospheric pressure, high-temperature**
 - KPM grease-packed bearings
- **Vacuum, high-temperature**
 - YS bearings with spacer joints
 - SJ bearings



DFO bearings

Non-magnetic requirements

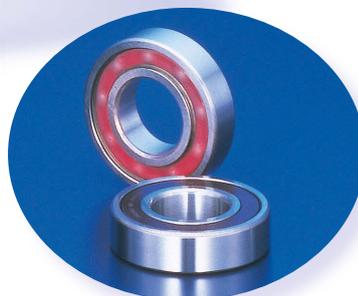
- All-ceramic bearings



All-ceramic bearings

Contaminated environments

- **At atmospheric pressure, dust-contaminated**
 - Molded-Oil™ bearings



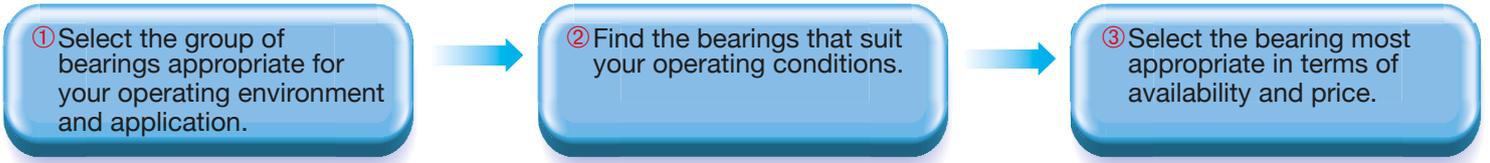
Molded-Oil™ bearings

SPACEA™

Series Bearings

B SPACEA™ Bearing Selection Guide-I

1. Select the most appropriate bearing with the following selection flow chart.



Operating environment		Product	Degree of vacuum Pa				Operating temperature °C				
			Atmospheric pressure	≥10 ⁻⁴	≥10 ⁻⁸	≤100	≤200	≤300	≤400		
Vacuum	Cleanroom	Classification of air cleanliness ⁽¹⁾ : Classes 5-6 (100-1 000)	10 ⁻⁴ Pa		200 °C		For details, please refer to Page A47.				
		Classification of air cleanliness ⁽¹⁾ : Classes 4-5 (10-100)	10 ⁻⁷ Pa		200 °C		For details, please refer to Page A50.				
	High-temperature	Up to 400 °C	10 ⁻⁸ Pa		400 °C						
		Up to 350 °C	10 ⁻⁸ Pa		350 °C						
Corrosive environments	Water	High-humidity			80 °C						
		Water spray, immersed			60 °C						
					150 °C						
		Water, sterilization liquid			150 °C						
	Weak acid and alkali					150 °C					
		Strong acid and reactive gas					100 °C				
					150 °C						

Notes

- (1) Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding structures, and other factors.
- (2) $d_m n = (\text{bearing bore diameter} + \text{bearing outer diameter (mm)}) \div 2 \times \text{rotational speed (min)}^{-1}$

- (3) The limiting load is estimated based on endurance (total rotational frequency) corresponding to 10⁷ as a guideline.
P: equivalent load (N), *C_H*: load rating (N) of stainless steel bearings
 (Durability varies by operating environment and conditions.)

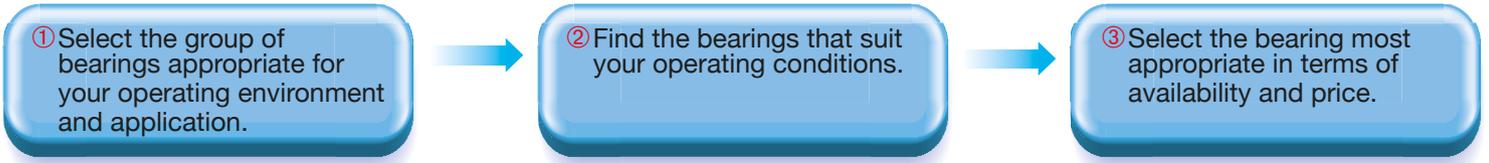
④ Check the operating instructions and notes.

② Operating conditions									③ Price comparison	③ Availability	④ Specifications ·Operating instructions ·Technical data
Cleanliness ⁽¹⁾ (ISO/US Fed. Std. Class)			Limiting rotational speed $d_m n^{(2)}$			Limiting load $P/C_H^{(3)}$					
Classes 5-6 (100-1 000)	Class 5 (100)	Class 4 (10)	≤20 000	≤50 000	≤150 000	≤1%	≤2%	≤5%			
			50 000			5%			Low	Page A21–A22	Page A47–A48
	Class 4 (10)		20 000			2%			High	Page A23	Page A49–A50
			20 000			5%					
			20 000			For details, please refer to Page A55.			Low	Page A26	Page A55–A56
			20 000			For details, please refer to Page A53.			High	Page A25	Page A53–A54
			150 000			5%			Low	Page A11–A14	Page A29–A30
			For details, please refer to Page A33.			1 to 5%					
			20 000			2%			High	Page A17	Page A35–A36
			20 000			2%					Page A37–A38
			20 000			2%			High	Page A18	Page A39–A40
			20 000			1%			Low	Page A20	Page A43–A44
			20 000			5%			High	Page A19	Page A41–A42

Remarks: Please consult NSK about any unclear bearing specifications.

B SPACEA™ Bearing Selection Guide-II

1. Select the most appropriate bearing with the following selection flow chart.



Operating environment ①		Product name	Degree of vacuum Pa				Operating temperature °C				
			Atmospheric pressure	≥10 ⁻⁴	≥10 ⁻⁸	≤100	≤200	≤300	≤400		
Cleanroom	For use at atmospheric pressure only	LG2/LGU grease-packed bearings	●			→	70 °C (LG2) 120 °C (LGU)				
	From atmospheric pressure up to vacuum	FG9 fluorine grease-packed bearings		→ 10 ⁻⁴ Pa			→ 200 °C			For details, please refer to Page A47.	
	Low outgassing and low particle emissions	V-DFO bearings			→ 10 ⁻⁷ Pa		→ 200 °C			For details, please refer to Page A50.	
E-DFO bearings						→ 150 °C					
High-temperature	For use at atmospheric pressure only, up to 230 °C	KPM grease-packed bearings	●				→ 230 °C				
	From normal atmosphere up to 10 ⁻⁸ Pa, up to 400 °C	SJ bearings			→ 10 ⁻⁸ Pa					→ 400 °C	
	From normal atmosphere up to 10 ⁻⁸ Pa, up to 350 °C	YS bearings with spacer joints			→ 10 ⁻⁸ Pa					→ 350 °C	
Non-magnetic	Completely non-magnetic (relative permeability 1.001 or less)	All-ceramic bearings	●				→ 150 °C				
Sanitary environments	In food processing machinery	RLS grease-packed bearings	●				→ 120 °C				
		High-temperature BL2 grease-packed bearings	●				→ 200 °C				
		Molded-Oil™ bearings with food grade lubricant	●				→ 60 °C				
Contaminated environments	Dust, wood waste, etc.	Molded-Oil™ bearings	●				→ 60 °C				

- Notes**
- (1) Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding structures and other factors.
 - (2) $d_m n = (\text{bearing bore diameter} + \text{bearing outer diameter (mm)}) \div 2 \times \text{rotational speed (min)}^{-1}$
 - (3) The limiting load is estimated based on endurance (total rotational frequency) corresponding to 10^7 as a guideline.
 P : equivalent load (N), C_H : load rating (N) of stainless steel bearings
 (Durability varies by operating environment and conditions.)

④ Check the operating instructions and notes.

② Operating conditions									③ Price comparison	③ Availability	④ Specifications ·Operating instructions ·Technical data
Cleanliness ⁽¹⁾ (ISO/US Fed. Std. Class)			Limiting rotational speed $d_m n^{(2)}$			Limiting load $P/C_H^{(3)}$					
Classes 5-6 (100-1 000)	Class 5 (100)	Class 4 (10)	≤20 000	≤50 000	≤150 000	≤1%	≤2%	≤5%			
			50 000			5%			Low	Page A21–A22	Page A45–A46
											High
	Class 4 (10)		20 000			2%			High	Page A23	
						5%					
			50 000			5%			High	Page A24	Page A51–A52
			20 000			For details, please refer to Page A55.					
						For details, please refer to Page A53.					
			20 000			5%			–	Page A19	Page A41–A42
			350 000			5%			Low	Page A27–A28	Page A58–A59
			300 000			5%					
			For details, please refer to Page A33.			1 to 5%			–	Page A16	Page A33–A34
			For details, please refer to Page A59.			1 to 5%			–	Page A60	Page A59–A60

Remarks: Please consult NSK about any unclear bearing specifications.

Dimensions, Accuracy, and Availability

1. Stainless Steel SPACEA™ Series Bearings

Accuracy of boundary dimensions and running accuracy

Note: The dimensional tolerance of the bore and outside diameter for corrosion-resistant coated bearings may deviate from the JIS Class 0 standard for coating thickness (maximum 5 μm in diameter).

● Dimensional accuracy of bore diameter of inner ring

Unit: μm

Nominal bore diameter d (mm)		deviation of mean bore diameter in a single plane Δd_{mp}		variation of bore diameter in a single plane V_{dsp}			Mean bore diameter variation (Cylindricity) V_{dmp}
				Diameter Series			
				7, 8, 9	0, 1	2, 3, 4	
Over	Incl	High	Low	Max			Max
2.5	10	0	-8	10	8	6	6
10	18	0	-8	10	8	6	6
18	30	0	-10	13	10	8	8
30	50	0	-12	15	12	9	9

● Dimensional accuracy of outside diameter of outer ring

Unit: μm

Nominal outside diameter D (mm)		Single plane mean outside diameter deviation (Deviation of single outside diameter) ΔD_{mp}		Mean outside diameter variation (Out-of-roundness) V_{Dsp}				Mean outside diameter variation (Cylindricity) V_{Dmp}
				Open			Sealed/ Shielded	
				Diameter Series				
				7, 8, 9	0, 1	2, 3, 4	2, 3, 4	
Over	Incl	High	Low	Max				Max
6	18	0	-8	10	8	6	10	6
18	30	0	-9	12	9	7	12	7
30	50	0	-11	14	11	8	16	8
50	80	0	-13	16	13	10	20	10

● Dimensional accuracy of inner/outer ring width

Unit: μm

Nominal bore diameter d (mm)		Deviation of a single inner/outer ring width ΔB_s or ΔC_s		Inner/outer ring width variation (Max-min) V_{Bs} or V_{Cs}
Over	Incl	High	Low	Max
2.5	10	0	-120	15
10	18	0	-120	20
18	30	0	-120	20
30	50	0	-120	20

● Running accuracy

Unit: μm

Nominal bore diameter d (mm)		Radial runout of assembled bearing inner ring k_{ia}		Radial runout of assembled bearing outer ring k_{ea}
Over	Incl	High	Low	Max
2.5	10	10		15
10	18	10		15
18	30	13		20
30	50	15		25

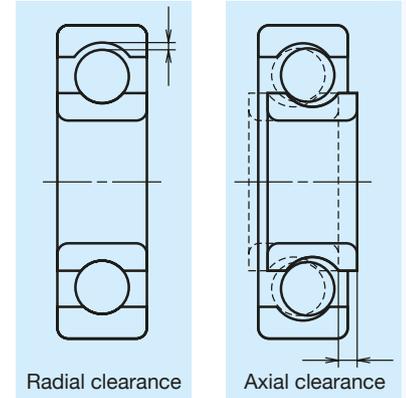
Bearing internal clearance and standard values

Internal clearance of bearings refers to the amount that one ring, either the inner or outer, can be displaced relative to the other ring when one is fixed and the other is displaced either vertically or horizontally. The amount of displacement in the radial plane is called radial clearance, while the amount of displacement in the axial plane is called axial clearance.

Clearance is measured by adding a specific measuring load to a bearing in order to obtain a stable measured value. As a result, the measured clearance value, or measured internal clearance, becomes slightly larger than the theoretical internal clearance value (also known as geometrical clearance in the case of a radial bearing). The difference is known as the elastic deformation.

Theoretical internal clearance is derived by compensating for clearance caused by elastic deformation.

Internal clearance of bearings prior to installation is usually defined by the theoretical internal clearance value.



● Radial internal clearance of nominal bore diameter

 Unit: μm

Nominal bore diameter d (mm)		Clearance									
		C2		CN		C3		C4		C5	
Over	Incl	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
10 only		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

Remarks When using the above values as measured clearance, the radial clearance caused by the measuring load must be compensated by the clearance compensation values listed in the following table. For compensation values for C2 clearance, the smaller value is applied to the smallest clearance and the larger value is applied to the largest clearance.

Clearance compensation

 Unit: μm

Nominal bore diameter d (mm)		Measuring load (N)	Clearance compensation value					
			C2	CN	C3	C4	C5	
Over	Incl							
10	18	24.5	3–4	4	4	4	4	
18	50	49	4–5	5	6	6	6	

● Radial internal clearance of extra-small ball bearings

 Unit: μm

Clearance code	MC1		MC2		MC3		MC4		MC5		MC6	
	Min	Max										
Clearance	0	5	3	8	5	10	8	13	13	20	20	28

Remarks 1. Standard clearances are MC3.
2. When used as measured internal clearance, add the correction values in the following table.

Clearance correction

 Unit: μm

Clearance code	MC1	MC2	MC3	MC4	MC5	MC6
Clearance correction value	1	1	1	1	2	2

Remarks The measuring load for an extra-small ball bearing is 4.4 N.

Dimensions, Accuracy, and Availability

1-1. Stainless Steel Bearings (Bore Diameter 1–12 mm)

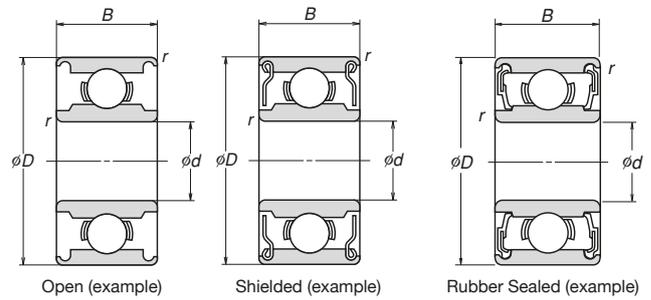
Stocked as standard inventory

Bearings Specifications Tech. Data Page A29–A30

● Inquiry designation⁽¹⁾

Type of inquiry designation	Open	Shielded	Rubber Sealed
(A)	□□□□ U-H-*MAZ	□□□□ -H-ZZ*MAZ NS7	□□□□ -H-DD*MAZ NS7
(B)	□□□□ U-H-20T1X*MA	□□□□ -H-20T1XZZ*MA NS7	□□□□ -H-20T1XDDU*MA NS7

Bore diameter <i>d</i> (mm)	Boundary dimensions			Basic designation ⁽²⁾	Dynamic load rating, <i>C_H</i> (reference value) (N)	Availability			Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation
	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)			Open	Shielded (ZZ)	Rubber sealed (DD)			
1	3	1	0.05	681	81	●	●		10 000	4	(A)
	3	1.5	0.05	MR31	81	●			10 000	4	
	4	1.6	0.1	691	120	●			10 000	6	
1.2	4	2.5	0.1	MR41X	96	●	●		10 000	4	
1.5	4	2	0.05	681X	96	●	●		10 000	4	
	5	2.6	0.15	691X	202	●	●		10 000	10	
	6	3	0.15	601X	281	●	●		10 000	14	
2	5	2.3	0.08	682	144	●	●		10 000	7	
	5	2.5	0.1	MR52	144	●	●		10 000	7	
	6	3	0.15	692	281	●	●		10 000	14	
	6	2.5	0.15	MR62	281	●	●		10 000	14	
	7	3	0.15	MR72	328	●	●		10 000	16	
2.5	7	3.5	0.15	602	328	●	●		10 000	16	
	6	2.6	0.08	682X	177	●	●		10 000	8	
	7	3.5	0.15	692X	328	●	●		10 000	16	
	8	2.5	0.2	MR82X	475	●			10 000	23	
3	8	4	0.15	602X	469	●	●		10 000	23	
	6	2.5	0.1	MR63	177	●	●		10 000	8	
	7	3	0.1	683	265	●	●		10 000	13	
	8	2.5	0.15	MR83	336	●			10 000	16	
	8	4	0.15	693	475	●	●		10 000	23	
	9	4	0.15	MR93	486	●	●		10 000	24	
	9	5	0.15	603	486	●	●		10 000	24	
	10	4	0.15	623	538	●	●	●	10 000	26	
13	5	0.2	633	1 100	●	●		10 000	55		
4	7	2.5	0.1	MR74	217	●	●		10 000	10	
	8	3	0.15	MR84	336	●	●		10 000	16	
	9	4	0.1	684	545	●	●	●	10 000	27	
	10	4	0.2	MR104	604	●	●	●	10 000	30	
	11	4	0.15	694	815	●	●	●	10 000	40	
	12	4	0.2	604	815	●	●	●	10 000	40	
	13	5	0.2	624	1 110	●	●	●	10 000	55	
16	5	0.3	634	1 140	●	●	●	10 000	56		
5	8	2.5	0.1	MR85	185	●	●		10 000	9	
	9	3	0.15	MR95	367	●	●		10 000	18	
	10	4	0.15	MR105	367	●		●	10 000	18	
	11	4	0.15	MR115	609	●	●		10 000	30	
	11	5	0.15	685	609	●	●	●	10 000	30	
	13	4	0.2	695	916	●	●	●	10 000	45	
	14	5	0.2	605	1 130	●	●	●	10 000	56	
	16	5	0.3	625	1 470	●	●	●	10 000	73	
19	6	0.3	635	1 990	●	●	●	10 000	99		



Bore diameter <i>d</i> (mm)	Boundary dimensions			Basic designation ⁽²⁾	Dynamic load rating, <i>C_H</i> (reference value) (N)	Availability			Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation
	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)			Open	Shielded (ZZ)	Rubber sealed (DD)			
6	10	3	0.1	MR106	423	●	●		10 000	21	(A)
	12	4	0.2	MR126	608	●	●	●	10 000	30	
	13	5	0.15	686	920	●	●	●	10 000	46	
	15	5	0.2	696	1 140	●	●	●	10 000	56	
	17	6	0.3	606	1 920	●	●	●	10 000	96	
	19	6	0.3	626	1 990	●	●	●	10 000	99	
	22	7	0.3	636	2 800	●	●	●	10 000	140	
7	11	3	0.15	MR117	388	●	●		10 000	19	(A)
	13	4	0.15	MR137	460	●	●		10 000	23	
	14	5	0.15	687	1 000	●	●	●	10 000	50	
	17	5	0.3	697	1 370	●	●	●	10 000	68	
	19	6	0.3	607	1 990	●	●	●	10 000	99	
	22	7	0.3	627	2 800	●	●	●	10 000	140	
8	12	3.5	0.15	MR128	463	●	●		10 000	23	(B)
	14	4	0.15	MR148	696	●	●	●	10 000	34	
	16	5	0.2	688	1 070	●	●	●	10 000	53	
	19	6	0.3	698	1 900	●	●	●	10 000	95	
	22	7	0.3	* 608	2 800	●	●	●	10 000	140	
	24	8	0.3	628	2 850	●	●	●	9 370	140	
	28	9	0.3	638	3 890	●	●	●	8 330	190	
9	17	5	0.2	689	1 130	●	●	●	10 000	56	(A)
	20	6	0.3	699	2 100	●	●	●	10 000	100	
	24	7	0.3	609	2 850	●	●	●	9 090	140	
	26	8	0.6	629	3 890	●	●	●	8 570	190	
	30	10	0.6	639	4 350	●	●		7 690	210	
10	15	3 4	0.15	6700	729	●		●	10 000	36	(B)
	19	5	0.3	* 6800	1 460	●	●	●	10 000	73	
	22	6	0.3	* 6900	2 290	●	●	●	9 370	110	
	26	8	0.3	* 6000	3 900	●	●	●	8 330	190	
	30	9	0.6	* 6200	4 350	●	●	●	7 500	210	
12	18	4	0.2	6701	789	●	●	●	10 000	39	(A)
	21	5	0.3	* 6801	1 630	●	●	●	9 090	82	
	24	6	0.3	* 6901	2 460	●	●	●	8 330	120	
	28	8	0.3	* 6001	4 350	●	●	●	7 500	210	
	32	10	0.6	* 6201	5 800	●	●	●	6 810	290	

Mark: ● Stocked as standard inventory.⁽⁴⁾

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) Limiting load values are for reference only; they are not guaranteed.

(4) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. Open bearings do not include grease. Ensure that an appropriate lubricant is used with these bearings.

2. The radial internal clearance for bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.

Dimensions, Accuracy, and Availability

1-1. Stainless Steel Bearings (Bore Diameter 15–60 mm)

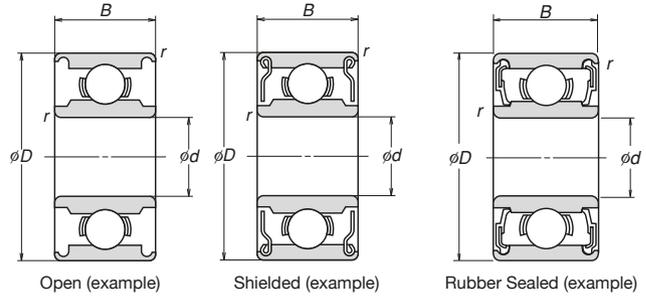
Stocked as standard inventory

Bearings Specifications Tech. Data

Page A29–A30

● Inquiry designation⁽¹⁾

Type of inquiry designation	Open	Shielded	Rubber Sealed
(A)	□□□□ U-H-*MAZ	□□□□ -H-ZZ*MAZ NS7	□□□□ -H-DD*MAZ NS7
(B)	□□□□ U-H-20T1X*MA	□□□□ -H-20T1XZZ*MA NS7	□□□□ -H-20T1XDDU*MA NS7



Bore diameter d (mm)	Boundary dimensions			Basic designation ⁽²⁾	Dynamic load rating, C_H (reference value) (N)	Availability			Limiting speed (reference value) (min^{-1})	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)			Open	Shielded (ZZ)	Rubber sealed (DD)			
15	21	4	0.2	6702	797	●	●	●	8 330	40	(A)
	24	5	0.3	* 6802	1 760	●	●	●	7 690	88	(B)
	28	7	0.3	* 6902	3 700	●	●	●	6 970	180	
	32	9	0.3	* 6002	4 750	●	●	●	6 380	230	
	35	11	0.6	* 6202	6 500	●	●	●	6 000	320	
17	23	4	0.2	6703	849	●	●	●	7 500	42	(A)
	26	5	0.3	* 6803	2 240	●	●	●	6 970	110	(B)
	30	7	0.3	* 6903	3 900	●	●	●	6 380	190	
	35	10	0.3	* 6003	5 100	●	●	●	5 760	250	
	40	12	0.6	* 6203	8 150	●	●	●	5 260	400	
20	27	4	0.2	6704	885	●	●	●	6 380	44	(A)
	32	7	0.3	* 6804	3 400	●	●	●	5 760	170	(B)
	37	9	0.3	* 6904	5 400	●	●	●	5 260	270	
	42	12	0.6	* 6004	7 950	●	●	●	4 830	390	
	47	14	1	* 6204	10 900	●	●	●	4 470	540	
25	32	4	0.2	6705	931	●	●	● ⁽⁴⁾	5 260	47	(A)
	37	7	0.3	* 6805	3 800	●	●	●	4 830	190	(B)
	42	9	0.3	* 6905	5 950	●	●	●	4 470	290	
	47	12	0.6	* 6005	8 550	●	●	●	4 160	420	
	52	15	1	* 6205	11 900	●	●	●	3 890	590	
30	37	4	0.2	6706	969	●	●	●	4 470	48	(A)
	55	13	1	* 6006	11 300	●	●	●	3 520	560	(B)
	62	16	1	* 6206	16 500	●	●	●	3 260	820	
35	44	5	0.3	6707	1 590	●	●	●	3 790	79	(A)
	62	14	1	* 6007	13 600	●	●	●	3 090	680	(B)
	72	17	1.1	* 6207	21 800	●	●	●	2 800	1 090	
40	50	6	0.3	6708	2 140	●	●	●	3 330	100	(A)
	68	15	1	* 6008	14 200	●	●	●	2 770	710	(B)
	80	18	1.1	* 6208	24 800	●	●	●	2 500	1 240	
45	75	16	1	* 6009	17 800	●	●	●	2 500	890	(B)
	85	19	1.1	* 6209	26 600	●	●	●	2 300	1 330	
50	80	16	1	* 6010	18 500	●	●	●	2 300	920	(B)
	90	20	1.1	* 6210	29 800	●	●	●	2 140	1 490	
55	90	18	1.1	* 6011	24 000	●	●	●	2 060	1 200	(B)
	100	21	1.5	* 6211	37 000	●	●	●	1 930	1 850	
60	95	18	1.1	* 6012	25 000	●	●	●	1 930	1 250	(B)
	110	22	1.5	* 6212	44 500	●	●	●	1 760	2 220	

Mark: ● Stocked as standard inventory.⁽⁵⁾

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) Limiting load values are for reference only; they are not guaranteed.

(4) Uses non-contact seals.

(5) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. Open bearings do not include grease. Ensure that an appropriate lubricant is used with these bearings.

2. The radial internal clearance for the bearings on this page is CN. See the radial internal clearance tables on Page A10 for further details.

1-2. Stainless Steel Bearings (with flanged outer ring)

Stocked as standard inventory

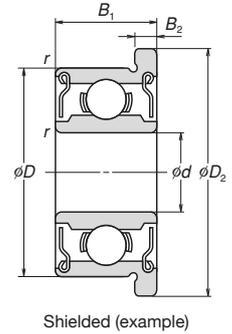
● Inquiry designation⁽¹⁾

□□□□ -H-ZZ*MAZ NS7

Bearings Specifications Tech. Data

Page A29–A30

Bore diameter d (mm)	Boundary dimensions					Basic designation	Dynamic load rating, C_H (reference value) (N)	Availability	Limiting speed (reference value) (min^{-1})	Limiting load ⁽²⁾ (reference value) (N)
	Outside diameter D (mm)	Width B_1 (mm)	Flanged Outside diameter D_2 (mm)	Flanged width B_2 (mm)	Chamfer dimension (min.) r (mm)					
1.5	4	2	5	0.6	0.05	F681X	96	●	10 000	4
	5	2.6	6.5	0.8	0.15	F691X	202	●	10 000	10
	6	3	7.5	0.8	0.15	F601X	281	●	10 000	14
2	5	2.3	6.1	0.6	0.08	F682	144	●	10 000	7
	5	2.5	6.2	0.6	0.1	MF52	144	●	10 000	7
	6	3	7.5	0.8	0.15	F692	281	●	10 000	14
	7	3	8.2	0.6	0.15	MF72	328	●	10 000	16
2.5	7	3.5	8.5	0.9	0.15	F602	328	●	10 000	16
	6	2.6	7.1	0.8	0.08	F682X	177	●	10 000	8
	7	3.5	8.5	0.9	0.15	F692X	328	●	10 000	16
	8	4	9.5	0.9	0.15	F602X	469	●	10 000	23
3	6	2.5	7.2	0.6	0.1	MF63	177	●	10 000	8
	7	3	8.1	0.8	0.1	F683	265	●	10 000	13
	8	4	9.5	0.9	0.15	F693	475	●	10 000	23
	9	4	10.6	0.8	0.15	MF93	486	●	10 000	24
	9	5	10.5	1	0.15	F603	486	●	10 000	24
	10	4	11.5	1	0.1	F623	538	●	10 000	26
4	7	2.5	8.2	0.6	0.1	MF74	217	●	10 000	10
	8	3	9.2	0.6	0.15	MF84	336	●	10 000	16
	9	4	10.3	1	0.1	F684	545	●	10 000	27
	10	4	11.6	0.8	0.2	MF104	604	●	10 000	30
	11	4	12.5	1	0.15	F694	815	●	10 000	40
	12	4	13.5	1	0.2	F604	815	●	10 000	40
	13	5	15	1	0.2	F624	1 110	●	10 000	55
5	16	5	18	1	0.3	F634	1 140	●	10 000	56
	8	2.5	9.2	0.6	0.1	MF85	185	●	10 000	9
	9	3	10.2	0.6	0.15	MF95	367	●	10 000	18
	10	4	11.6	0.8	0.15	MF105	367	●	10 000	18
	11	5	12.5	1	0.15	F685	609	●	10 000	30
	13	4	15	1	0.2	F695	916	●	10 000	45
	14	5	16	1	0.2	F605	1 130	●	10 000	56
	16	5	18	1	0.3	F625	1 470	●	10 000	73
6	19	6	22	1.5	0.3	F635	1 990	●	10 000	99
	10	3	11.2	0.6	0.15	MF106	423	●	10 000	21
	12	4	13.6	0.8	0.2	MF126	608	●	10 000	30
	13	5	15	1.1	0.15	F686	920	●	10 000	46
	15	5	17	1.2	0.2	F696	1 140	●	10 000	56
	17	6	19	1.2	0.3	F606	1 920	●	10 000	96
7	19	6	22	1.5	0.3	F626	1 990	●	10 000	99
	11	3	12.2	0.6	0.15	MF117	388	●	10 000	19
	13	4	14.6	0.8	0.15	MF137	460	●	10 000	23
	14	5	16	1.1	0.15	F687	1 000	●	10 000	50
	17	5	19	1.2	0.3	F697	1 370	●	10 000	68
	19	6	22	1.5	0.3	F607	1 990	●	10 000	99
8	22	7	25	1.5	0.3	F627	2 800	●	10 000	140
	12	3.5	13.6	0.8	0.15	MF128	463	●	10 000	23
	14	4	15.6	0.8	0.15	MF148	696	●	10 000	34
	16	5	18	1.1	0.2	F688	1 070	●	10 000	53
	19	6	22	1.5	0.3	F698	1 900	●	10 000	95
9	22	7	25	1.5	0.3	F608	2 800	●	10 000	140
	17	5	19	1.1	0.2	F689	1 130	●	10 000	56
	20	6	23	1.5	0.3	F699	2 100	●	10 000	100
10	19	5	21	1	0.3	F6800	1 460	●	10 000	73



Bearings Dimensions, Accuracy, and Availability

Mark: ● Stocked as standard inventory.⁽³⁾

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) Limiting load values are for reference only; they are not guaranteed.

(3) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. The radial internal clearance for bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.

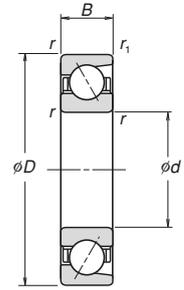
2. Shielded bearings are standard.

Dimensions, Accuracy, and Availability

2. Stainless Steel Angular Contact Ball Bearings

Stocked as standard inventory

Bearings Specifications Tech. Data Page A31



● Inquiry designation⁽¹⁾

For atmospheric pressure environments	For vacuum environments
□□□□ -H-20TYSULP5	□□□□ -H-20(T4N)SULP5U264

Boundary dimensions					Basic designation ⁽²⁾	Dynamic load rating, C_H (reference value) (N)	Availability		Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)	Chamfer dimension (min.) r_1 (mm)			For use in atmospheric pressure and cleanroom environments	For use in vacuum, cleanroom and high-temperature environments		
6	17	6	0.3	0.15	* 706A	1 730	●	●	10 000	86
8	22	7	0.3	0.15	* 708A	2 840	●	●	10 000	140
10	26	8	0.3	0.15	* 7000A	4 250	●	●	8 330	210
12	28	8	0.3	0.15	* 7001A	4 600	●	●	7 500	230
15	28	7	0.3	0.15	* 7902A5	3 850	●	●	6 970	190
	32	9	0.3	0.15	* 7002A	4 900	●	●	6 380	240
	35	11	0.6	0.3	* 7202A	6 900	●	●	6 000	340
17	35	10	0.3	0.15	* 7003A	5 200	●	●	5 760	260
20	37	9	0.3	0.15	* 7904A5	5 600	●	●	5 260	280
	42	12	0.6	0.3	* 7004A	8 750	●	●	4 830	430
	47	14	1	0.6	* 7204A	11 600	●	●	4 470	580
25	47	12	0.6	0.3	* 7005A	9 150	●	●	4 160	450
	52	15	1	0.6	* 7205A	13 100	●	●	3 890	650
30	47	9	0.3	0.15	* 7906A5	6 700	●	●	3 890	330

Mark: ● Stocked as standard inventory.⁽⁴⁾

- Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.
 (2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.
 (3) Limiting load values are for reference only; they are not guaranteed.
 (4) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks: Ensure that an appropriate lubricant is used with these bearings.

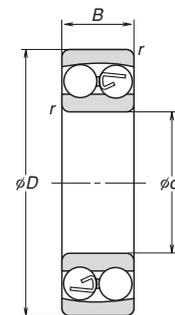
3. Stainless Steel Self-Aligning Ball Bearings

Stocked as standard inventory

Bearings Specifications Tech. Data Page A32

● Inquiry designation⁽¹⁾

□□□□ -H-20



Boundary dimensions				Basic designation ⁽²⁾	Dynamic load rating, C_H (reference value) (N)	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Radial internal clearance (mm)
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)						
10	30	9	0.6	* 1200	4 750	●	7 500	230	0.006–0.017
12	32	10	0.6	* 1201	4 850	●	6 810	240	0.006–0.019
15	35	11	0.6	* 1202	6 450	●	6 000	320	0.008–0.021
17	40	12	0.6	* 1203	6 800	●	5 260	340	0.008–0.021
20	47	14	1	* 1204	8 500	●	4 470	420	0.010–0.023
25	52	15	1	* 1205	10 400	●	3 890	520	0.011–0.024

Mark: ● Stocked as standard inventory.⁽⁴⁾

- Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.
 (2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.
 (3) Limiting load values are for reference only; they are not guaranteed.
 (4) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks: Ensure that an appropriate lubricant is used with these bearings.

4. Molded-Oil™ Bearings

Stocked as standard inventory

Available on a production-by-order basis

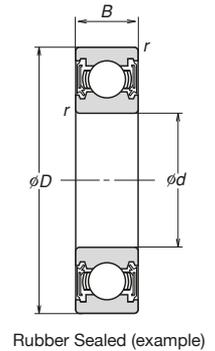
Bearings Specifications Tech. Data

Page A33–A34

● Inquiry designation⁽¹⁾

General grade lubricant	Food grade lubricant
□□□□ L11-H-20DDU GVS	□□□□ L21-H-20DDUU401 GVS

Bore diameter d (mm)	Boundary dimensions			Basic designation ⁽²⁾	Availability		Limiting speed ⁽³⁾ (reference value) (min ⁻¹)	Applied load ⁽⁴⁾ (reference value) (N)
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)		General grade lubricant	Food grade lubricant		
10	22	6	0.3	* 6900	●	○	9 370	23 – 110
	26	8	0.3	* 6000	●	○	8 330	39 – 190
	30	9	0.6	* 6200	●	○	7 500	44 – 210
12	24	6	0.3	* 6901	●	○	8 330	25 – 120
	28	8	0.3	* 6001	●	○	7 500	44 – 210
	32	10	0.6	* 6201	●	○	6 810	58 – 290
15	32	9	0.3	* 6002	●	○	6 380	48 – 230
	35	11	0.6	* 6202	●	○	6 000	65 – 320
17	35	10	0.3	* 6003	●	○	5 760	51 – 250
	40	12	0.6	* 6203	●	○	5 260	82 – 400
20	42	12	0.6	* 6004	●	○	4 830	80 – 390
	47	14	1	* 6204	●	○	4 470	110 – 540
25	47	12	0.6	* 6005	●	○	4 160	86 – 420
	52	15	1	* 6205	●	○	3 890	120 – 590
30	55	13	1	* 6006	●	○	3 520	120 – 560



Mark: ● Stocked as standard inventory.⁽⁵⁾

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) The limiting speed of these bearings has been calculated for 25 °C operating conditions. Limiting speeds will be slower for operating conditions of 35 °C or higher. (Refer to Page A33 for further details.)

(4) Applied load values are for reference only; they are not guaranteed.

(5) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. The radial internal clearance for the bearings on this page is CN. See the radial internal clearance tables on Page A10 for further details.

2. Rubber contact seals are standard.

C Dimensions, Accuracy, and Availability

5. Hybrid Bearings

Available on a production-by-order basis

Bearings Specifications Tech. Data

Page A35–A36

● Inquiry designation⁽¹⁾

□□□□ -H-20SN14T36ZZU76A GVS

Dimensions, accuracy, and availability are listed in the next section.

6. Corrosion-Resistant Coated Bearings

Available on a production-by-order basis

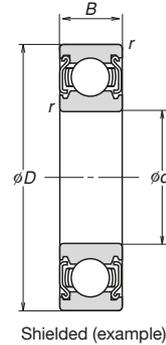
Bearings Specifications Tech. Data

Page A37–A38

● Inquiry designation⁽¹⁾

U- □□□□ -H-20SN14S5NYT36ZZU76A GVS

Boundary dimensions				Basic designation ⁽²⁾	Availability		Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)		Hybrid bearings	Corrosion-resistant coated bearings		
10	26	8	0.3	* 6000	○	○	1 000	78
	30	9	0.6	* 6200	○	○	1 000	87
12	28	8	0.3	* 6001	○	○	1 000	87
	32	10	0.6	* 6201	○	○	900	110
15	32	9	0.3	* 6002	○	○	850	95
	35	11	0.6	* 6202	○	○	800	130
17	35	10	0.3	* 6003	○	○	760	100
	40	12	0.6	* 6203	○	○	700	160
20	37	9	0.3	* 6904	○	○	700	100
	42	12	0.6	* 6004	○	○	640	150
	47	14	1	* 6204	○	○	590	210
25	42	9	0.3	* 6905	○	○	590	110
	47	12	0.6	* 6005	○	○	550	170
	52	15	1	* 6205	○	○	510	230
30	55	13	1	* 6006	○	○	470	220



Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicated that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for the bearings on this page ranges from CN (minimum clearance) to C3 (maximum clearance). See the radial internal clearance tables on Page A10 for further details.

2. Shielded bearings are standard.

7. ESZ Bearings

Available on a production-by-order basis

Bearings Specifications Tech. Data

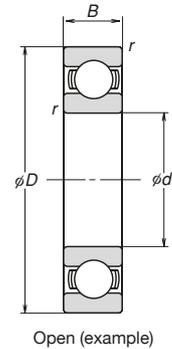
Page A39–A40

Deep Groove Ball Bearings

● Inquiry designation⁽¹⁾

ESZ □□□□

Boundary dimensions				Basic designation	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽²⁾ (reference value) (N)
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)				
10	26	8	0.3	6000	○	1 000	78
	30	9	0.6	6200	○	1 000	87
12	28	8	0.3	6001	○	1 000	87
	32	10	0.6	6201	○	900	110
15	32	9	0.3	6002	○	850	95
	35	11	0.6	6202	○	800	130
17	35	10	0.3	6003	○	760	100
	40	12	0.6	6203	○	700	160
20	42	12	0.6	6004	○	640	150
	47	14	1	6204	○	590	210
25	47	12	0.6	6005	○	550	170
	52	15	1	6205	○	510	230
30	55	13	1	6006	○	470	220
	62	16	1	6206	○	430	330
35	62	14	1	6007	○	410	270
	72	17	1.1	6207	○	370	430
40	68	15	1	6008	○	370	280
	80	18	1.1	6208	○	330	490
45	75	16	1	6009	○	330	350
	85	19	1.1	6209	○	300	530
50	80	16	1	6010	○	300	370
	90	20	1.1	6210	○	280	590
55	90	18	1.1	6011	○	270	480
	100	21	1.5	6211	○	250	740
60	95	18	1.1	6012	○	250	500
	110	22	1.5	6212	○	230	890



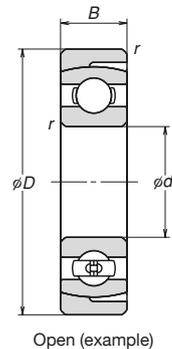
Bearings Dimensions, Accuracy, and Availability

Deep Groove Ball Bearings With Aligning Housing Ring

● Inquiry designation⁽¹⁾

ESZ □□□□

Boundary dimensions				Basic designation	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽²⁾ (reference value) (N)
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)				
10	35	9	0.6	CD200	○	1 000	87
12	37	10	0.6	CD201	○	900	110
15	40	11	0.6	CD202	○	800	130
17	46	12	0.6	CD203	○	700	160
20	54	14	1	CD204	○	590	210
25	60	15	1	CD205	○	510	230
30	72	16	1	CD206	○	430	330



Mark: ○ Available on a production-by-order basis.

Note (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for the bearings on this page is C3. See the radial internal clearance tables on Page A10 for further details.

2. Open bearings are standard.

8. All-Ceramic Bearings

Available on a production-by-order basis

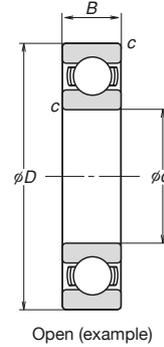
Bearings Specifications Tech. Data

Page A41-A42

● Inquiry designation⁽¹⁾

□□□□ SZ1T36

Boundary dimensions				Basic designation	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽²⁾ (reference value) (N)
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)				
8	22	7	0.3	608	○	1 000	140
10	19	5	0.3	6800	○	1 000	73
	26	8	0.3	6000	○	1 000	190
12	28	8	0.3	6001	○	1 000	210
20	42	12	0.6	6004	○	640	390
	47	14	1	6204	○	590	540
30	62	16	1	6206	○	430	820
40	68	15	1	6008	○	370	710



Mark: ○ Available on a production-by-order basis.

Note (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for bearings with bore diameters smaller than 10 mm ranges from MC3 (minimum clearance) to MC5 (maximum clearance).

The radial internal clearance for bearings with bore diameters of 10 mm or larger ranges from CN (minimum clearance) to C4 (maximum clearance). See the radial internal clearance tables on Page A10 for further details.

2. Open bearings are standard.

9. Aqua-Bearing™

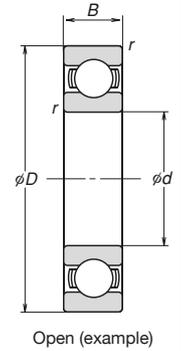
Available on a production-by-order basis

Bearings Specifications Tech. Data Page A43–A44

● Inquiry designation⁽¹⁾

□□□□ L-PT3

Bore diameter d (mm)	Boundary dimensions ⁽²⁾			Basic designation	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Radial internal clearance (mm)
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)					
10	22	6	0.3	6900	○	1 000	22	0.04–0.12
	26	8	0.3	6000	○	1 000	39	
	30	9	0.6	6200	○	1 000	43	
12	28	8	0.3	6001	○	1 000	43	0.05–0.14
	32	10	0.6	6201	○	900	58	
15	32	9	0.3	6002	○	850	47	0.05–0.14
	35	11	0.6	6202	○	800	65	
20	37	9	0.3	6904	○	700	54	0.05–0.15
	42	12	0.6	6004	○	640	79	
	47	14	1	6204	○	590	100	
25	42	9	0.3	6905	○	590	59	0.06–0.16
	47	12	0.6	6005	○	550	85	



Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) Tolerances: bore diameter: 0 mm to +0.05 mm; outer diameter: -0.05 mm to 0 mm

(3) Limiting load values are for reference only; they are not guaranteed.

Remarks : Open bearings are standard.

Dimensions, Accuracy, and Availability

10. LG2/LGU Grease-Packed Bearings

Stocked as standard inventory

Available on a production-by-order basis

Bearings Specifications Tech. Data Page A45–A46

● Inquiry designation⁽¹⁾

Type of inquiry designation	LG2 Grease-Packed Bearing	LGU Grease-Packed Bearing
(A)	Availability ● : □□□□ -H-ZZU76 LG2L Availability ○ : □□□□ LZZ-H LG2L	□□□□ L-ZZ-H LGUL
(B)	Availability ● : □□□□ -H-ZZU76 LG2L Availability ○ : □□□□ -H-20ZZU76A LG2L	□□□□ -H-20ZZU76A LGUL

Dimensions, accuracy, and availability are listed in the next section.

11. FG9 Fluorine Grease-Packed Bearings

Available on a production-by-order basis

Bearings Specifications Tech. Data Page A47–A48

● Inquiry designation⁽¹⁾

Type of inquiry designation	FG9 Grease-Packed Bearing
(A)	□□□□ LZZ-H FG9
(B)	□□□□ -H-20ZZU552 FG9

Bore diameter d (mm)	Boundary dimensions			Basic designation ⁽²⁾	Availability			Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)		LG2 grease	LGU grease	FG9 grease			
3	6	2.5	0.1	MR63	●			1 000	8	(A)
	8	4	0.15	693	●			1 000	23	
	10	4	0.15	623	●			1 000	26	
4	7	2.5	0.1	MR74	●			1 000	10	
	9	4	0.1	684	●	○	○	1 000	27	
	11	4	0.15	694	●	○	○	1 000	40	
	12	4	0.2	604	●	○	○	1 000	40	
	13	5	0.2	624	●	○	○	1 000	55	
5	11	5	0.15	685	○	○	○	1 000	30	
	13	4	0.2	695	●	○	○	1 000	45	
	14	5	0.2	605	●	○	○	1 000	56	
	16	5	0.3	625	●	○	○	1 000	73	
6	13	5	0.15	686	●	○	○	1 000	46	
	15	5	0.2	696	●	○	○	1 000	56	
	17	6	0.3	606	●	○	○	1 000	96	
	19	6	0.3	626	●	○	○	1 000	99	
7	14	5	0.15	687	●	○	○	1 000	50	
	17	5	0.3	697	●	○	○	1 000	68	
	19	6	0.3	607	●	○	○	1 000	99	
	22	7	0.3	* 627	○	○	○	1 000	140	(B)
8	16	5	0.2	688	●	○	○	1 000	53	(A)
	19	6	0.3	698	●	○	○	1 000	95	(A)
	22	7	0.3	* 608	●	○	○	1 000	140	(B)
	24	8	0.3	628	●	○	○	1 000	140	(B)
9	17	5	0.2	689	●	○	○	1 000	56	(A)
	20	6	0.3	699	○	○	○	1 000	100	(A)
	24	7	0.3	* 609	○	○	○	1 000	140	(A)
	26	8	0.6	* 629	○	○	○	1 000	190	(B)
9.525	22.225	7.142	0.4	* R6	○	○	○	1 000	140	(B)

Mark: ● Stocked as standard inventory.⁽⁴⁾ ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

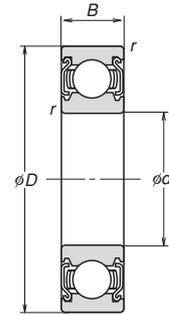
(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring. However, stocked as standard inventory items use standard stainless steel.

(3) Limiting load values are for reference only; they are not guaranteed.

(4) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. The radial internal clearance for bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.

2. Shielded bearings are standard.



Shielded (example)

Bore diameter d (mm)	Boundary dimensions			Basic designation ⁽²⁾	Availability			Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation	
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)		LG2 grease	LGU grease	FG9 grease				
10	19	5	0.3	* 6800	●	○	○	1 000	73	(B)	
	22	6	0.3	* 6900	●	○	○	1 000	110		
	26	8	0.3	* 6000	●	○	○	1 000	190		
	30	9	0.6	* 6200	●	○	○	1 000	210		
12	21	5	0.3	* 6801	●	○	○	1 000	82		
	24	6	0.3	* 6901	●	○	○	1 000	120		
	28	8	0.3	* 6001	●	○	○	1 000	210		
	32	10	0.6	* 6201	●	○	○	1 000	290		
15	24	5	0.3	* 6802	○	○	○	1 000	88		
	28	7	0.3	* 6902	●	○	○	1 000	180		
	32	9	0.3	* 6002	●	○	○	1 000	230		
	35	11	0.6	* 6202	●	○	○	1 000	320		
17	26	5	0.3	* 6803	○	○	○	1 000	110		
	30	7	0.3	* 6903	●	○	○	1 000	190		
	35	10	0.3	* 6003	●	○	○	1 000	250		
	40	12	0.6	* 6203	●	○	○	1 000	400		
20	32	7	0.3	* 6804	●	○	○	1 000	170		
	37	9	0.3	* 6904	●	○	○	1 000	270		
	42	12	0.6	* 6004	●	○	○	1 000	390		
	47	14	1	* 6204	●	○	○	1 000	540		
25	37	7	0.3	* 6805	○	○	○	1 000	190		
	42	9	0.3	* 6905	●	○	○	1 000	290		
	47	12	0.6	* 6005	●	○	○	1 000	420		
	52	15	1	* 6205	●	○	○	1 000	590		
30	42	7	0.3	6806	○	○	○	1 000	190		(A)
	47	9	0.3	6906	○	○	○	1 000	300		
	55	13	1	* 6006	○	○	○	1 000	560		
	62	16	1	* 6206	○	○	○	1 000	820		(B)
35	62	14	1	* 6007	○	○	○	1 000	680		(A)
	72	17	1.1	6207	○	○	○	930	1 090		
40	68	15	1	6008	○	○	○	920	710		
	80	18	1.1	6208	○	○	○	830	1 240		

Dimensions, Accuracy, and Availability

12. DFO Bearings

Available on a production-by-order basis

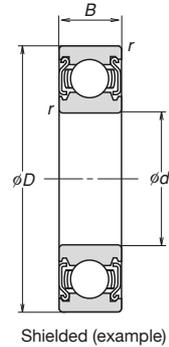
Bearings Specifications Tech. Data

Page A49-A50

● Inquiry designation⁽¹⁾

Type of inquiry designation	E-DFO Bearing	V-DFO Bearing
(A)	□□□□ LZZ-HFD4 GVS	□□□□ -LZZ-HFD GVS
(B)	U- □□□□ -H-20S8FD4ZZ GVS	U- □□□□ -H-20S8FDZZ GVS

Boundary dimensions				Basic designation ⁽²⁾	E-DFO Bearings			V-DFO Bearings			Type of inquiry designation
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)		Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	
4	9	4	0.1	684	○	1 000	27	○	1 000	10	(A)
	11	4	0.15	694	○	1 000	40	○	1 000	16	
	12	4	0.2	604	○	1 000	40	○	1 000	16	
	13	5	0.2	624	○	1 000	55	○	1 000	22	
5	11	5	0.15	685	○	1 000	30	○	1 000	12	(A)
	13	4	0.2	695	○	1 000	45	○	1 000	18	
	14	5	0.2	605	○	1 000	56	○	1 000	22	
	16	5	0.3	625	○	1 000	73	○	1 000	29	
6	13	5	0.15	686	○	1 000	46	○	1 000	18	(A)
	15	5	0.2	696	○	1 000	56	○	1 000	22	
	17	6	0.3	606	○	1 000	96	○	1 000	38	
	19	6	0.3	626	○	1 000	99	○	1 000	39	
7	14	5	0.15	687	○	1 000	50	○	1 000	20	(B)
	17	5	0.3	697	○	1 000	68	○	1 000	27	
	19	6	0.3	607	○	1 000	99	○	1 000	39	
	22	7	0.3	* 627	○	1 000	140	○	1 000	56	
8	16	5	0.2	688	○	1 000	53	○	1 000	21	(A)
	19	6	0.3	698	○	1 000	95	○	1 000	38	
	22	7	0.3	* 608	○	1 000	140	○	1 000	56	
	24	8	0.3	* 628	○	1 000	140	○	1 000	57	
9	17	5	0.2	* 689	○	1 000	56	○	1 000	22	(A)
	20	6	0.3	699	○	1 000	100	○	1 000	42	
	24	7	0.3	* 609	○	1 000	140	○	1 000	57	
	26	8	0.6	* 629	○	1 000	190	○	1 000	78	
9.525	22.225	7.142	0.4	* R6	○	1 000	140	○	1 000	56	
10	19	5	0.3	* 6800	○	1 000	73	○	1 000	29	(A)
	22	6	0.3	* 6900	○	1 000	110	○	1 000	45	
	26	8	0.3	* 6000	○	1 000	190	○	1 000	78	
	30	9	0.6	* 6200	○	1 000	210	○	1 000	87	
12	21	5	0.3	* 6801	○	1 000	82	○	1 000	32	(A)
	24	6	0.3	* 6901	○	1 000	120	○	1 000	49	
	28	8	0.3	* 6001	○	1 000	210	○	1 000	87	
	32	10	0.6	* 6201	○	900	290	○	900	110	
15	24	5	0.3	* 6802	○	1 000	88	○	1 000	35	(B)
	28	7	0.3	* 6902	○	930	180	○	930	74	
	32	9	0.3	* 6002	○	850	230	○	850	95	
	35	11	0.6	* 6202	○	800	320	○	800	130	
17	26	5	0.3	* 6803	○	930	110	○	930	44	(A)
	30	7	0.3	* 6903	○	850	190	○	850	78	
	35	10	0.3	* 6003	○	760	250	○	760	100	
	40	12	0.6	* 6203	○	700	400	○	700	160	
20	32	7	0.3	* 6804	○	760	170	○	760	68	(A)
	37	9	0.3	* 6904	○	700	270	○	700	100	
	42	12	0.6	* 6004	○	640	390	○	640	150	
	47	14	1	* 6204	○	590	540	○	590	210	
25	37	7	0.3	* 6805	○	640	190	○	640	76	(A)
	42	9	0.3	* 6905	○	590	290	○	590	110	
	47	12	0.6	* 6005	○	550	420	○	550	170	
	52	15	1	* 6205	○	510	590	○	510	230	
30	42	7	0.3	6806	○	550	190	○	550	77	(A)
	47	9	0.3	6906	○	510	300	○	510	120	
	55	13	1	* 6006	○	470	560	○	470	220	
	62	16	1	* 6206	○	430	820	○	430	330	
35	62	14	1	* 6007	○	410	680	○	410	270	(B)
	72	17	1.1	6207	○	370	1 090	○	370	430	
40	68	15	1	6008	○	370	710	○	370	280	(A)
	80	18	1.1	6208	○	330	1 240	○	330	490	



Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.

2. Shielded bearings are standard.

13. KPM Grease-Packed Bearings

Available on a production-by-order basis

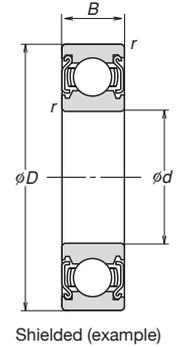
Bearings Specifications Tech. Data

Page A51-A52

● Inquiry designation⁽¹⁾

Type of inquiry designation	KPM Grease-Packed Bearing
(A)	□□□□ LZZ-H KPM
(B)	□□□□ -H-20ZZU76A KPM

Bore diameter d (mm)	Boundary dimensions			Basic designation ⁽²⁾	Availability ⁽³⁾	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽⁴⁾ (reference value) (N)	Type of inquiry designation
	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)					
4	9	4	0.1	684	○	1 000	27	(A)
	11	4	0.15	694	○	1 000	40	
	12	4	0.2	604	○	1 000	40	
	13	5	0.2	624	○	1 000	55	
5	11	5	0.15	685	○	1 000	30	
	13	4	0.2	695	○	1 000	45	
	14	5	0.2	605	○	1 000	56	
	16	5	0.3	625	○	1 000	73	
6	13	5	0.15	686	○	1 000	46	
	15	5	0.2	696	○	1 000	56	
	17	6	0.3	606	○	1 000	96	
	19	6	0.3	626	○	1 000	99	
7	14	5	0.15	687	○	1 000	50	
	17	5	0.3	697	○	1 000	68	
	19	6	0.3	607	○	1 000	99	
	22	7	0.3	* 627	○	1 000	140	(B)
8	16	5	0.2	688	○	1 000	53	(A)
	19	6	0.3	698	○	1 000	95	(A)
	22	7	0.3	* 608	○	1 000	140	(B)
	24	8	0.3	* 628	○	1 000	140	(B)
9	17	5	0.2	* 689	○	1 000	56	(A)
	20	6	0.3	699	○	1 000	100	(A)
	24	7	0.3	* 609	○	1 000	140	(A)
	26	8	0.6	* 629	○	1 000	190	(A)
9.525	22.225	7.142	0.4	* R6	○	1 000	140	(A)
10	19	5	0.3	* 6800	○	1 000	73	(B)
	22	6	0.3	* 6900	○(C3)	1 000	110	
	26	8	0.3	* 6000	○(C3)	1 000	190	
	30	9	0.6	* 6200	○(C3)	1 000	210	
12	21	5	0.3	* 6801	○(C3)	1 000	82	
	24	6	0.3	* 6901	○(C3)	1 000	120	
	28	8	0.3	* 6001	○(C3)	1 000	210	
	32	10	0.6	* 6201	○(C3)	1 000	290	
15	24	5	0.3	* 6802	○(C3)	1 000	88	
	28	7	0.3	* 6902	○(C3)	1 000	180	
	32	9	0.3	* 6002	○(C3)	1 000	230	
	35	11	0.6	* 6202	○(C3)	1 000	320	
17	26	5	0.3	* 6803	○(C3)	1 000	110	
	30	7	0.3	* 6903	○(C3)	1 000	190	
	35	10	0.3	* 6003	○(C3)	1 000	250	
	40	12	0.6	* 6203	○(C3)	1 000	400	
20	32	7	0.3	* 6804	○(C3)	1 000	170	
	37	9	0.3	* 6904	○(C3)	1 000	270	
	42	12	0.6	* 6004	○(C3)	1 000	390	
	47	14	1	* 6204	○(C3)	1 000	540	
25	37	7	0.3	* 6805	○(C3)	1 000	190	
	42	9	0.3	* 6905	○(C3)	1 000	290	
	47	12	0.6	* 6005	○(C3)	1 000	420	
	52	15	1	* 6205	○(C3)	1 000	590	
30	42	7	0.3	6806	○	1 000	190	(A)
	47	9	0.3	6906	○	1 000	300	(A)
	55	13	1	* 6006	○(C3)	1 000	560	(B)
	62	16	1	* 6206	○(C3)	1 000	820	(B)
35	62	14	1	* 6007	○(C3)	1 000	680	(B)
	72	17	1.1	6207	○	930	1 090	(A)
40	68	15	1	6008	○	920	710	(A)
	80	18	1.1	6208	○	830	1 240	(A)



Bearings Dimensions, Accuracy, and Availability

Mark: ○ Available on a production-by-order basis.

- Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.
 (2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.
 (3) Bearings that may have a radial internal clearance of C3 are indicated by (C3) next to the availability mark.
 (4) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.
 2. Shielded bearings are standard.

14. YS Bearing with Spacer Joints

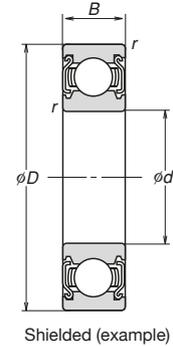
Available on a production-by-order basis

Bearings Specifications Tech. Data Page A53-A54

● Inquiry designation⁽¹⁾

Type of inquiry designation	YS Bearing with Spacer Joints
(A)	□□□□ LZZC4-HMSS2 GVS
(B)	U- □□□□ -H-20S4MYSV01ZZC4** GVS

Boundary dimensions				Basic designation ⁽²⁾	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Type of inquiry designation
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)					
6	17	6	0.3	606	○	1 000	38	(A)
7	19	6	0.3	607	○	1 000	39	
8	22	7	0.3	* 608	○	1 000	56	(B)
	24	8	0.3	* 628	○	1 000	57	
9	20	6	0.3	699	○	1 000	42	(A)
	24	7	0.3	* 609	○	1 000	57	(B)
	26	8	0.6	* 629	○	1 000	78	
10	19	5	0.3	* 6800	○	1 000	29	(A)
	22	6	0.3	* 6900	○	1 000	45	
	26	8	0.3	* 6000	○	1 000	78	
	30	9	0.6	* 6200	○	1 000	87	
12	24	6	0.3	* 6901	○	1 000	49	(A)
	28	8	0.3	* 6001	○	1 000	87	
	32	10	0.6	* 6201	○	900	110	
15	24	5	0.3	* 6802	○	1 000	35	(B)
	28	7	0.3	* 6902	○	930	74	
	32	9	0.3	* 6002	○	850	95	
	35	11	0.6	* 6202	○	800	130	
17	30	7	0.3	* 6903	○	850	78	(A)
	35	10	0.3	* 6003	○	760	100	
20	32	7	0.3	* 6804	○	760	68	(B)
	37	9	0.3	* 6904	○	700	100	
	42	12	0.6	* 6004	○	640	150	
	47	14	1	* 6204	○	590	210	
25	37	7	0.3	* 6805	○	640	76	(A)
	42	9	0.3	* 6905	○	590	110	
	47	12	0.6	* 6005	○	550	170	
	52	15	1	* 6205	○	510	230	
30	47	9	0.3	6906	○	510	120	(B)
	55	13	1	* 6006	○	470	220	
	62	16	1	* 6206	○	430	330	
35	62	14	1	* 6007	○	410	270	(A)
	72	17	1.1	* 6207	○	370	430	
40	68	15	1	* 6008	○	370	280	(B)
	80	18	1.1	* 6208	○	330	490	
45	75	16	1	* 6009	○	330	350	(A)



Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring bearing steel material.

(3) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearances for the bearings on this Page are listed below. See the radial internal clearance tables on Page A10 for further details.

Bore diameters smaller than 10 mm: 0.014 mm to 0.029 mm.

Bore diameters of 10 mm or larger: C4

2. Shielded bearings are standard.

15. SJ Bearings

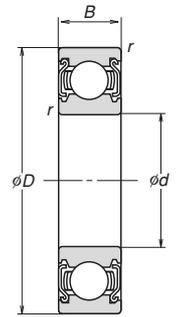
Available on a production-by-order basis

Bearings Specifications Tech. Data

Page A55–A56

● Inquiry designation⁽¹⁾

U- □□□□ -H-20S4MBSJ06ZZ GVS



Shielded (example)

Boundary dimensions				Basic designation ⁽²⁾	Availability	Limiting speed (reference value) (min ⁻¹)	Limiting load ⁽³⁾ (reference value) (N)	Radial internal clearance (min)
Bore diameter d (mm)	Outside diameter D (mm)	Width B (mm)	Chamfer dimension (min.) r (mm)					
8	22	7	0.3	* 608	○	1 000	56	0.037–0.080
10	26	8	0.3	* 6000	○	1 000	78	
	30	9	0.6	* 6200	○	1 000	87	
12	28	8	0.3	* 6001	○	1 000	87	0.045–0.090
	32	10	0.6	* 6201	○	900	110	
15	32	9	0.3	* 6002	○	850	95	0.045–0.090
	35	11	0.6	* 6202	○	800	130	
17	35	10	0.3	* 6003	○	760	100	0.045–0.090
	40	12	0.6	* 6203	○	700	160	
20	42	12	0.6	* 6004	○	640	150	0.048–0.096
	47	14	1	* 6204	○	590	210	
25	52	15	1	* 6205	○	510	230	0.053–0.106
30	55	13	1	* 6006	○	470	220	0.053–0.106

Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) Limiting load values are for reference only; they are not guaranteed.

Remarks: Shielded bearings are standard.

Dimensions, Accuracy, and Availability

16. Food Grade Grease-Packed Bearings

Available on a production by-order basic

Bearings Specifications Tech. Data

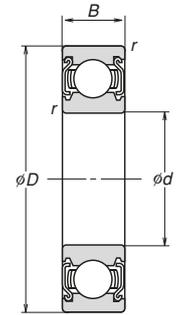
Page A57-A58

● Inquiry designation⁽¹⁾

Type of inquiry designation	RLS Grease	BL2 Grease for High Temperature
(A)	□□□□ LZZ-H RLS	□□□□ LZZ-H BL2
(B)	□□□□ -H-20ZZU23 RLS	□□□□ -H-20ZZU23 BL2

◆ See the Molded-Oil™ Bearings with food grade lubricant on Page A16.

Boundary dimensions				Basic designation ⁽²⁾	NSF H1				Limiting load ⁽⁴⁾ (reference value) (N)	Type of inquiry designation
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)		RLS grease		BL2 grease for high temperature			
					Availability	Limiting speed ⁽³⁾ (reference value) (min ⁻¹)	Availability	Limiting speed ⁽³⁾ (reference value) (min ⁻¹)		
4	9	4	0.1	684	○	37,100	○	31,800	27	(A)
	11	4	0.15	694	○	33,600	○	28,800	40	
	12	4	0.2	604	○	33,600	○	28,800	40	
	13	5	0.2	624	○	28,000	○	24,000	55	
5	11	5	0.15	685	○	31,500	○	27,000	30	
	13	4	0.2	695	○	30,100	○	25,800	45	
	14	5	0.2	605	○	28,000	○	24,000	56	
	16	5	0.3	625	○	25,200	○	21,600	73	
6	13	5	0.15	686	○	28,000	○	24,000	46	
	15	5	0.2	696	○	28,000	○	24,000	56	
	17	6	0.3	606	○	26,600	○	22,800	96	
	19	6	0.3	626	○	22,400	○	19,200	99	
7	14	5	0.15	687	○	28,000	○	24,000	50	
	17	5	0.3	697	○	25,200	○	21,600	68	
	19	6	0.3	607	○	25,200	○	21,600	99	
	22	7	0.3	* 627	○	21,000	○	18,000	140	
8	16	5	0.2	688	○	25,200	○	21,600	53	(A)
	19	6	0.3	698	○	25,200	○	21,600	95	
	22	7	0.3	* 608	○	23,800	○	20,400	140	
	24	8	0.3	* 628	○	19,600	○	16,800	140	(B)
9	17	5	0.2	* 689	○	25,200	○	21,600	56	(A)
	20	6	0.3	699	○	23,800	○	20,400	100	
	24	7	0.3	* 609	○	22,400	○	19,200	140	
	26	8	0.9	* 629	○	19,600	○	16,800	190	
9.525	22.225	7.142	0.4	* R6	○	22,400	○	19,200	140	(B)
10	19	5	0.3	* 6800	○	23,800	○	20,400	73	
	22	6	0.3	* 6900	○	22,400	○	19,200	110	
	26	8	0.3	* 6000	○	21,000	○	18,000	190	
	30	9	0.6	* 6200	○	16,800	○	14,400	21	
12	21	5	0.3	* 6801	○	22,400	○	19,200	82	
	24	6	0.3	* 6901	○	21,000	○	18,000	120	
	28	8	0.3	* 6001	○	19,600	○	16,800	210	
	32	10	0.6	* 6201	○	14,000	○	12,000	290	
15	24	5	0.3	* 6802	○	19,600	○	16,800	88	
	28	7	0.3	* 6902	○	18,200	○	15,600	180	
	32	9	0.3	* 6002	○	16,800	○	14,400	230	
	35	11	0.6	* 6202	○	14,000	○	12,000	320	



Shielded (example)

Boundary dimensions				Basic designation ⁽²⁾	NSF H1				Limiting load ⁽⁴⁾ (reference value) (N)	Type of inquiry designation
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)		RLS grease		BL2 grease for high temperature			
					Availability	Limiting speed ⁽³⁾ (reference value) (min ⁻¹)	Availability	Limiting speed ⁽³⁾ (reference value) (min ⁻¹)		
17	26	5	0.3	* 6803	○	18,200	○	15,600	110	(B)
	30	7	0.3	* 6903	○	16,800	○	14,400	190	
	35	10	0.3	* 6003	○	15,400	○	13,200	250	
	40	12	0.6	* 6203	○	11,900	○	10,200	400	
20	32	7	0.3	* 6804	○	15,400	○	13,200	170	
	37	9	0.3	* 6904	○	13,300	○	11,400	270	
	42	12	0.6	* 6004	○	12,600	○	10,800	390	
	47	14	1	* 6204	○	10,500	○	9,000	540	
25	37	7	0.3	* 6805	○	12,600	○	10,800	190	
	42	9	0.3	* 6905	○	11,200	○	9,600	290	
	47	12	0.6	* 6005	○	10,500	○	9,000	420	
	52	15	1	* 6205	○	9,100	○	7,800	590	
30	55	13	1	* 6006	○	9,100	○	7,800	560	
	62	16	1	* 6206	○	7,700	○	6,600	820	
35	62	14	1	* 6007	○	7,700	○	6,600	680	
	72	17	1.1	* 6207	○	6,650	○	5,700	1090	
40	68	15	1	* 6008	○	7,000	○	6,000	710	
	80	18	1.1	* 6208	○	5,250	○	4,500	1240	

Mark: ○ Available on a production-by-order basis.

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) An asterisk (*) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.

(3) The limiting speeds listed are for shielded bearings. Please contact NSK for the limiting speeds of bearings with rubber contact seals.

(4) Limiting load values are for reference only; they are not guaranteed.

Remarks 1. The radial internal clearance for the bearings with bore diameters smaller than 10 mm is MC3. The radial internal clearance for bearings with bore diameters of 10 mm or larger is CN. See the radial internal clearance tables on Page A10 for further details.

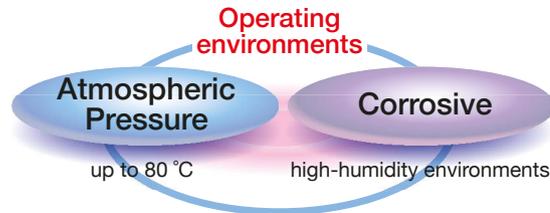
2. Shielded bearings are standard.

1. Stainless Steel Bearings

Pages A11–A14

Dimensions, accuracy and availability of bearings.

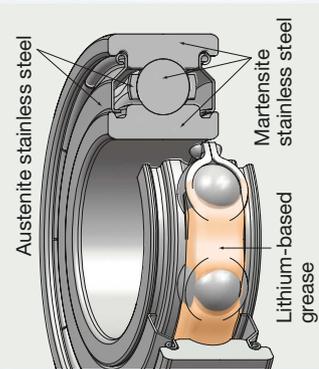
Stainless steel bearings, the standard products of the NSK SPACEA™ Series for special environments, are suitable for high-humidity environments.



Product Specifications



Representative Structure



Structure		Open, Shielded, Sealed
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Polyamide resin or stainless steel
	Lubricant	Lithium-based grease <small>(Open bearings do not come with packed grease.)</small>
	Shields/Seals	Austenite stainless steel/Nitrile rubber

Applications: Equipment used in high-humidity environments: food processing, cleaning, chemical processing, fishery equipment

Operating Instructions and Notes

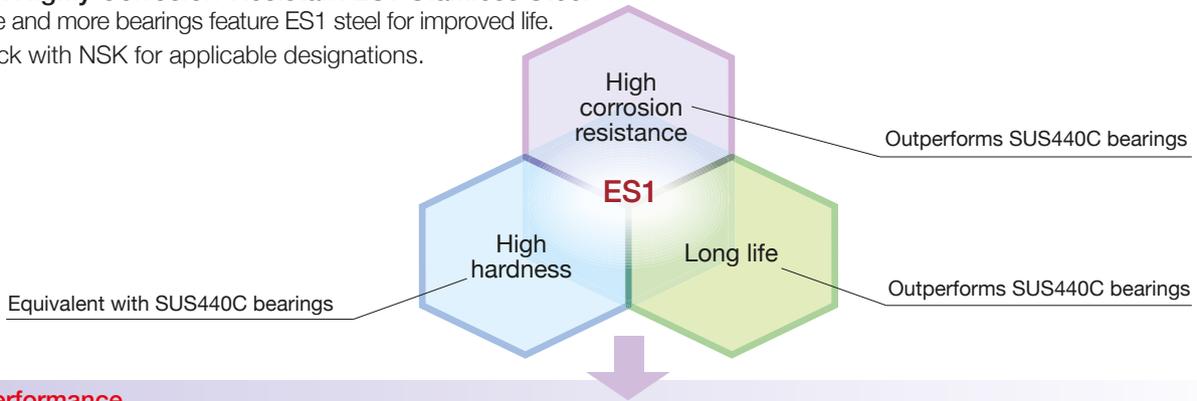
- For use in normal atmospheric conditions only.
- Bearings stocked as standard inventory items are prepacked with NS7 (lithium-based) grease.
- Keep bearings packed until immediately before mounting.
- See the tables on Pages A11 through A14 for limiting loads and limiting rotational speeds.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- For use at normal atmospheric pressure, with grease lubrication
- Higher corrosion resistance than bearing steel
- Open, shielded, and contact sealed bearings are available (see A11–A14)

NSK Highly Corrosion-Resistant ES1 Stainless Steel

More and more bearings feature ES1 steel for improved life. Check with NSK for applicable designations.



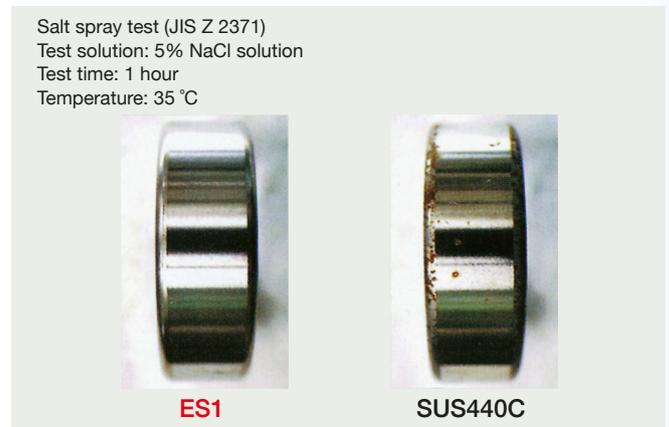
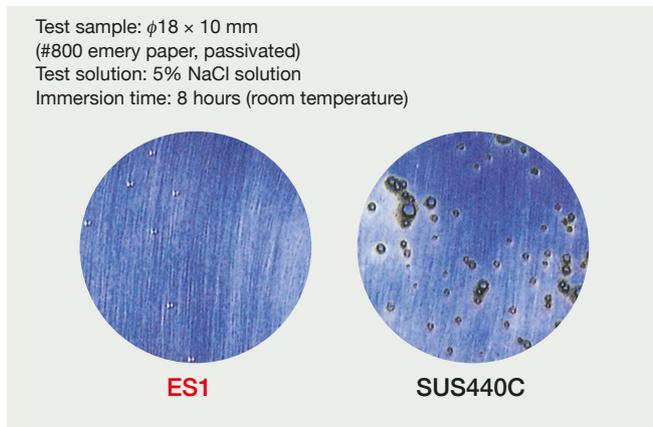
Performance

Material	Hardness, HRC	Corrosion resistance ⁽¹⁾	Features
NSK highly corrosion-resistant ES1 stainless steel	58–62	○	NSK-developed steel
Martensite stainless steel SUS440C	58–62	△	Ordinary stainless steel
Bearing steel SUJ2	60–64	×	Ordinary steel for bearings

Note (1) Comparative assessment between three kinds of materials

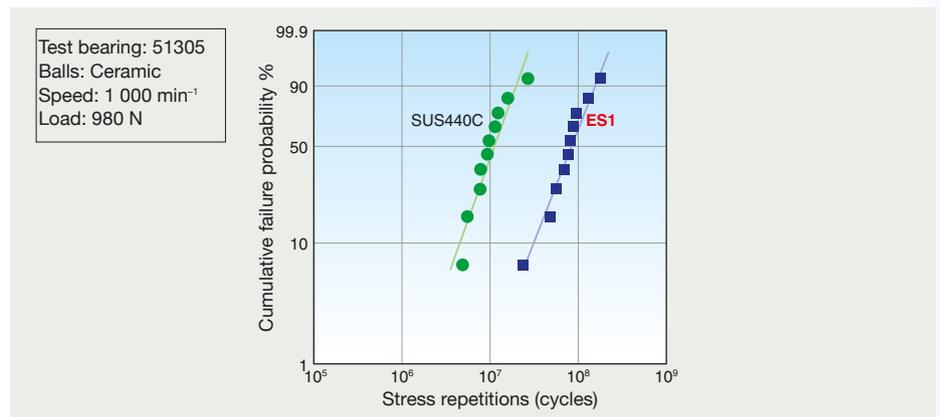
● **Corrosion resistance of ES1**

Outperforms SUS440C in corrosion resistance



● **Immersion rolling fatigue life**

Outperforms SUS440C in durability



2. Stainless Steel Angular Contact Ball Bearings

For use in atmospheric pressure and cleanroom environments

For use in vacuum, cleanroom, and high-temperature environments

Page A15

Dimensions, accuracy and availability of bearings.



Features

- Outperforms standard bearing steel in terms of corrosion resistance.
- Achieves high running accuracy to ISO tolerance class P5.
- Supports universal matching with light preload when mounted in a face-to-face (DF) arrangement or back-to-back (DB) arrangement.
- Stainless steel angular contact ball bearings come in two variations: one set is suitable for cleanroom and normal atmospheric pressure conditions while the other is suited for cleanroom, vacuum, and high-temperature environments.

Specifications of Bearings

Application environment		Atmospheric pressure and cleanroom environments	Vacuum, cleanroom and high-temperature environments
Contact angle		30° (A) or 25° (A5)	
Material	Outer/Inner rings, Balls	Martensite stainless steel	
	Cage	Polyamide resin (TYN)	Natural PEEK resin (T4N) or Stainless steel
Arrangement		Universal arrangement (single row)	
Preload		Light preload	
Accuracy		P5	

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- For cleanroom and normal environment bearings, first clean the bearings to remove the anti-corrosion agent before applying a suitable grease.
- Vacuum, cleanroom, and high-temperature environment bearings have already been degreased and cleaned. Please apply a suitable grease.
- See the tables on Page A15 for limiting loads and limiting rotational speeds.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

3. Stainless Steel Self-Aligning Ball Bearings

Featuring highly corrosion-resistant ES1 stainless steel

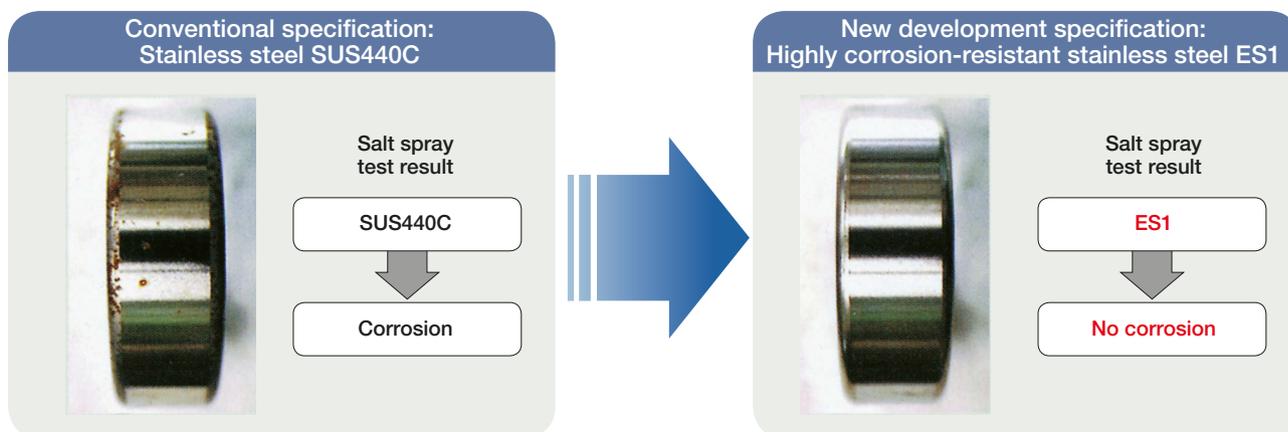
Page A15 Dimensions, accuracy and availability of bearings.



Applications: Flat panel display cleaning equipment, film cleaning systems, etching equipment, conveyance equipment

Features

- Highly resistant to corrosion thanks to ES1: a highly corrosion-resistant stainless steel.
- Self-aligning with the ability to accommodate misalignment of the axis and housing from 4 to 7 degrees.



Operating Instructions and Notes

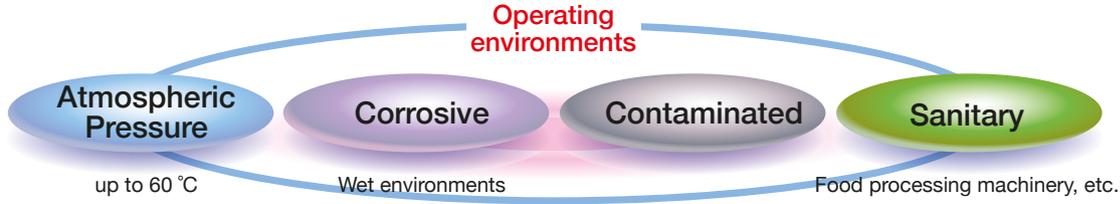
- Keep bearings packed until immediately before mounting.
- Clean the bearings to remove the anti-corrosion agent before applying a suitable grease.
- See the tables on Page A15 for limiting loads and limiting rotational speeds.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

4. Molded-Oil™ Bearings

Dimensions, accuracy and availability of bearings.

Molded-Oil™ bearings, made of stainless steel, are lubricated with an original oil-containing material, Molded-Oil™, and are suitable for corrosive and contaminated environments at atmospheric pressure.

Food grade lubricants are also available.



Product Specifications

General grade Food grade

Representative Structure

Austenite stainless steel
Martensite stainless steel
Nitrile rubber
Molded-Oil™

Structure		Open, Shielded, Sealed
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Stainless steel
	Lubricant	Molded-oil™ (General or food-grade lubricants)
	Seals/Shields	Nitrile rubber/Austenite stainless steel

Applications: Semiconductor cleaning equipment, FPD cleaning equipment, hard-disk cleaning equipment, food processing machinery, various conveyor lines

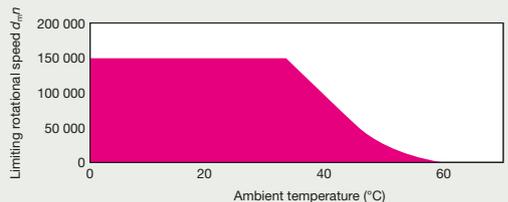
Operating Instructions and Notes

- For use in normal atmospheric conditions only.
- Because the solid lubricant used in these bearings will melt at a temperature of 120 °C, take care not to exceed temperatures of 100 °C when heating this bearing during the shrink-fit process for mounting.
- A radial load is required for the bearings to properly rotate. The minimum radial load to maintain proper rotation is at least 1 % of the basic dynamic load rating.
- Keep bearings packed until immediately before mounting.
- The scope of application (applied load, limiting $d_m n$ value) is listed in the table to the right.
- Avoid exposure to organic solvents with a degreasing effect.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide "as is" without express or implied warranties of any kind.

The scope of Molded-Oil™ bearings

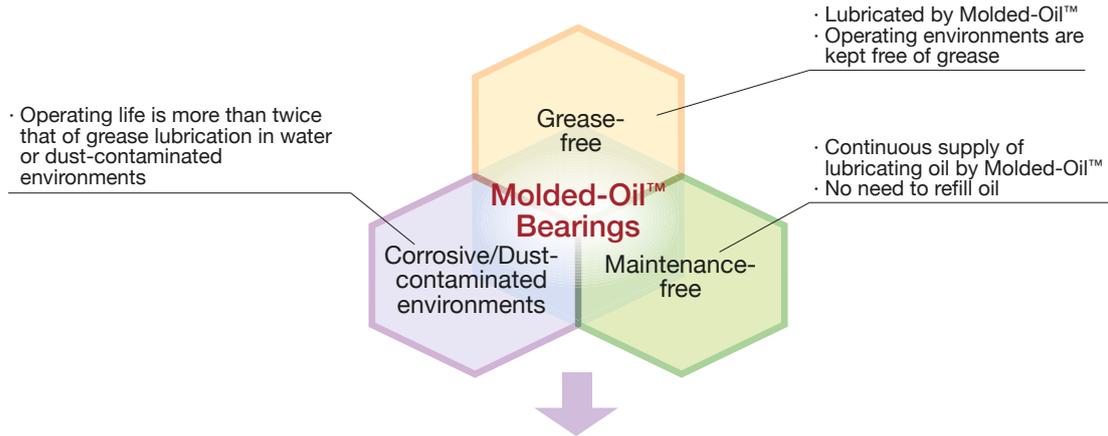
Applied load	Between 1% and 5% of the stainless steel bearing dynamic load rating C_H <At least 1% of C_H must be applied.>
Limiting rotational speed, $d_m n^{(1)}$	150 000 Refer to the chart below for temperatures above 35 °C

Note (1) $d_m n = (\text{Bearing bore diameter} + \text{bearing outer diameter (mm)}) \div 2 \times \text{Rotational speed (min}^{-1}\text{)}$



Features

- Molded-Oil™ provides continuous supply of lubrication oil
- No grease or oil refilling keeps operating environments clean
- Operating life more than twice that of grease lubrication in water or dust-contaminated environments
- Contact-seal bearings available in standard inventory (see Page A16)
- NSF H1 food-grade lubricants for food processing machinery also available.



Performance

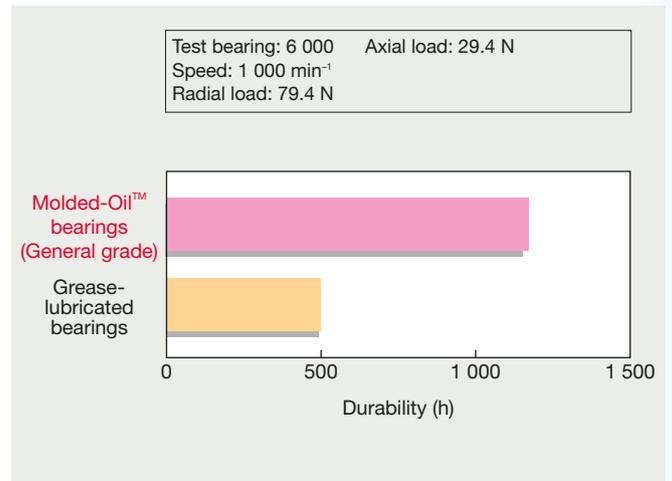
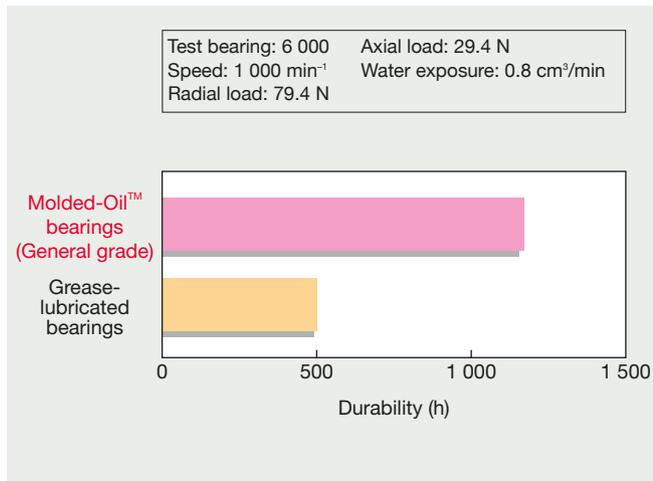
Portion containing high proportion of polyolefin
Polyolefin is used for packaging food in supermarkets, replacing dioxin-generating vinyl chloride.

Portion containing high proportion of lubricating oil
Molded-Oil comes in both general-grade (mineral-oil based) and NSF H1* food grade variants.
*NSF Category Code H1: Incidental food contact

Close-up of Molded-Oil™ 100 μm

● **Durability under wet and water-immersed conditions**

Molded-Oil™ bearings have an operating life twice that of grease-lubricated bearings.

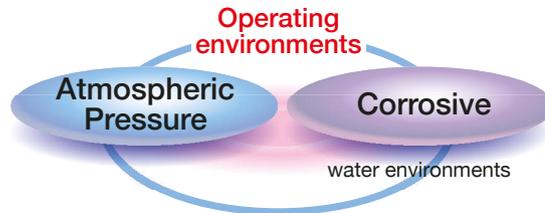


5. Hybrid Bearings

Page A17

Dimensions, accuracy and availability of bearings.

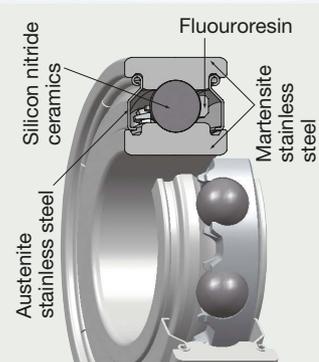
Hybrid bearings, combining ceramic balls and a fluoro-resin self-lubricating cage, are suitable for corrosive environments at atmospheric pressure.



Product Specifications



Representative Structure



Structure		Shielded (Open)
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Silicon nitride ceramics
	Cage	Fluoro-resin
	Lubricant	Fluorine solid lubricant
	Shields	Austenite stainless steel

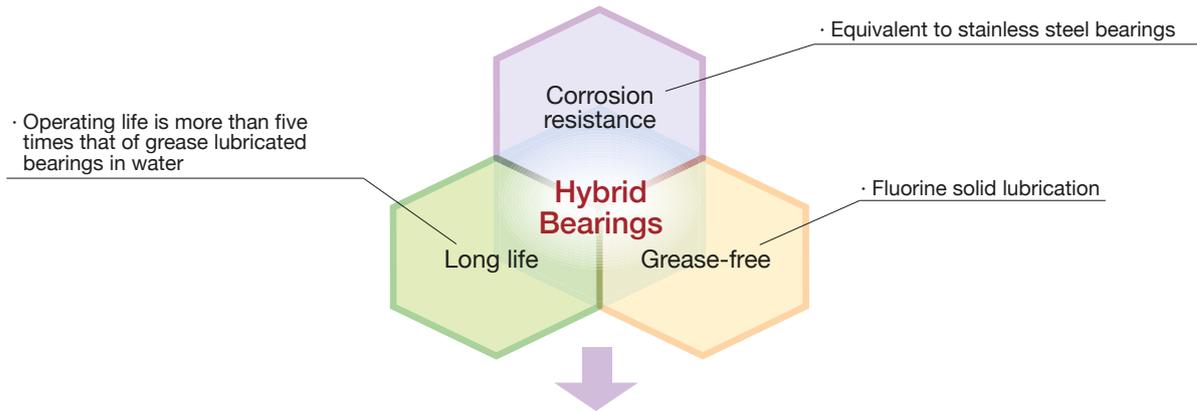
Applications: Devices and conveyor lines used in water-spray or other wet environments such as food processing and fishery equipment

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- See the tables on Page A17 for limiting loads and limiting rotational speeds.
- A special clearance is adopted for the radial internal clearance. See the tables on Page A17.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

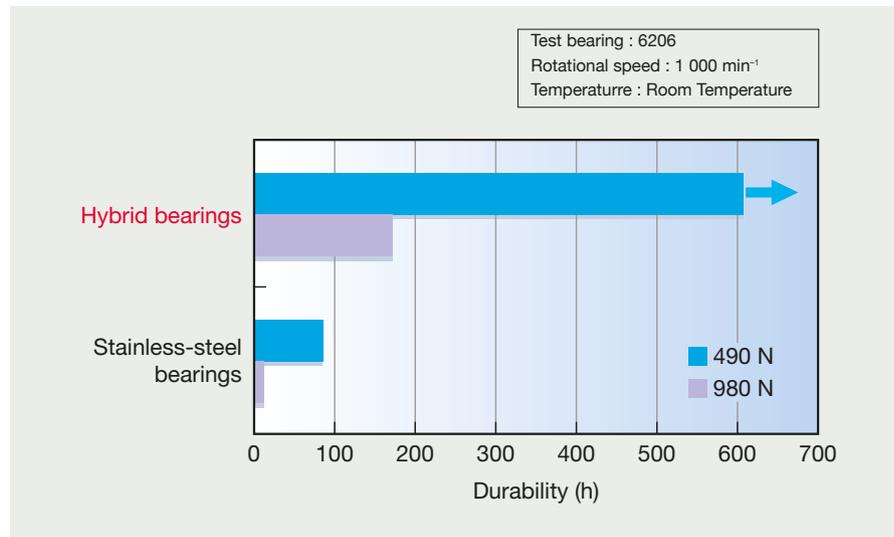
- Grease-free, fluorine-based solid lubricant
- Operating life more than five times that of stainless steel bearings in water-immersed environments



Performance

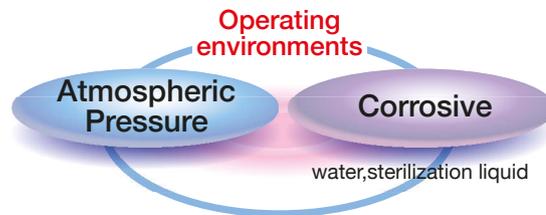
● **Durability in water-immersed environments**

Hybrid bearings have an operating life more than five times that of stainless steel bearings.



6. Corrosion-Resistant Coated Bearings

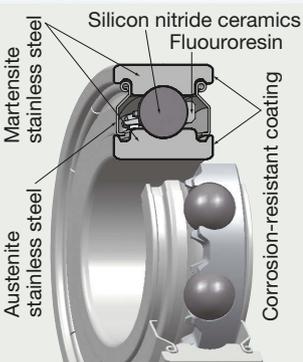
Corrosion-resistant coated bearings are coated with a nickel coating on the outer and inner rings to enhance corrosion resistance and durability, and are suitable for corrosive environments at atmospheric pressure.



Product Specifications



Representative Structure



Structure		Shielded
Specifications	Outer/Inner rings	Martensite stainless steel and nickel coating
	Balls	Silicon nitride ceramics
	Cage	Fluororesin
	Lubricant	Fluorine solid lubricant
	Shields	Austenite stainless steel

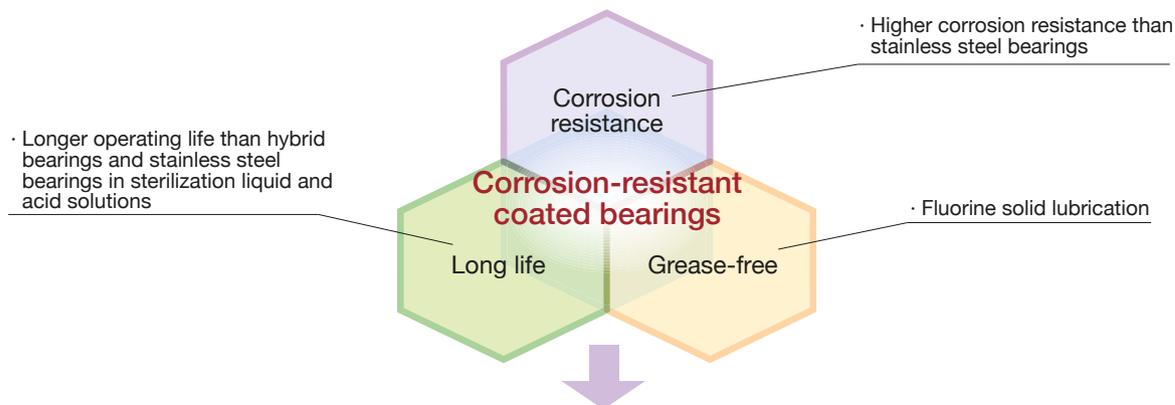
Applications: Semiconductor/FPD/HD cleaning equipment, etching equipment, food processing machinery, various conveyor lines

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- See the tables on Page A17 for limiting loads and limiting rotational speeds.
- A special clearance is adopted for the radial internal clearance. See the tables of SPACEA™ bearing nomenclature on Page A17.
- Dimensional tolerances of the bore and the outside diameter for corrosion-resistant coated bearings may deviate from the JIS Class 0 standard for coating thickness by a maximum of 5 μm in diameter.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- Grease-free, fluorine-based solid lubricant
- Higher corrosion-resistance and longer life than stainless steel bearings or hybrid bearings
- Resistant to sterilization liquids such as hydrogen peroxide and oxonia



Performance

Immersed in a sodium hypochlorite solution
Concentration: 150 ppm



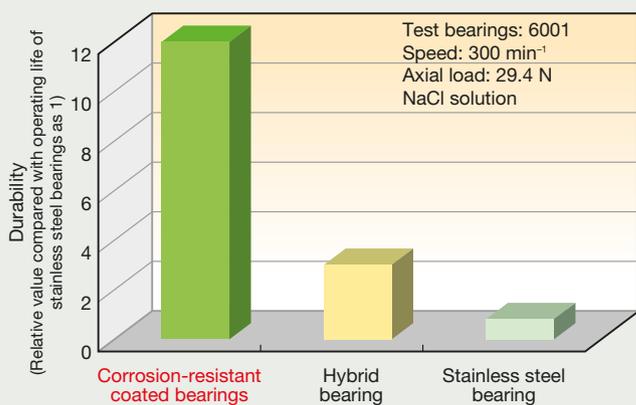
Stainless steel bearing SUS440C



Corrosion-resistant coated bearings

● **Corrosion resistance in sodium hypochlorite solution**

While stainless steel bearings rusted in 10 hours, corrosion-resistant coated bearings did not rust, even after 72 hours.



● **Durability in NaCl solution**

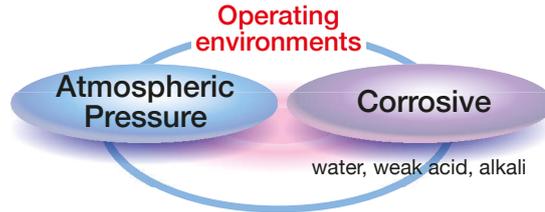
In a NaCl solution, corrosion-resistant coated bearings have an operating life more than four times that of hybrid bearings, and more than 12 times that of stainless steel bearings.

Bearings
Corrosion-Resistant Coated Bearings

7. ESZ Bearings

ESZ bearings are highly corrosion-resistant, high-hardness stainless steel bearings offering corrosion resistance on a par with SUS630 and over 30% more hardness than SUS630.

The bearings are suitable for corrosive environments at atmospheric pressure.



Product Specifications

Representative Structure

Representative Structure With Aligning Housing Ring

Structure		Deep groove ball bearings	
		Shielded (Open)	Deep groove ball bearings with aligning housing ring Open
Specifications	Outer/Inner rings	Highly corrosion-resistant, high hardness stainless steel: ESZ	Highly corrosion-resistant, high hardness stainless steel: ESZ
	Balls	Oxide-based ceramics or silicon nitride ceramics	Oxide-based ceramics or silicon nitride ceramics
	Cage	Fluororesin or PEEK resin	Fluororesin
	Lubricant	Solid lubricant	Solid lubricant
	Shields	Austenite stainless steel	—
	Aligning housing ring	—	Austenite stainless steel

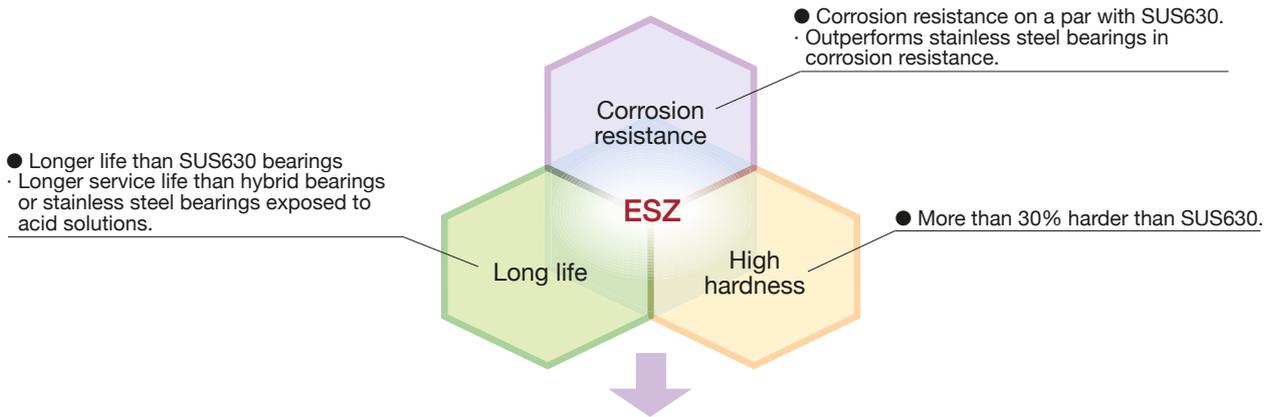
Applications: High function film conveyor, cleaning equipment, food processing machinery, various conveyor lines

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- See the tables on Page A18 for limiting loads and limiting rotational speeds.
- C3 is the standard radial internal clearance.
- When bearings with aligning housing rings are used under radial loads, ensure that the radial load position is not on the notches (in two spots).
- The fit between the aligning housing ring and housing should be loose with a sufficient amount of clearance to ensure smooth, self-aligning performance.
- Please contact NSK if a bearing with an aligning housing ring will be mounted to a vertical shaft.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

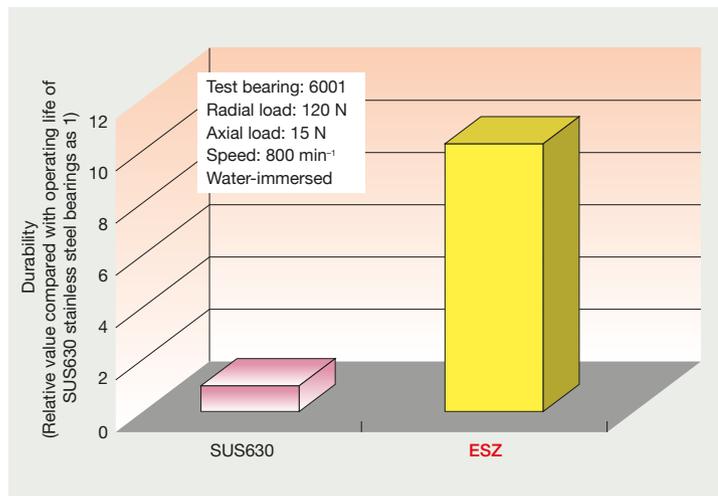
Features

- Product lineup includes standard deep groove ball bearings and deep groove ball bearings with an aligning housing ring.
- Corrosion resistance on par with SUS630. Able to withstand exposure to sodium hypochlorite solutions.
- Over 30% harder than SUS630.
- Able to accommodate bending associated with wider rollers and allows for misalignment of the shaft and housing.

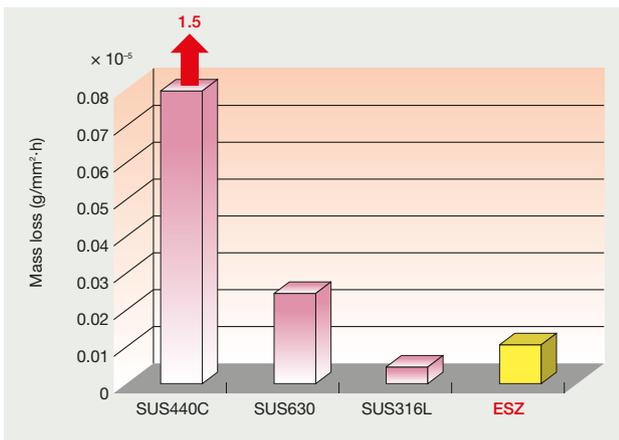


Performance

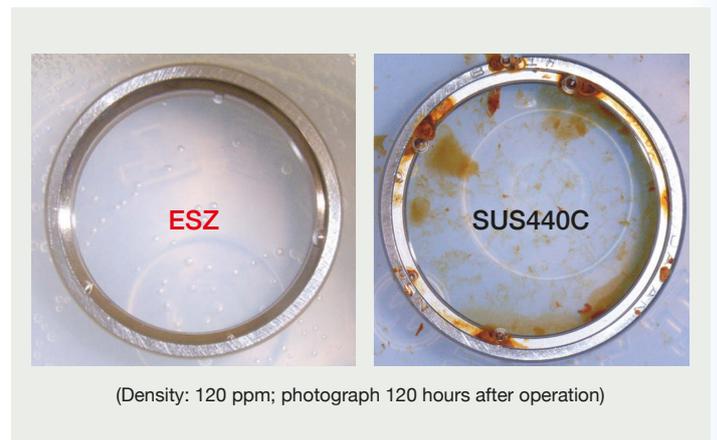
- Durability in water-immersed conditions



- Results of 5% sulfuric acid immersion test



- Results of sodium hypochlorite solution immersion test



8. All-Ceramic Bearings

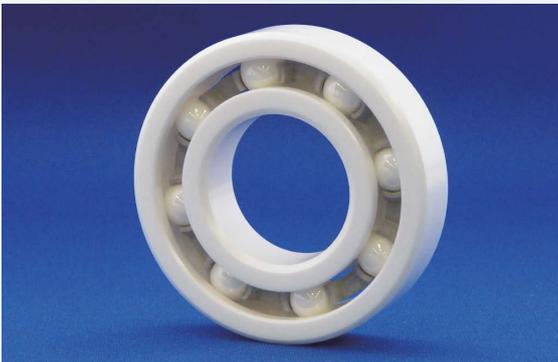
Page A19

Dimensions, accuracy and availability of bearings.

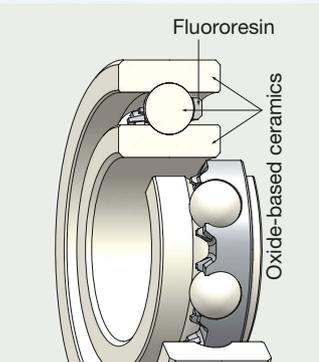
With ceramic outer/inner rings and balls, all-ceramic bearings have self-lubricating fluoro-resin cages and are suitable for corrosive environments and non-magnetic requirements at atmospheric pressure.



Product Specifications



Representative Structure



Structure		Open only
Specifications	Outer/Inner rings	Oxide-based ceramics
	Balls	Oxide-based ceramics
	Cage	Fluoro-resin
	Lubricant	Fluorine solid lubricant

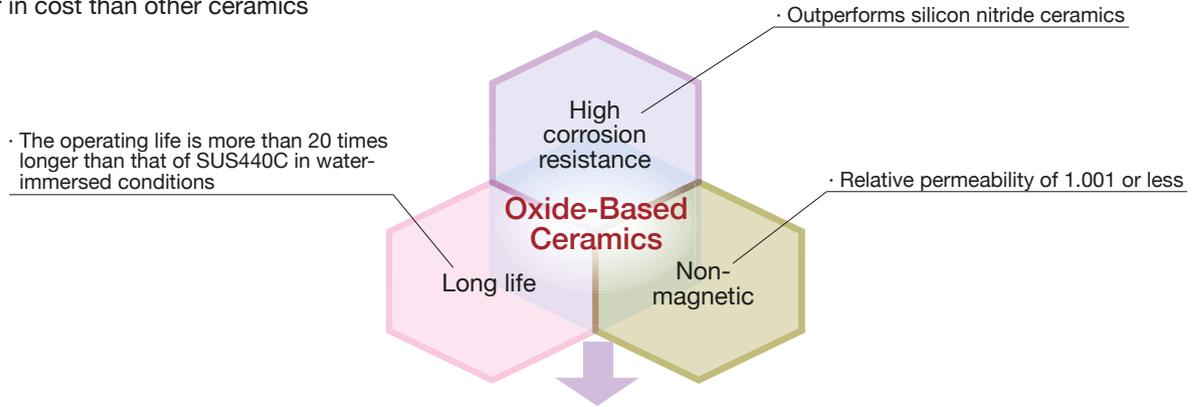
Applications: Corrosive environments: Semiconductor production machinery, chemical processing equipment, metal plating equipment
 Non-magnetic requirements: Electron beam drawing devices, electron beam exposure equipment, inspection equipment

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- See the tables on Page A19 for limiting loads and limiting rotational speeds.
- Due to the fragility of ceramic materials, please observe the following precautions:
 - ★ Do not drop or strike the bearing.
 - ★ Allow for sufficient clearance when installing the bearing.
 - ★ Do not strike the bearing with a hammer or other tool when installing the bearing to a shaft or axlebox.
- A special clearance is adopted for the radial internal clearance. See the tables of SPACEA™ bearing nomenclature on Page A19.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- Grease-free, fluorine-based solid lubricant
- Higher corrosion resistance and longer life than conventional stainless steel bearings and hybrid bearings
- Completely non-magnetic
- Lower in cost than other ceramics



Performance

● **Comparison of performance and cost**

Oxide-based ceramics are:

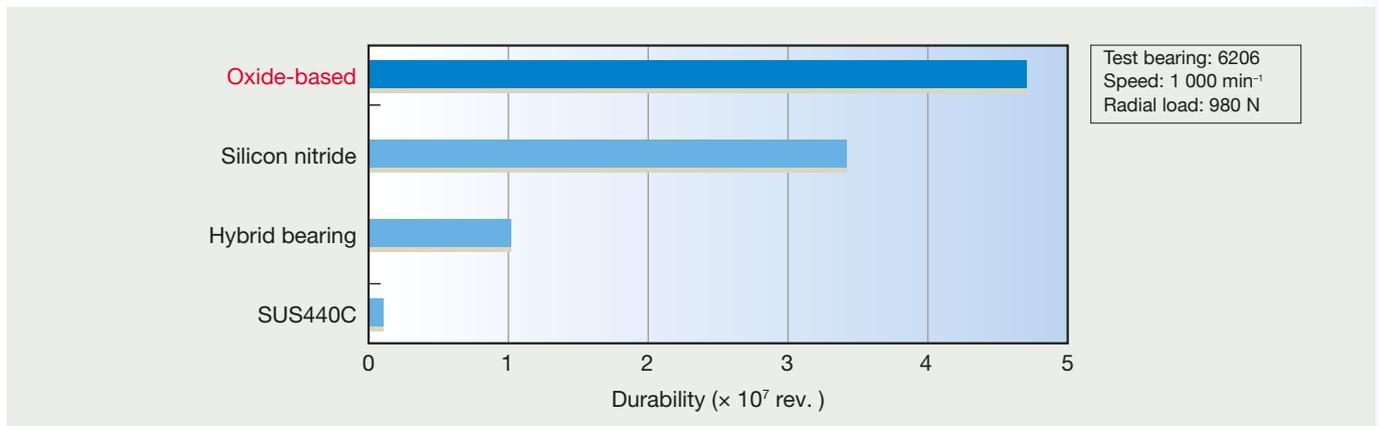
- ★ More corrosion-resistant than stainless steel SUS440C or silicon nitride ceramics (Si_3N_4)
- ★ Lower in price than other ceramics

Evaluation item		Ceramics		Stainless steel
		Oxide-based	Silicon nitride	SUS440C
Corrosion resistance	3% Sulfuric acid (room temperature)	○	△	×
	8% Hydrochloric acid (room temperature)	○	△	×
	5% Fluoric acid (room temperature)	△	△	×
Relative permeability		1.001 or less	1.001 or less	Ferromagnetic body

Corrosion resistance evaluation ○: Slightly corroded △: Partially corroded ×: Corroded

● **Durability in water-immersed conditions**

Oxide-based ceramics are 20 times more durable than SUS440C under water-immersed conditions.

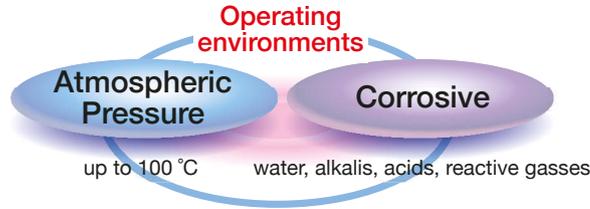


9. Aqua-Bearing™

Page A20

Dimensions, accuracy and availability of bearings.

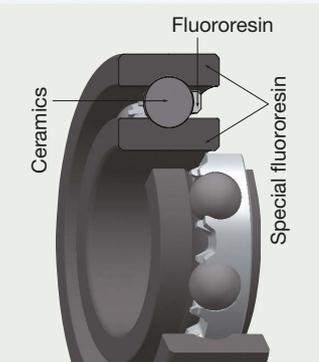
Aqua-Bearing™ features a special fluoro-resin for outer/inner rings and cage equipped to meet a broad range of applications in water, alkali and strong acid environments. Aqua-Bearing™ is suitable for corrosive environments at normal pressures.



Product Specifications



Representative Structure



Structure		Open only
Specifications	Outer/Inner rings	Special fluoro-resin
	Balls	Ceramics
	Cage	Fluoro-resin
	Lubricant	Fluorine-based solid lubricant

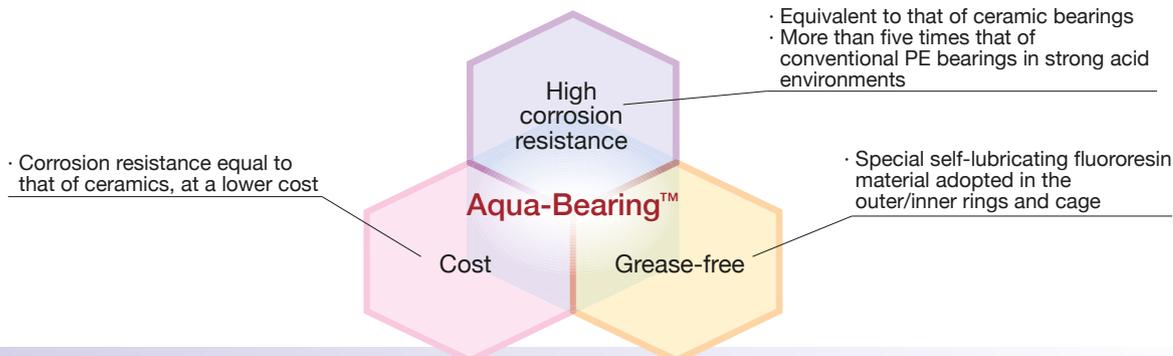
Applications: Semiconductor cleaning equipment, FPD cleaning equipment, hard-disk cleaning equipment, metal plating equipment, etching equipment, food processing machinery

Operating Instructions and Notes

- For use in normal atmospheric conditions only.
- Keep bearings packed until immediately before mounting.
- See the tables on Page A20 for limiting loads and limiting rotational speeds.
- The Aqua-Bearing™ adopts special standards for dimensional accuracy of the inner ring bore diameter, outside diameter of the outer ring, and radial internal clearance. See the tables on Page A20.
- Note that the bearing fit is large due to the linear expansion coefficient of the special fluoro-resin material ($\alpha = 1.7 \times 10^{-4}/^{\circ}\text{C}$).
- These bearings may not be usable with certain liquid medicines or under certain concentrations.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- High corrosion resistance equivalent to that of ceramic bearings
- Excellent durability in acid solvents: over 1 000 times more resistant than SUS440C stainless bearings and over five times more resistant than conventional resin (PE) bearings
- Special self-lubricating fluoro-resin eliminates need for grease/oil refilling.



Performance

● **Comparison of corrosion resistance**

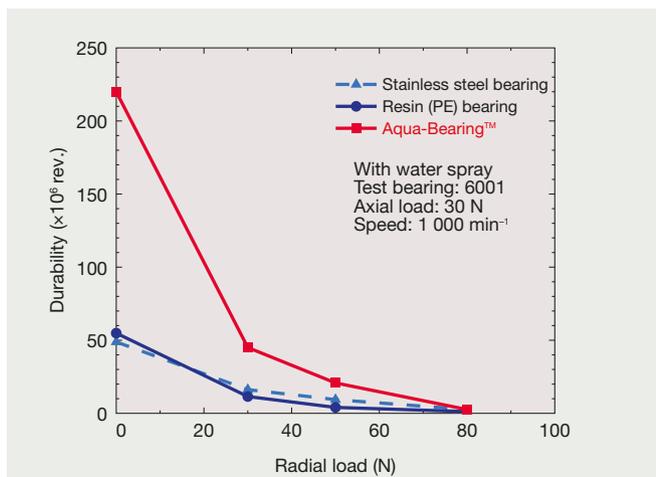
Corrosion resistance equal to or higher than all-ceramic bearings (oxide-based)

	Aqua-Bearing™	PE	All-ceramic bearings (Oxide-based)
5% Sulfuric acid	△	×	△
8% Hydrochloric acid	△	×	△
Aqua regalis	◎	×	◎
15% Acetic acid	◎	△	◎
70% Aqua fortis	△	×	△
70% Phosphoric acid	◎	△	◎
40% Hydrogen peroxide solution	◎	△	◎

Corrosion resistance evaluation ◎: Not corroded △: Partially corroded ×: Corroded

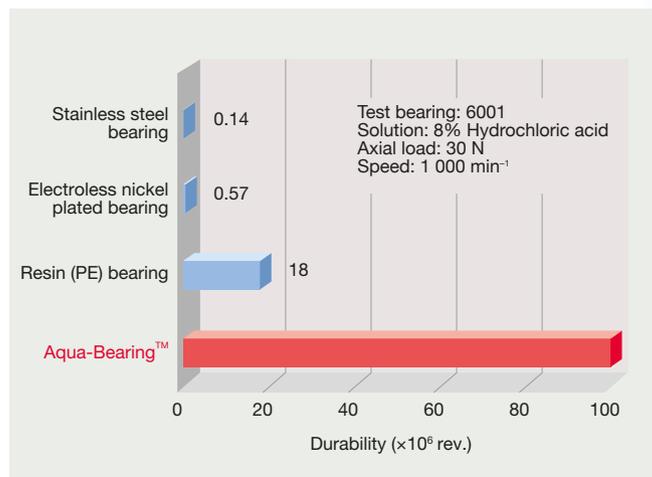
● **Results of water-spray durability tests**

Remarkable durability under light-load conditions.



● **Results of durability tests in strong acid solution**

Durability is higher than that of SUS440C bearings and conventional resin bearings and more than 1 000 times and five times respectively.

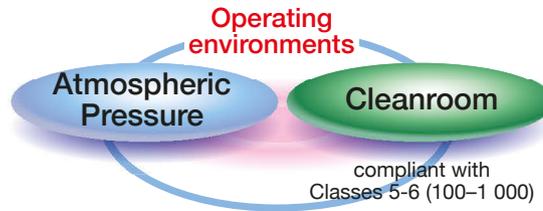


10. LG2/LGU Grease-Packed Bearings

Pages A21–A22

Dimensions, accuracy and availability of bearings.

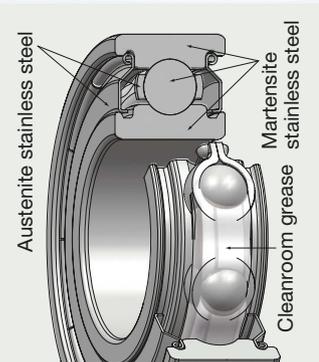
LG2/LGU Cleanroom grease-packed stainless steel bearings are suitable for cleanroom environments at atmospheric pressure.



Product Specifications



Representative Structure



Structure		Shielded Type
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Stainless steel or resin
	Lubricant	NSK LG2/LGU grease
	Shields	Austenite stainless steel

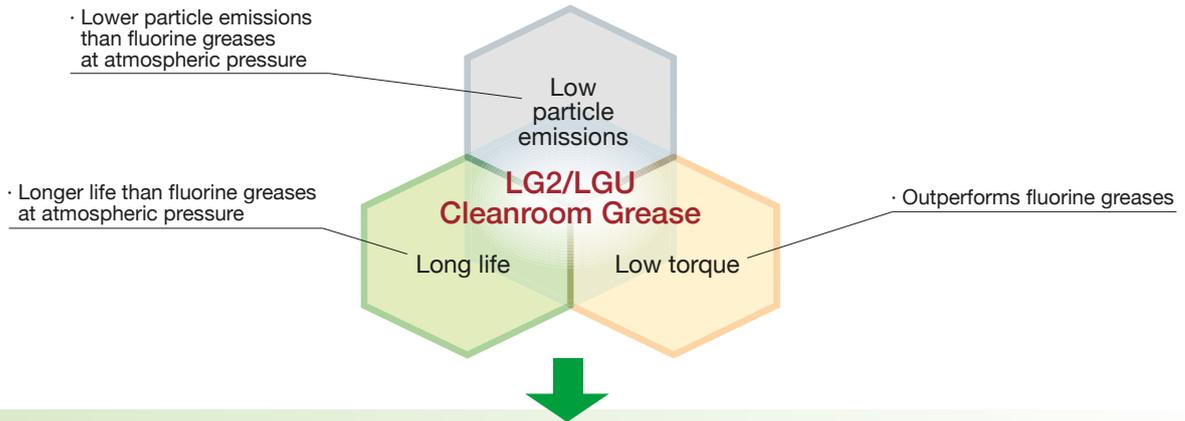
Applications: Equipment in cleanrooms

Operating Instructions and Notes

- LG2/LGU grease products are for use in normal atmospheric conditions only.
- Keep bearings packed until immediately before mounting.
- See the tables on Pages A21 and A22 for limiting loads and limiting rotational speeds.
- Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding components, and other factors.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- Cleanroom grease lubrication for use at atmospheric pressure only
- Lower particle emissions, lower torque, longer operating life, and higher corrosion resistance than commercially available fluorine greases
- LGU grease is free of metallic elements



Performance

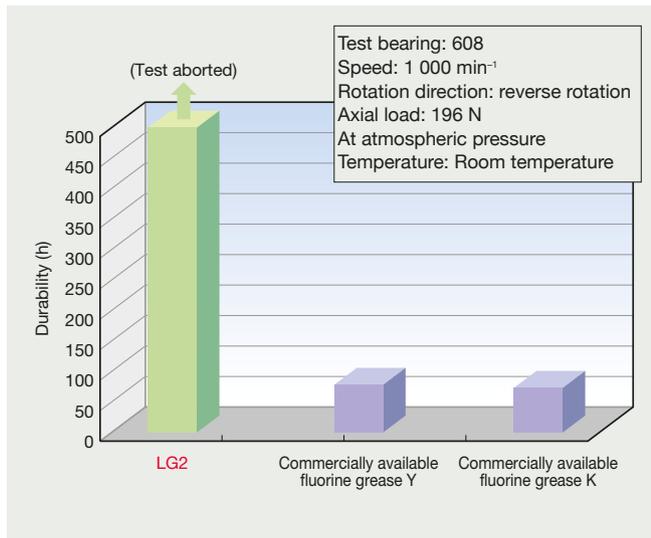
● **Properties of grease**

Operating environment	For use at atmospheric pressure only	
Product	LG2	LGU
Base oil	Mineral oil and synthetic hydrocarbon oil	Synthetic hydrocarbon oil
Thickener	Lithium soap	Diurea
Kinematic viscosity (mm ² /s, 40 °C)	32	96
Consistency	199	201
Maximum operating temperature (°C)	up to 70	up to 120

LGU grease is free of metallic elements

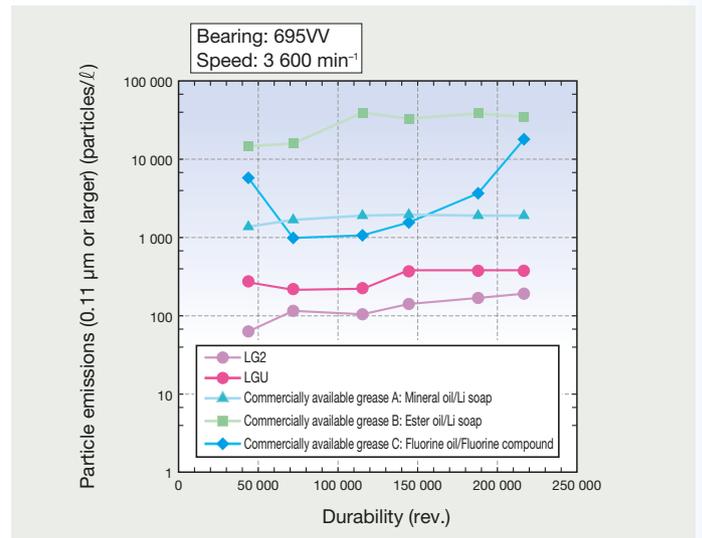
● **Results of durability tests**

LG2/LGU grease feature longer life than other grease at atmospheric pressure.



● **Results of particle emission tests**

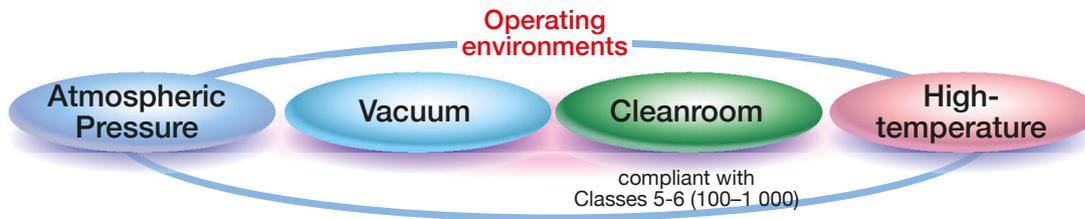
LG2/LGU grease limit particle emissions at atmospheric pressure.



11. FG9 Fluorine Grease-Packed Bearings

Pages A21–A22 Dimensions, accuracy and availability of bearings.

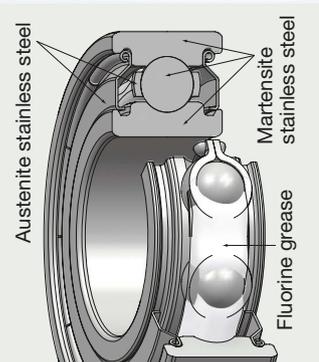
FG9 fluorine grease-packed stainless steel bearings are suitable for cleanroom environments at atmospheric pressure up to vacuum.



Product Specifications



Representative Structure

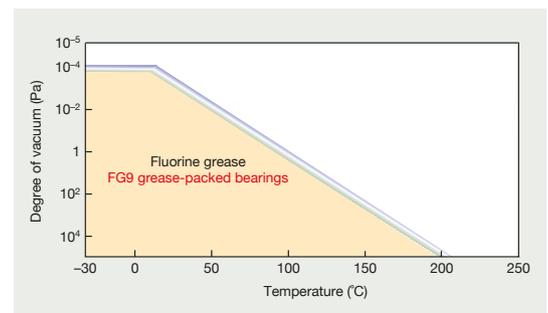


Structure		Shielded
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Stainless steel
	Lubricant	FG9 grease
	Shields	Austenite stainless steel

Applications: Semiconductor/ organic electro-luminescence/ FPD manufacturing equipment, hard disk manufacturing equipment

Operating Instructions and Notes

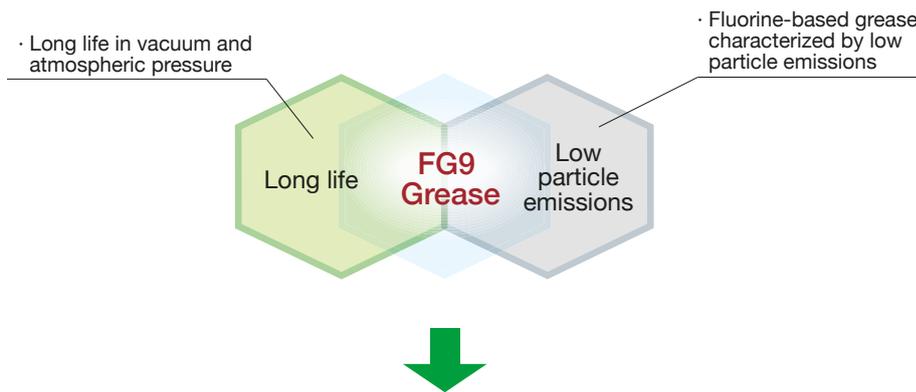
- Keep bearings packed until immediately before mounting.
- The scope of application (degree of vacuum, temperature) is listed in the table to the right.
- See the tables on Pages A21 and A22 for limiting loads and limiting rotational speeds.
- Ensure an optimum radial internal clearance for maximum rotational performance by applying a fit that considers bearing load, operating temperatures, materials of the shaft and/or housing (due to coefficient of linear expansion), etc.
- Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding components, and other factors.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.



Features

- Fluorine grease lubrication
- More suitable for vacuums and at higher temperatures than LG2/LGU greases
- Lower particle emissions and longer life than conventional fluorine greases
- Satisfies EU POPs regulations for restrictions on PFOA*

*Annex I to Regulation (EU) 2019/1021



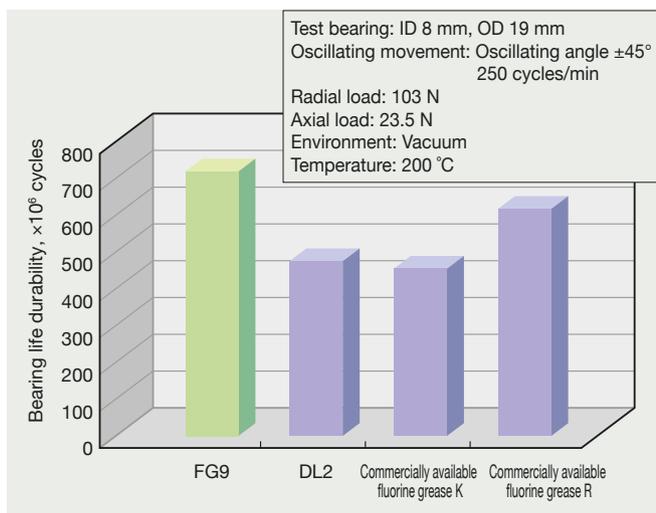
Performance

● **Properties of grease**

Operating environments	From atmospheric pressure to vacuum
Name	FG9
Base oil	Fluorine oil
Thickener	PTFE
Kinematic viscosity (mm ² /s, 40 °C)	200
Maximum operating temperature (°C)	up to 200

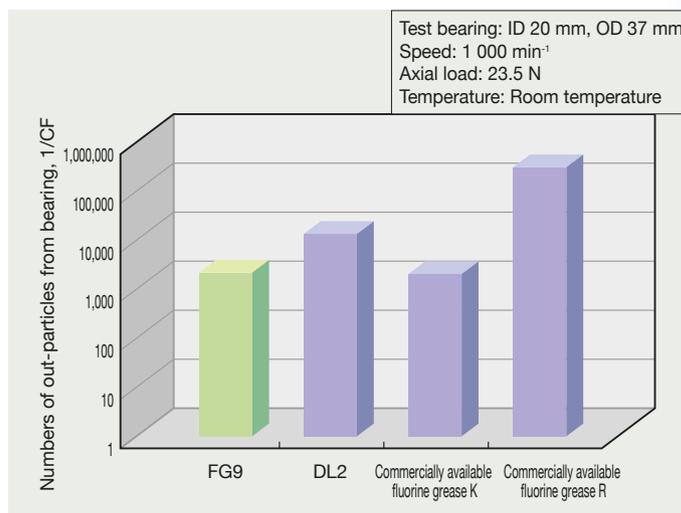
● **Results of durability tests in vacuum**

FG9 provides the longest life in vacuum environments.



● **Results of particle emission tests at atmospheric pressure**

FG9 grease limits particle emissions at atmospheric pressure.



12. E-DFO Bearings, V-DFO Bearings

New concept V-DFO and E-DFO bearings have special lubrication coatings applied to the rings, balls, and cage that deliver superior cleanliness and long life. The V-DFO specification uses low-vapor-pressure fluorinated lubricant while the E-DFO specification uses low-vapor-pressure hydrocarbon lubricant.

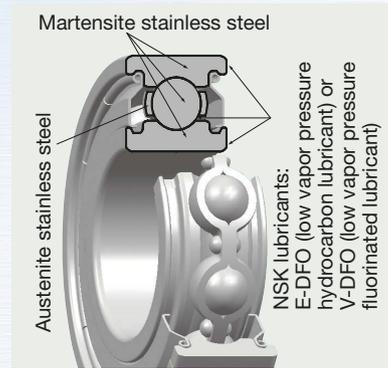
These bearings are suitable for cleanroom environments ranging from atmospheric pressure to vacuum conditions.



Product Specifications



Representative Structure



Structure		E-DFO	V-DFO
		Shielded	Shielded
Specifications	Outer/Inner rings	Martensite stainless steel and E-DFO	Martensite stainless steel and V-DFO
	Balls	Martensite stainless steel and E-DFO	Martensite stainless steel and V-DFO
	Cage	Stainless steel and E-DFO	Stainless steel and V-DFO
	Lubricant	NSK lubricant E-DFO	NSK lubricant V-DFO
	Shields	Austenite stainless steel	Austenite stainless steel

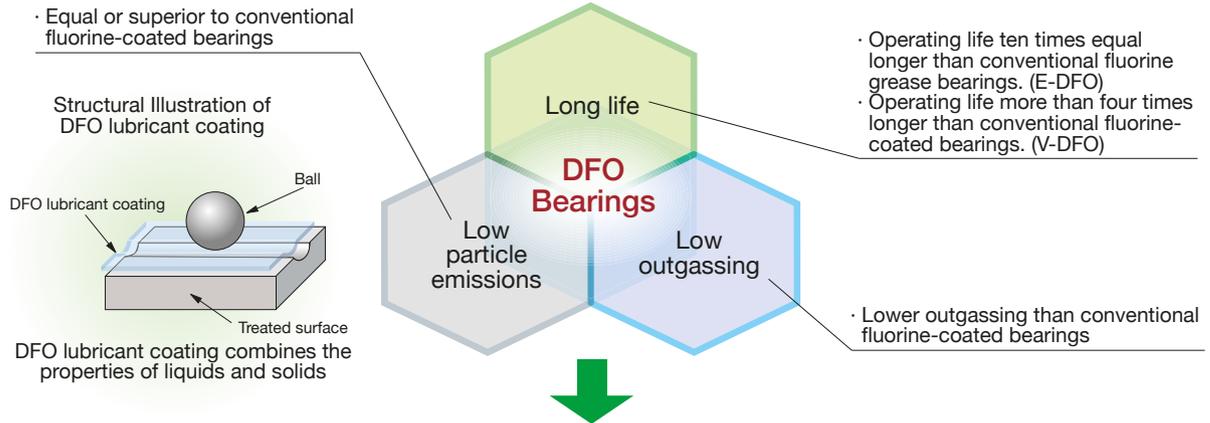
Applications: Manufacturing equipment for semiconductors, OLEDs, flat-panel displays, and hard disks; solar cell manufacturing; robots for vacuum environments

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- Avoid storing the bearing for a long amount of time.
- Wear clean gloves when handling.
- Mount the bearing without washing.
- Avoid exposure to any oil or moisture.
- See the tables on Page A23 for limiting loads and limiting rotational speeds.
- Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding components, and other factors.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide "as is" without express or implied warranties of any kind.

Features

- Operating life more than four times longer than conventional fluorine-coated bearings
- Lower particle emissions and outgassing than MoS₂ solid lubricated bearings
- Usable in environments where lubricants containing metallic elements such as MoS₂ are not suitable
- Usable from atmospheric pressure to vacuums at 10⁻⁷ Pa (room temperature), although the degree of vacuum in which the bearings can be used varies according to operating temperature



Performance

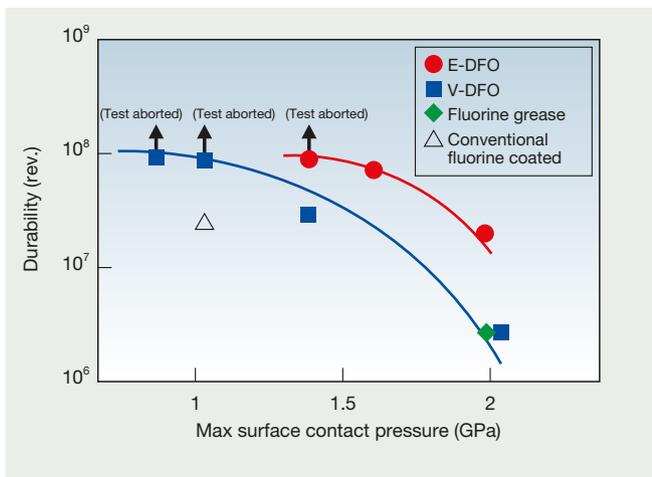
● Comparison of operating environments for NSK lubricant E-DFO and V-DFO:

Conditions	E-DFO	V-DFO
Corrosive gas	×	○
Vacuum	◎ (up to 150°C)	○ (up to 150°C)
Atmospheric pressure	◎ (up to 50°C)	◎ (up to 200°C)
Limiting load	◎ (up to 5%)	○ (up to 2%)

● Durability under vacuum conditions

1. E-DFO offers nearly ten times more durability than conventional fluorine grease.
2. V-DFO offers upwards of four times the durability of a fluorine coated bearing.

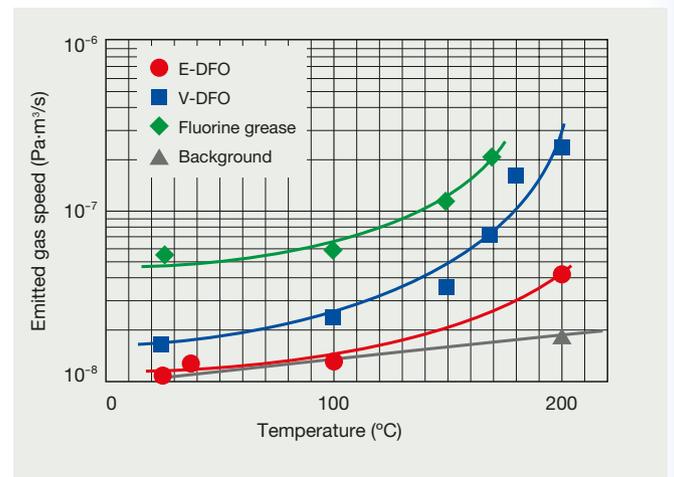
Test conditions
 Test bearing: 708
 Speed: 3 000 min⁻¹
 Degree of vacuum: 2 × 10⁻⁴ Pa



● Outgassing under high-temperature conditions

Low outgassing characteristics

Test conditions
 Test bearing: 608
 Degree of vacuum: 8 × 10⁻⁴ Pa

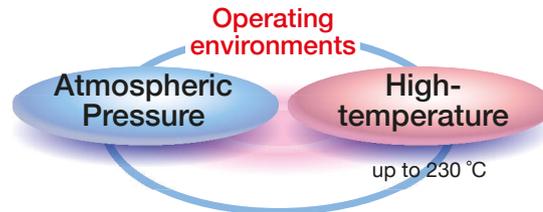


13. KPM Grease-Packed Bearings

Page A24

Dimensions, accuracy and availability of bearings.

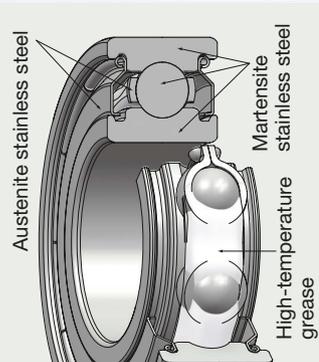
These high-temperature bearings are packed with NSK's long-life, high-temperature KPM grease for use at atmospheric pressure only.



Product Specifications



Representative Structure



Structure		Shielded
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Stainless steel
	Lubricant	NSK high-temperature KPM grease
	Shields	Austenite stainless steel

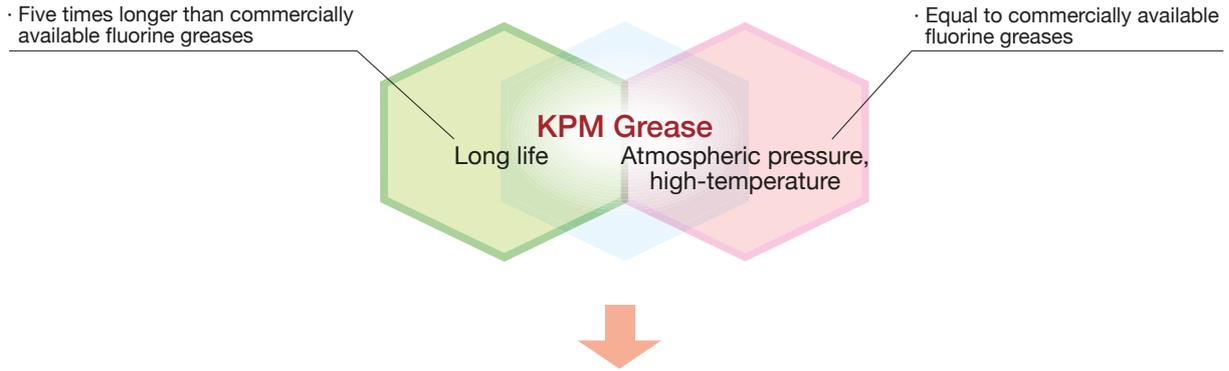
Applications: Copying machines, kilns, high-temperature conveyance equipment, other equipment for high-temperature environments

Operating Instructions and Notes

- KPM grease is for normal atmospheric conditions only.
- Not applicable for cleanroom environments.
- Keep bearings packed until immediately before mounting.
- See the tables on Page A24 for limiting loads and limiting rotational speeds.
- Ensure an optimum radial internal clearance for maximum rotational performance by applying a fit to the bearing that considers bearing load, operating temperatures, materials of the shaft and/or housing (due to coefficient of linear expansion), etc.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide "as is" without express or implied warranties of any kind.

Features

- Usable in high-temperature environments up to 230 °C
- Longer operating life than commercially available fluorine greases (five times longer at 200 °C)
- Longer operating life than solid lubricant high-temperature bearings



Performance

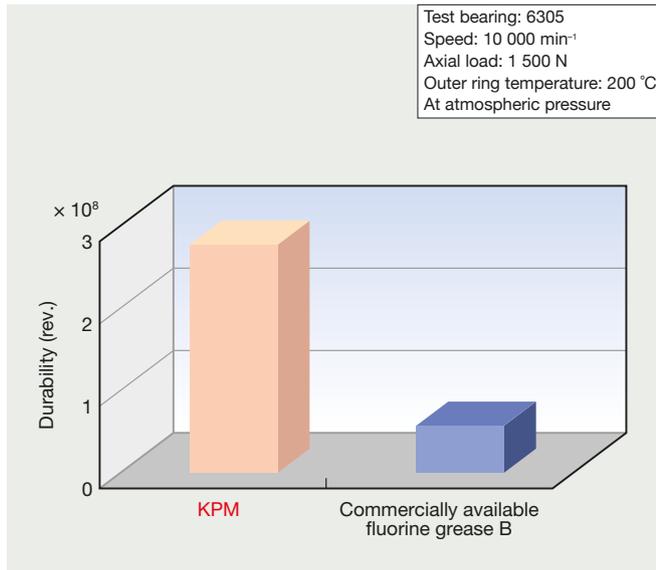
● **Properties of grease**

Name	NSK high-temperature KPM grease	Commercially available fluorine grease B
Base oil	Fluorine oil	Fluorine oil
Thickener	PTFE	PTFE
Kinematic viscosity (mm ² /s, 40 °C)	420	390
Consistency	290	280
Maximum operating temperature (°C)	230	230

KPM: NSK-developed grease for use at atmospheric pressure only

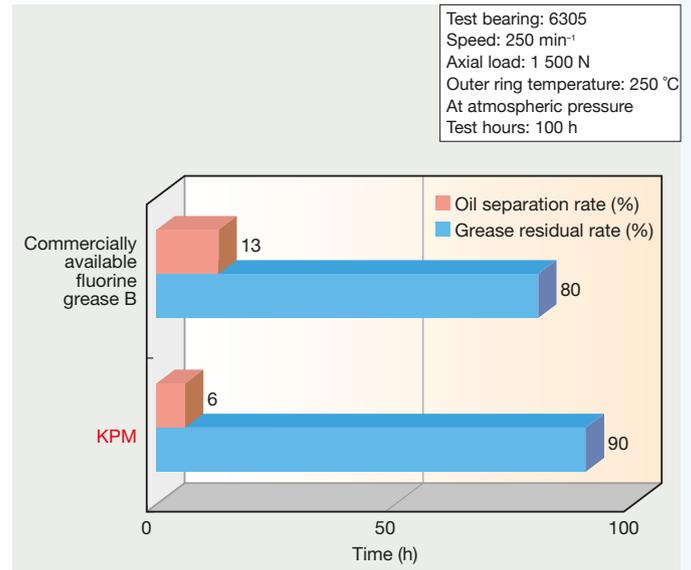
● **Durability**

KPM's operating life is approximately five times longer than commercially available fluorine greases.



● **Oil separation and grease residual rates**

KPM is highly heat resistant, with lower oil separation rates at higher temperatures than commercially available fluorine greases.

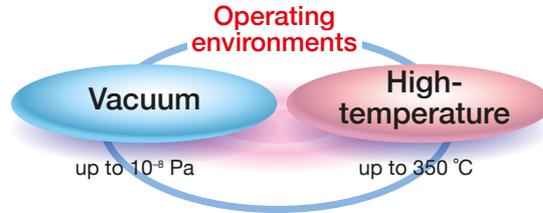


14. YS Bearings With Spacer Joints

Page A25

Dimensions, accuracy and availability of bearings.

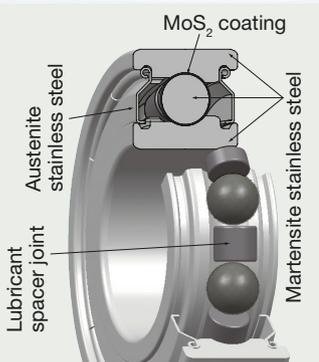
YS bearings with spacer joints are made of an alloy-based self-lubricating material (sintered alloy) between balls. They are suitable for high-temperature and vacuum environments.



Product Specifications



Representative Structure

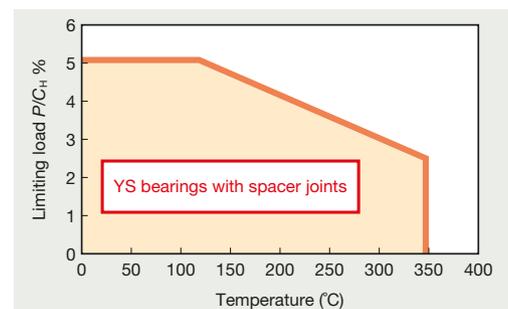


Structure		Shielded
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel and MoS ₂ coating
	Cage	Lubricating spacer joints (sintered alloy)
	Lubricant	MoS ₂ solid lubricant
	Shields	Austenite stainless steel

Applications: Ion implantation equipment, sputtering equipment, vacuum vapor deposition equipment

Operating Instructions and Notes

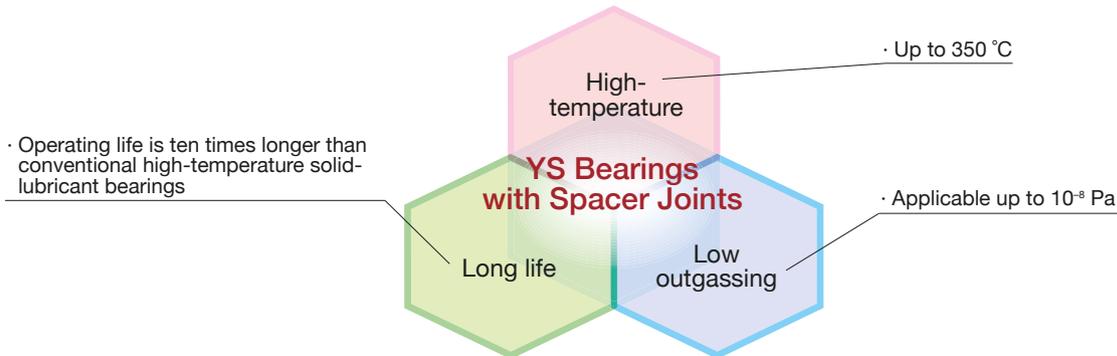
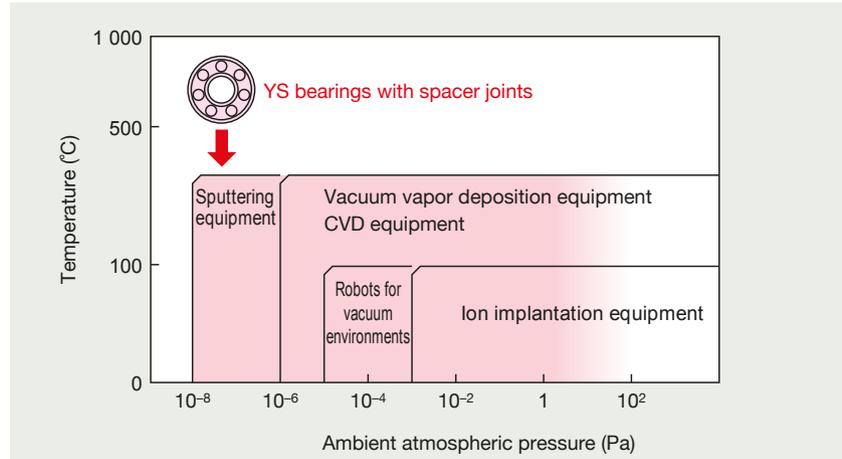
- For use in vacuum environments.
- Restrictions apply to bearings mounted to a vertical shaft due to a notch in the outer and inner rings. (Refer to the bearing manual)
- Keep bearings packed until immediately before mounting.
- Avoid storing the bearing for a long amount of time.
- Avoid exposure to any oil or moisture.
- The scope of application (limiting load, temperature) is listed in the table to the right.
- See the tables on Page A25 for limiting loads and limiting rotational speeds.
- Ensure an optimum radial internal clearance for maximum rotational performance by applying a fit to the bearing that considers bearing load, operating temperatures, materials of the shaft and/or housing (due to coefficient of linear expansion), etc.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.



Features

- Grease-free, MoS₂ solid lubrication
- Usable in vacuum up to 10⁻⁸ Pa and temperatures up to 350 °C
- Operating life is 10 times longer than conventional high-temperature solid-lubricant bearings

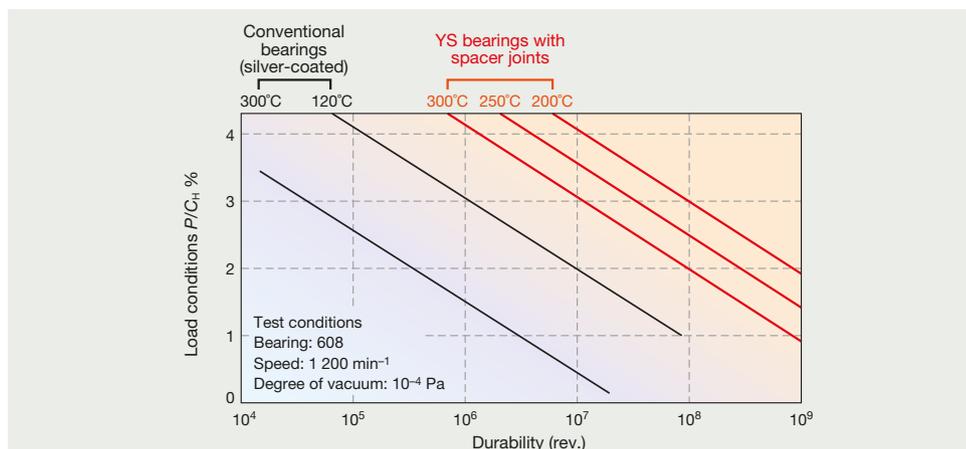
● **Bearing applications**



Performance

● **Durability**

Over ten times more durable than conventional high-temperature solid-lubricant bearings.



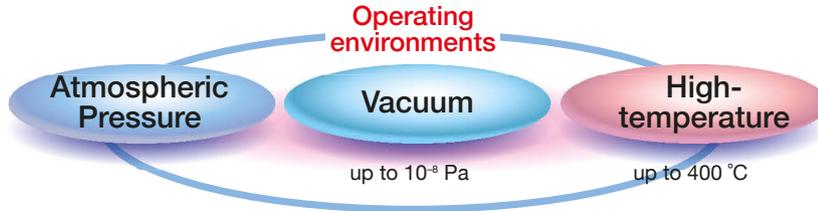
Bearings
YS Bearings with Spacer Joints

15. SJ Bearings

Page A26

Dimensions, accuracy and availability of bearings.

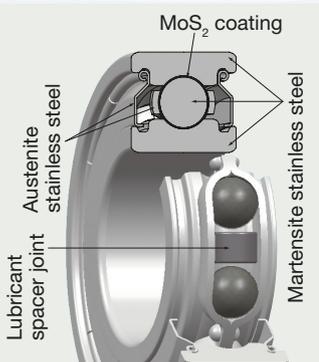
SJ bearings have a “peapod” structure, with solid lubricant spacer joints mounted between two balls in cage pockets. These bearings are suitable for high-temperature environments at atmospheric pressure up to vacuum.



Product Specifications



Representative Structure

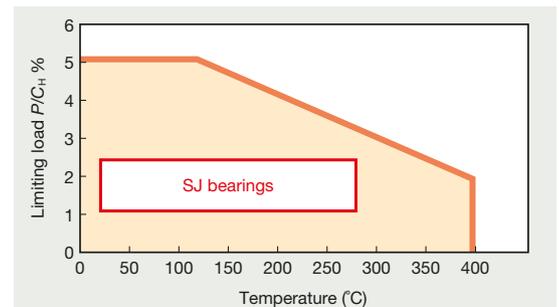


Structure		Shielded
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel and MoS ₂ coating
	Cage	Stainless steel and lubricating spacer joints (sintered alloy)
	Lubricant	MoS ₂ solid lubricant
	Shields	Austenite stainless steel

Applications: Vacuum vapor deposition equipment, kilns, kiln cars, steel plants, high-temperature conveyance equipment

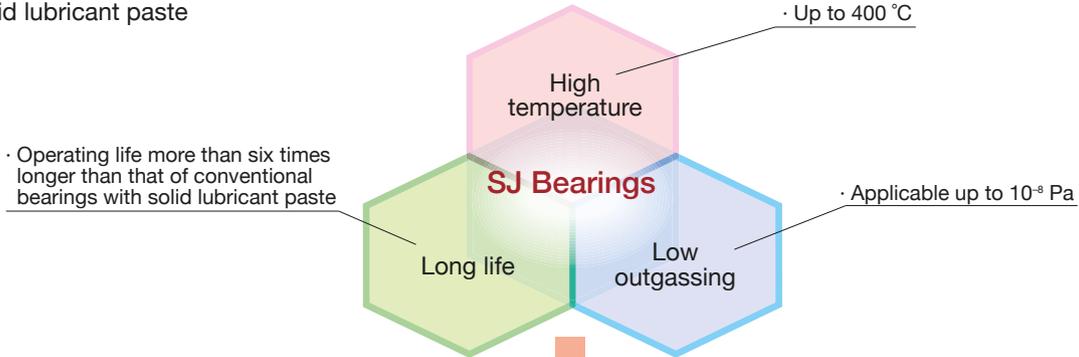
Operating Instructions and Notes

- Do not use this bearing in an environment with excessive moisture or humidity.
- Keep bearings packed until immediately before mounting.
- Avoid storing the bearing for a long amount of time.
- Avoid exposure to any oil or moisture before use.
- The scope of application (limiting load, temperature) is listed in the table to the right.
- See the tables on Page A26 for limiting loads and limiting rotational speeds.
- Ensure an optimum radial internal clearance for maximum rotational performance by applying a fit to the bearing that considers bearing load, operating temperatures, materials of the shaft and/or housing (due to coefficient of linear expansion), etc.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.



Features

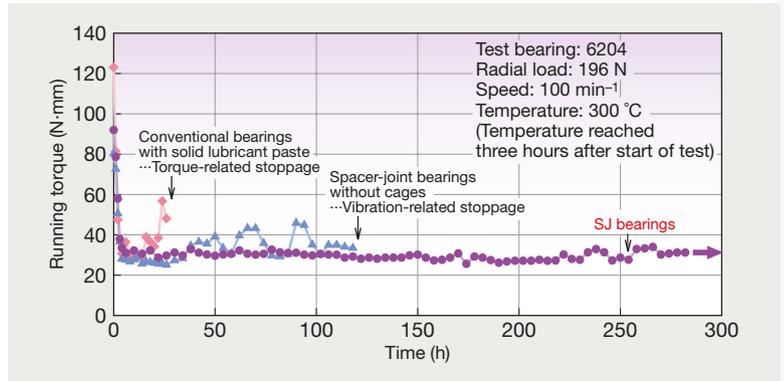
- Grease-free, MoS₂ solid lubricant
- Applicable from atmospheric pressure up to vacuums at 10⁻⁸ Pa and temperatures up to 400 °C
- “Peapod” structure provides excellent torque stability and long life
- Over six times more durable than conventional high-temperature bearings with solid lubricant paste



Performance

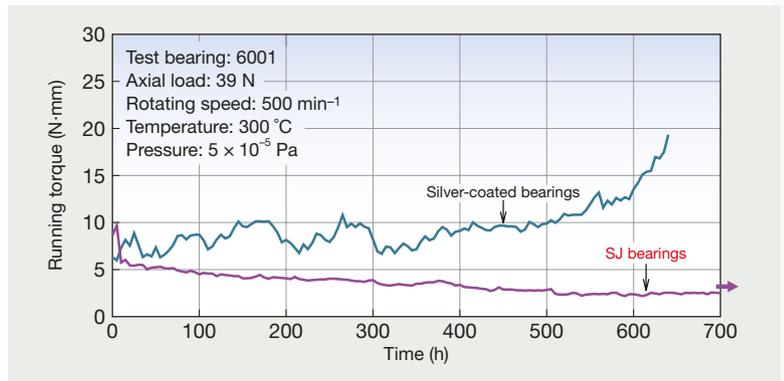
● Durability

More than six times more durable than bearings with conventional solid lubricant paste, and more than twice as durable as conventional cageless bearings with spacer joints.



● Durability of bearings in vacuum conditions

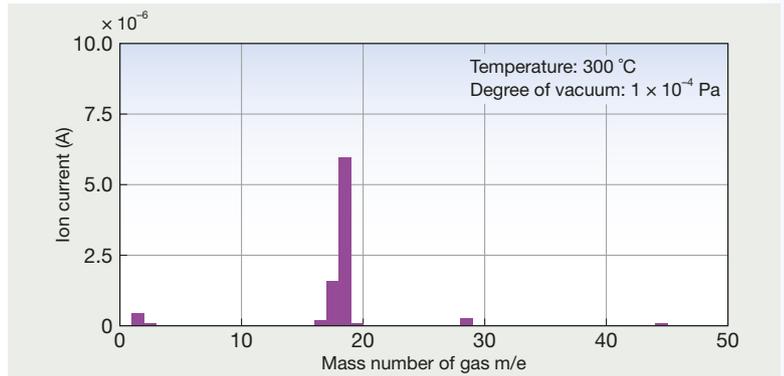
Outperforms silver-coated bearings in durability and torque stability.



● Outgassing in vacuum conditions

No outgassing from chemical decomposition of the solid lubricant in spacer joints was seen in a high-temperature, vacuum environment.

Thus, pollution is not a concern with SJ bearings.



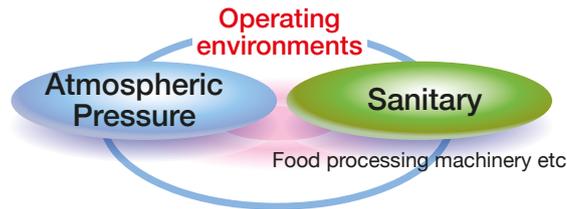
16. Food Grade Grease-Packed Bearings

Pages A27–A28

Dimensions, accuracy and availability of bearings.

These stainless steel bearings employ food-grade NSF*-registered grease for improved safety and are suitable for food processing machinery and pharmaceutical manufacturing equipment.

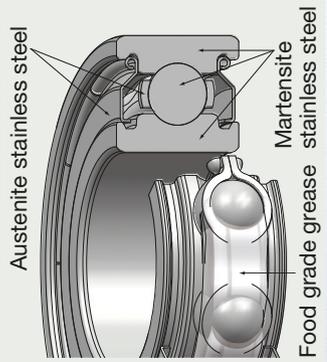
*NSF (International) : U.S. non-profit third party accreditation organization that is internationally recognized in the field of public safety and health.



Product Specifications



Representative Structure



Structure		Shielded, Sealed
Specifications	Outer/Inner rings	Martensite stainless steel
	Balls	Martensite stainless steel
	Cage	Stainless steel
	Lubricant	Food grade grease
	Seals/Shields	Nitrile rubber/Austenite stainless steel

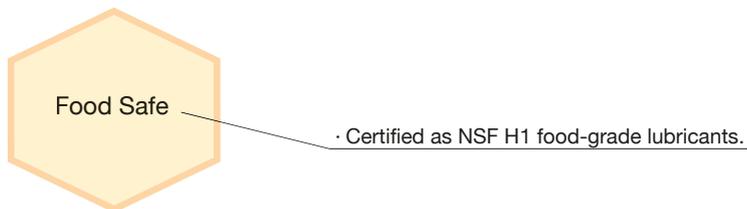
Applications: Food processing machinery, pharmaceutical manufacturing equipment

Operating Instructions and Notes

- Keep bearings packed until immediately before mounting.
- See the tables on Pages A27 and A28 for limiting loads and limiting rotational speeds.
- The grease is safe for incidental food contact only. Do not eat the grease.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

Features

- RLS grease is usable at temperatures up to 120 °C while BL2 grease is usable up to 200 °C.
- Both RLS and BL2 grease meet Halal and Kosher dietary laws.



NSF Lubricant Categories

Safety Level



High H1: Usable where incidental food contact is possible

Low H2: Usable where there is no possibility of food contact

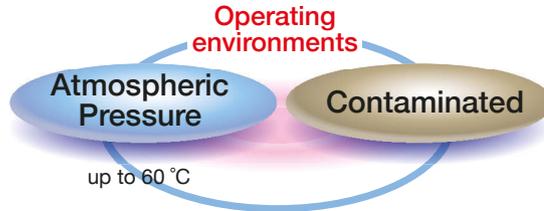
Performance

● Properties of grease

Name	RLS	BL2 for high temperatures
NSF category	H1	H1
Base oil	Synthetic hydrocarbon oil	Fluorine oil
Thickener	Aluminum alloy soap	PTFE
Kinematic viscosity (mm ² /s, 40 °C)	150	415
Consistency	280	280
Water wash-out	7.6%	0.1%
Operating temperature	0 – 120 °C	0 – 200 °C

17. Molded-Oil™ Bearings (For Contaminated Environments)

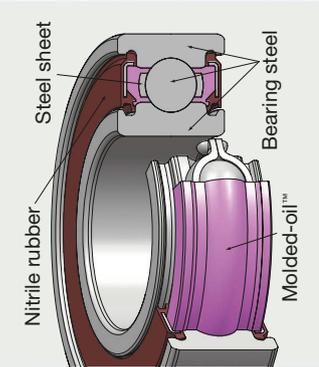
Molded-Oil™ bearings feature a special material that provides a continuous supply of lubricating oil, allowing them to stand up to dust-contaminated environments at atmospheric pressure.



Product Specifications



Representative Structure



	Structure	Sealed Type
Specifications	Outer/Inner rings	Bearing steel
	Balls	Bearing steel
	Cage	Steel sheet
	Lubricant	Molded-oil™
	Seals	Nitrile rubber

Applications: Food processing equipment, agricultural machines, woodworking machines, various conveyor lines

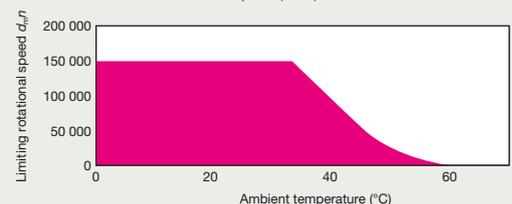
Operating Instructions and Notes

- For use in normal atmospheric conditions only.
- Because the solid lubricant used in these bearings will melt at a temperature of 120 °C, take care not to exceed temperatures of 100 °C when heating this bearing during the shrink-fit process for mounting.
- A radial load is required for the bearings to properly rotate. The minimum radial load to maintain proper rotation is at least 1 % of the basic dynamic load rating.
- Keep bearings packed until immediately before mounting.
- See the “4. Molded-Oil™ Bearings (Stainless Steel)” on Pages A33 and A34 for applications requiring corrosion resistance.
- The scope of application (applied load, limiting $d_m n$ value) is listed in the table to the right.
- Avoid exposure to organic solvents with a degreasing effect.
- Bearings may not be usable in certain corrosive environments or conditions.
- All comments referencing certain values or performance in this catalog are for reference only. NSK provides this guide “as is” without express or implied warranties of any kind.

The scope of Molded-Oil™ bearings

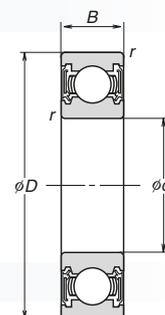
Applied load	Between 1% and 5% of the stainless steel bearing dynamic load rating C_H <At least 1% of C_H must be applied.>
Limiting rotational speed, $d_m n^{(1)}$	150 000 Refer to the chart below for temperatures above 35 °C

Note (1) $d_m n$ = (Bearing bore diameter + bearing outer diameter (mm))
÷ 2 × Rotational speed (min⁻¹)



Features

- Continuous controlled flow of oil from Molded-Oil™ inside the bearing provides sufficient lubrication
- No grease or oil filling keeps operating environments clean
- Operating life in dust-contaminated environments is more than twice that with grease
- Comes standard with a contact seal (See table below).



Rubber Sealed Type (example)

Table of Dimensions and Availability (Contact-Seal Type)

● Inquiry designation⁽¹⁾ □□□□ L11DDU

Boundary dimensions				Basic designation	Availability	Limiting speed ⁽²⁾ (reference value) (min ⁻¹)	Applied load ⁽³⁾ (reference value) (N)	
Bore diameter <i>d</i> (mm)	Outside diameter <i>D</i> (mm)	Width <i>B</i> (mm)	Chamfer dimension (min.) <i>r</i> (mm)					
10	22	6	0.3	6900	●	9 370	25	– 110
	26	8	0.3	6000	●	8 330	40	– 190
	30	9	0.6	6200	●	7 500	45	– 210
12	24	6	0.3	6901	●	8 330	25	– 120
	28	8	0.3	6001	●	7 500	45	– 210
	32	10	0.6	6201	●	6 810	60	– 290
15	28	7	0.3	6902	●	6 970	40	– 180
	32	9	0.3	6002	●	6 380	50	– 230
	35	11	0.6	6202	●	6 000	65	– 320
17	35	10	0.3	6003	●	5 760	55	– 250
	40	12	0.6	6203	●	5 260	85	– 400
20	42	12	0.6	6004	●	4 830	80	– 390
	47	14	1	6204	●	4 470	110	– 540
25	47	12	0.6	6005	●	4 160	90	– 420
	52	15	1	6205	●	3 890	120	– 590
	62	17	1.1	6305	●	3 440	180	– 870
30	55	13	1	6006	●	3 520	120	– 560
	62	16	1	6206	●	3 260	170	– 820
	72	19	1.1	6306	●	2 940	230	– 1 130
35	62	14	1	6007	●	3 090	140	– 680
	72	17	1.1	6207	●	2 800	220	– 1 090
	80	21	1.5	6307	●	2 600	290	– 1 410
40	68	15	1	6008	●	2 770	150	– 710
	80	18	1.1	6208	●	2 500	250	– 1 240
	90	23	1.5	6308	●	2 300	350	– 1 720
45	75	16	1	6009	●	2 500	180	– 890
	85	19	1.1	6209	●	2 300	270	– 1 330
	100	25	1.5	9309	●	2 060	450	– 2 250
50	80	16	1	6010	●	2 300	190	– 920
	90	20	1.1	6210	●	2 140	300	– 1 490
	110	27	2	6310	●	1 870	520	– 2 600

Mark: ● Stocked as standard inventory.⁽⁴⁾

Notes (1) The actual designation may differ from the inquiry designation. □□□□ indicates the basic designation.

(2) The limiting speed of these bearings has been calculated for 25 °C operating conditions. Limiting speeds will be slower for operating conditions of 35 °C or higher. (Refer to the previous page for further details.)

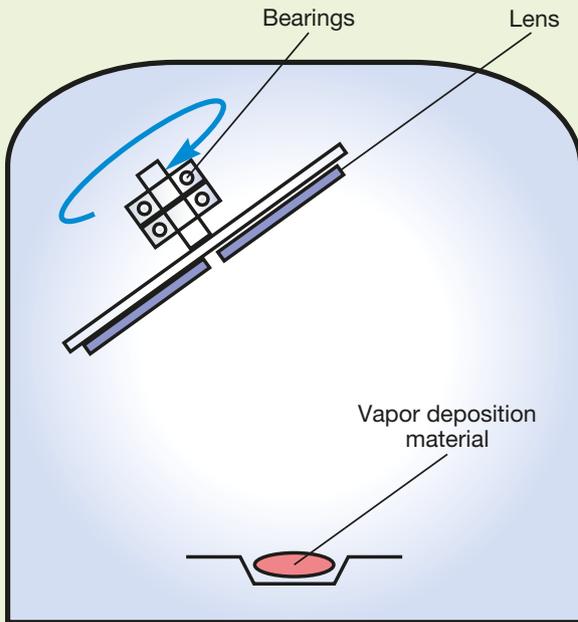
(3) Applied load values are for reference only; they are not guaranteed.

(4) Orders for standard inventory may be delayed, particularly if shipped from Japan.

Remarks 1. The radial internal clearance for the bearings on this page is CN. See the radial internal clearance tables on Page A10 for further details.
2. Rubber sealed bearings are standard.

E Applications of SPACEA™ Series Bearings

Vacuum Vapor Deposition Equipment



Operating Conditions

Vacuum/High temperature environments

- Degree of vacuum: 10^{-4} Pa
- Temperature: 200 to 300 °C
- Speed: Up to 100 min⁻¹
- Load: Up to 50 N

Conventional bearings

- Silver-coated bearing (6002, 6004, etc.)
- Operating life: 2 to 3 months

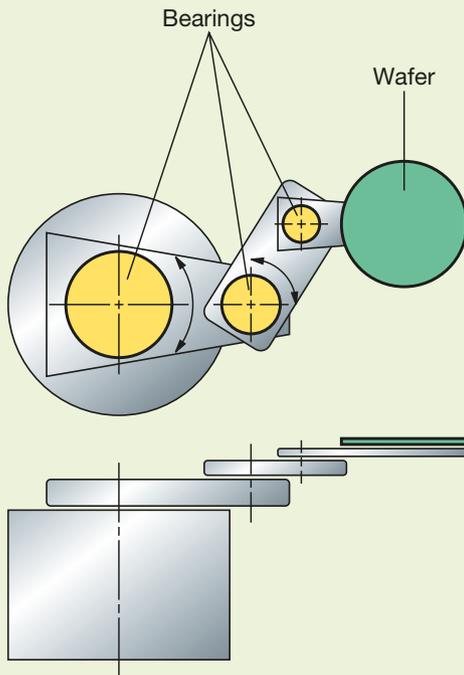


NSK SPACEA™ Series

YS Bearings with Spacer Joints

- Operating life: More than 1 year

Robots for Vacuum Environments



Operating Conditions

Vacuum/Cleanroom environments

- Degree of vacuum: 10^{-4} Pa
- Temperature: Up to 120 °C
- Speed: Low-speed swing
- Load: Moment load

Conventional bearings

- Thin-walled bearing
Inner/Outer rings: Stainless steel
Balls: Special glass balls
- Operating life: 2 to 3 months



NSK SPACEA™ Series

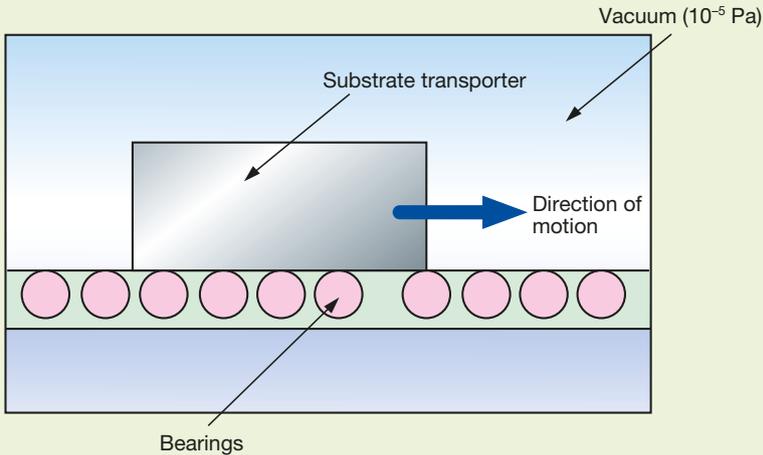
N Series Thin-section Bearings

(NBA2504, NBX15206, etc.)

Inner/Outer rings: Stainless steel
Balls: Ceramics

- Operating life: More than 1 year

Sputtering Equipment



Operating Conditions

Vacuum/Cleanroom environments

- Degree of vacuum: 10^{-5} Pa
- Temperature: Up to 150 °C, inclusive
- Speed: Up to 500 min⁻¹
- Load: Up to 50 N

Conventional bearings

- Fluoresin coated bearing (bore diameter: 3/8")
- Operating life: 3 months

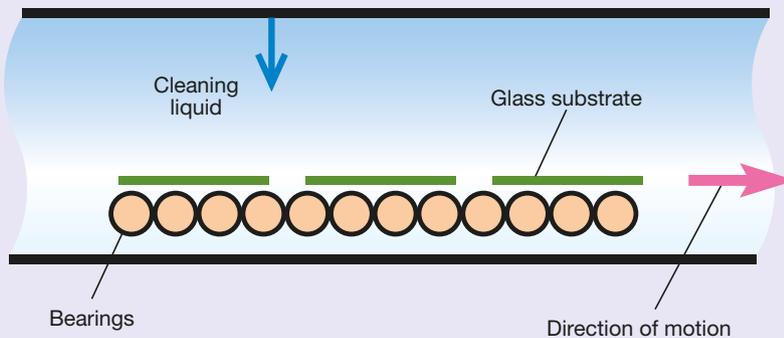


NSK SPACEA™ Series

V-DFO Bearings

- Operating life: 6 months

Liquid Crystal Cleaning Equipment



Operating Conditions

Corrosive environments

- Cleaning liquid-spray environments
- Speed: Up to 50 min⁻¹
- Load: Light load

Conventional bearings

- Plain resin bearing
- Operating life: 2 to 3 months



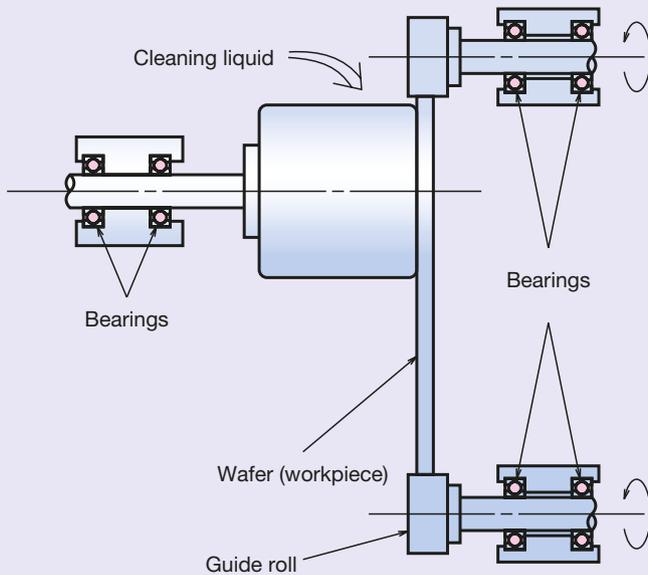
NSK SPACEA™ Series

Aqua-Bearing™

- Operating life: More than 1 year

E Applications of SPACEA™ Series Bearings

Silicon Wafer Cleaning Equipment



Operating Conditions

Corrosive environments

- Cleaning liquid-spray environments
- Speed: Up to 100 min⁻¹
- Load: Up to 50 N

Conventional bearings

- Stainless steel bearing (degreased products 6000, 6001, 6901, etc.)
- Operating life: 2 weeks to 1 month

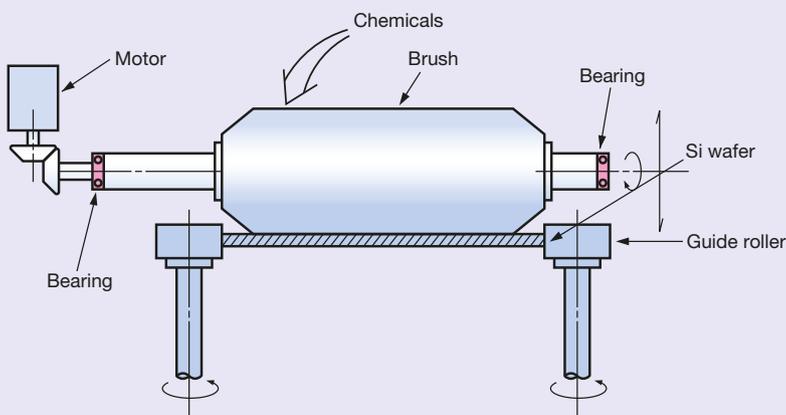


NSK SPACEA™ Series

Hybrid Bearings

- Operating life: 2 to 3 months

Wafer Polishing Equipment (CMP Equipment)



Operating Conditions

Corrosive environments

- Cleaning liquid-spray environments
- Speed: Up to 30 min⁻¹
- Load: Light load

Conventional bearings

- Stainless steel bearing (6001, 6800, etc.)
- Operating life: 2 weeks to 1 month

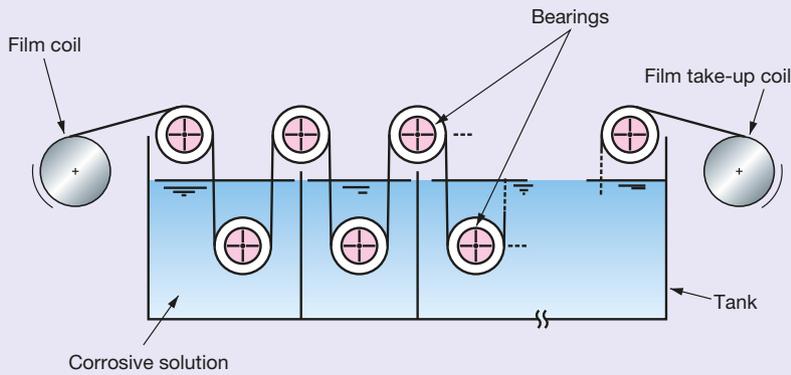


NSK SPACEA™ Series

All-Ceramic Bearings

- Operating life: More than 1 year

Cleaning Device



Operating Conditions

Corrosive environments

- Strong acid solution
- Speed: Up to 100 min⁻¹
- Load: Up to 100 N
- Temperature: Up to 80 °C

Conventional bearings

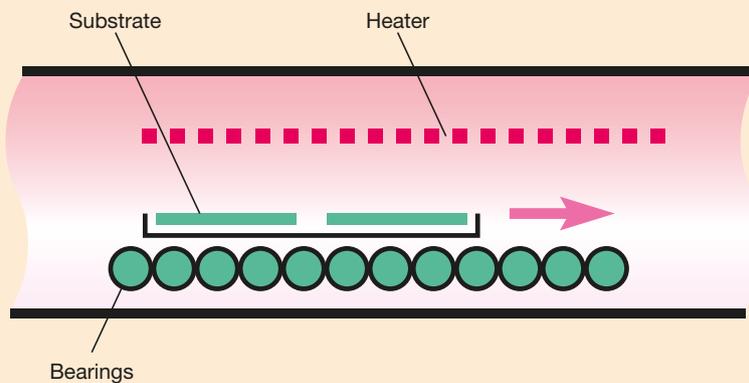
- All-ceramic bearing (silicon nitride 6204, 6206, etc.)
- Operating life: More than 1 year

NSK SPACEA™ Series

All-Ceramic Bearings

- Operating life: More than 3 years

Furnace Conveyor



Operating Conditions

High-temperature environments

- At atmospheric pressure
- Temperature: Up to 400 °C
- Speed: Up to 100 min⁻¹

Conventional bearings

- Stainless steel bearing (degreased products 6204, 6205, etc.)
- Operating life: 1 month

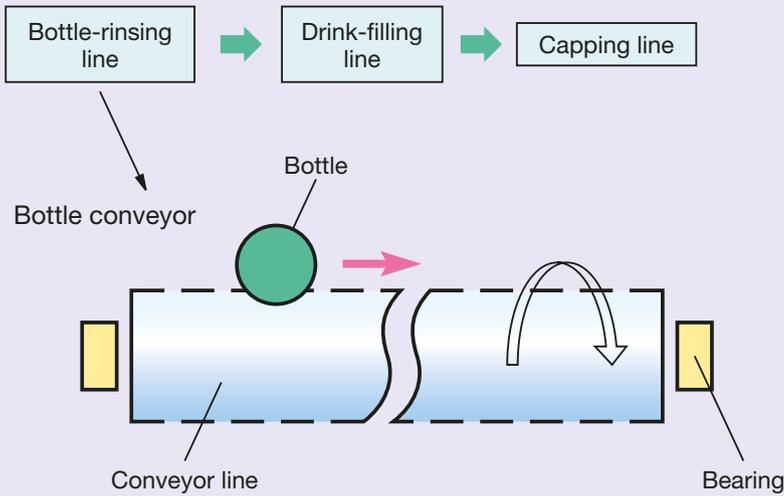
NSK SPACEA™ Series

SJ Bearings

- Operating life: More than 1 year

E Applications of SPACEA™ Series Bearings

Aseptic Filling Equipment for Soft Drinks



Operating Conditions

Corrosive environments

- Corrosive liquid-spray (for sterilization and rinsing)
- Speed: Up to 300 min⁻¹
- Load: Up to 50 N
- Temperature: Up to 80 °C

Conventional bearings

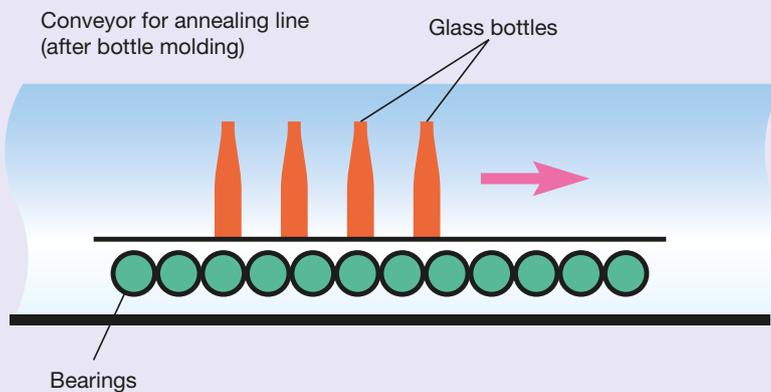
- Stainless steel bearing (6205, 6212, 6306, etc.)
- Operating life: Several months

NSK SPACEA™ Series

Corrosion-Resistant Coated Bearings

- Operating life: More than 1 year

Conveyor for Glass-Bottle Production Machine



Operating Conditions

High-temperature/Corrosive environments

- Corrosive gas atmosphere
- Temperature: Up to 200 °C
- Speed: Up to 100 min⁻¹

Conventional bearings

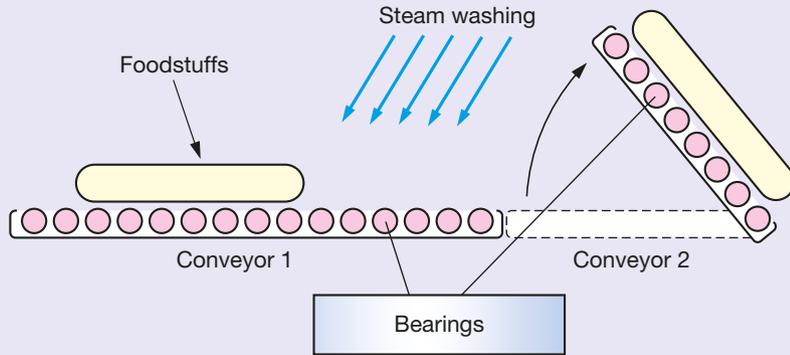
- High-temperature grease-packed stainless steel bearing (6005, 6306, etc.)
- Operating life: Several months

NSK SPACEA™ Series

Corrosion-Resistant Coated Bearings

- Operating life: More than 1 year

Raw Material Preparation Device



Operating Conditions

Corrosive environments

- Water spray, steam
- Speed: Up to 1 000 min⁻¹
- Temperature: Up to 80 °C

Conventional bearings

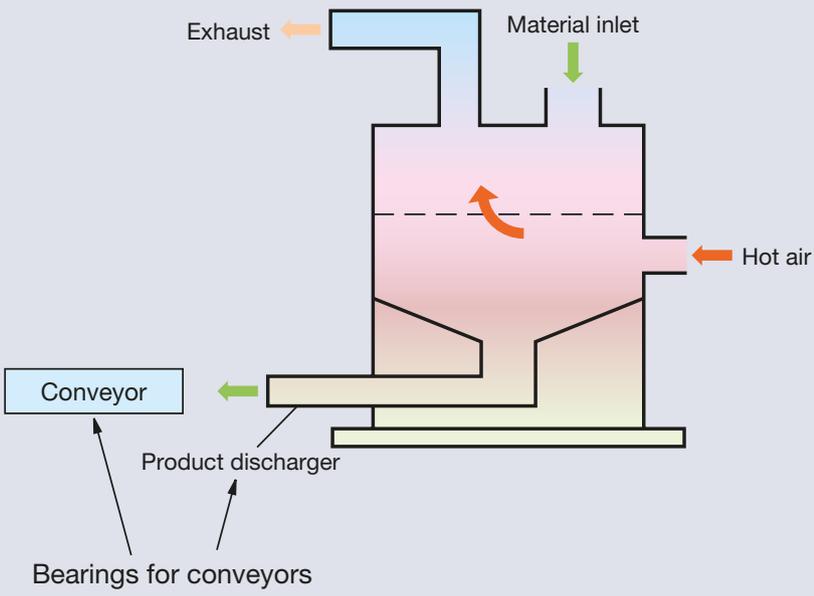
- Grease-packed stainless steel bearing

NSK SPACEA™ Series

Hybrid Bearings

- Operating life: More than five times longer than conventional bearings

Grain Dryer



Operating Conditions

Contaminated environments

- Chaff, powder, and dust
- Temperature: Up to 60 °C
- Speed: Up to 100 min⁻¹

Conventional bearings

- Stainless steel bearing (696, 6800, etc.)
- Operating life: Approx. 2 months

NSK SPACEA™ Series

Molded-Oil™ Bearings

- Operating life: More than 1 year

SPACEA™ Series Precision Machine Components: Trusted Solutions for Special Environments

SPACEA™ Series ball screws and NSK Linear Guides utilize NSK's state-of-the-art technologies to deliver excellent performance, even in severe operating conditions.

Please see Pages B5-B6 for recommended products for specific applications.



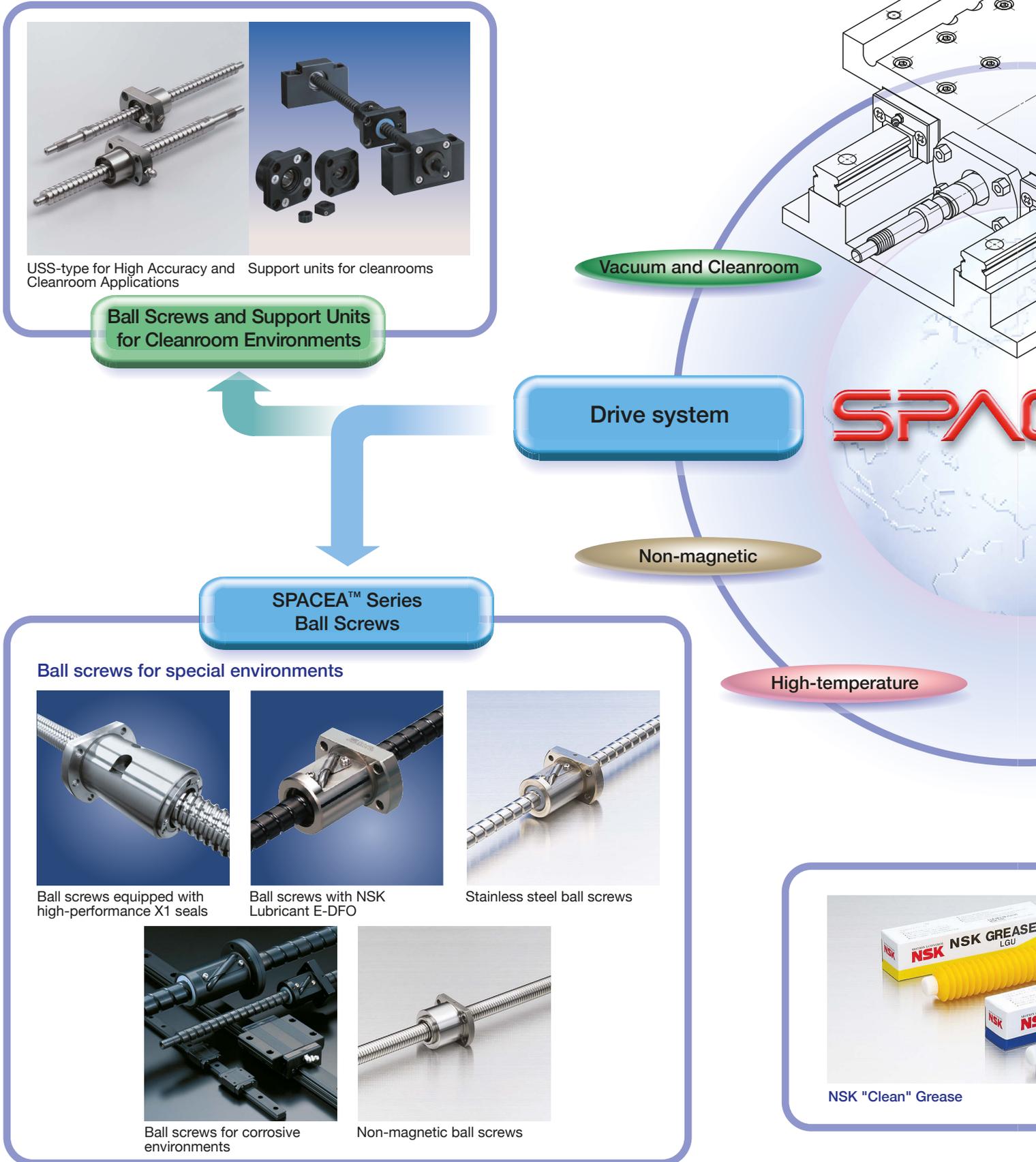
● SPACEA™ Series Ball Screws and NSK Linear Guides ●

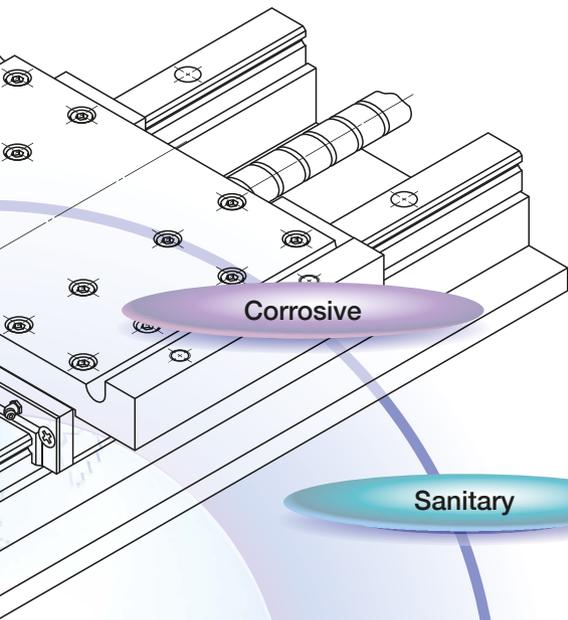
A	Inventory	B3–B4
B	Selection Guide	B5–B6
C	Types and Specifications	B7–B8
D	Dimensions and Availability	B9–B12
	1. Ball Screws	
	2. Support Units for Cleanrooms	
	3. NSK Linear Guides	
E	Specifications, Operating Instructions, and Technical Data	B13–B32
	1. Corrosion-Resistant Ball Screws and NSK Linear Guides (Fluoride Low-Temperature Chrome Plating).....	B13–B14
	2. LG2/LGU "Clean" Greases	B15–B16
	3. NSK Lubricant E-DFO.....	B17–B18
	4. Compact FA-USS Model: High-Accuracy type for Cleanrooms	B19–B20
	5. Support Units for Cleanroom Environments.....	B21–B22
	6. NSK K1™/NSK K1-L™ Lubrication Unit	B23–B26
	7. NSK High-Performance Seals	B27–B30
	8. Ball Screws and NSK Linear Guides for High-Temperature Environments	B31–B32
F	Applications for SPACEA™ Series Ball Screws and NSK Linear Guides	B33–B34
	1. Semiconductor Manufacturing Equipment/Flat Panel Display Manufacturing Equipment	

A SPACEA™ Series Ball Screws and NSK Linear

Product lineup by operating environment

NSK's SPACEA™ Series ball screws and NSK linear guides are the optimal components for linear drive mechanisms in demanding operating environments, such as semiconductor/FPD/hard disk production machinery, food processing machinery, medicine/cosmetic production machinery, and ceramics/chemical/optical equipment.





Corrosive



Sanitary



Linear guide system

Ball screws and linear guides for special environments



Maintenance-Free Ball Screws and NSK Linear Guides

SPACEA™ Series
NSK Linear Guides

Linear guides for special environments



Linear guides equipped with high-performance seals



Linear guides with NSK Lubricant E-DFO



Stainless steel linear guides



Linear guides for corrosive environments



Linear guides for food processing



Linear guides for high temperatures



B SPACEA™ Series Ball Screws and NSK



Select the most appropriate product with the following flow chart.



① Operating environment			Product name		Degree of vacuum Pa				
					Atmospheric pressure	10 ⁻⁴ ≤	10 ⁻⁸ ≤		
Vacuum and cleanroom	Cleanroom	Atmospheric pressure (room temperature)	LG2 grease-packed ball screws and linear guides	(Standard grease) (Standard seal)	●				
			LGU grease-packed ball screws and linear guides						
	Vacuum	From atmospheric pressure up to vacuum (room temperature)	Fluorine grease-packed ball screws and linear guides	(Fluorine grease) (Corrosion-Resistant seal)	●	See the scope of applications for			
		From atmospheric pressure up to vacuum (up to 150 °C)	Ball screws and linear guides with NSK Lubricant E-DFO			See the scope of applications			
Non-magnetic	Non-magnetic (relative permeability 1.01 or less) (from atmospheric pressure up to vacuum)		Non-magnetic stainless steel ball screws and linear guides			10 ⁻⁵ Pa			
Corrosive	Water	Water vapor, high-humidity environments	Ball screws and linear guides for corrosive environments	(Standard grease) (Standard seal)	●				
		Water-immersed, water-spray	Ball screws and linear guides for corrosive environments						
	Weak acid, weak alkali Strong acid, strong alkali		Corrosion-Resistant coated ball screws and linear guides	(Fluorine grease) (Corrosion-Resistant seal)	●				
		Stainless steel ball screws and linear guides							
Sanitary	Food processing environments		Ball screws and linear guides for food processing		●				
Contaminated	Dust or wood chips		Ball screws equipped with high-performance X1 seal Linear guides equipped with high-performance seal		●				
High-temperature	Atmospheric pressure (up to 150 °C)		Ball screws and linear guides for high-temperature environments		●				
Non-magnetic	From atmospheric pressure up to vacuum		Non-magnetic stainless steel ball screws and linear guides			10 ⁻⁵ Pa			

(1) Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes).

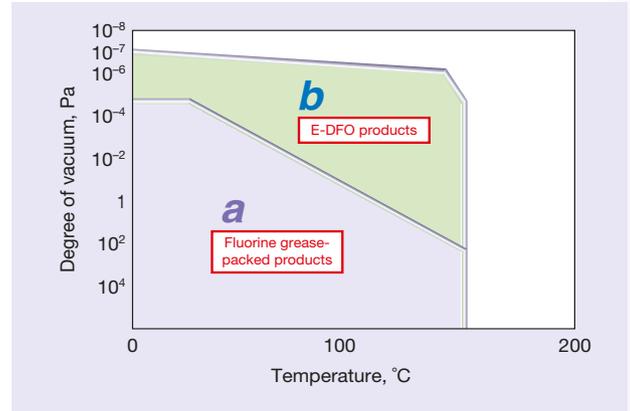
Cleanliness may vary depending on the usage conditions and surrounding structure.

(2) $d \cdot n$ = Shaft diameter of ball screws (mm) × rotational speed (min⁻¹)

③ Select the product most appropriate in terms of availability and price.

④ Check the operating instructions and notes.

● Scope of applications for fluorine grease-packed products and E-DFO products



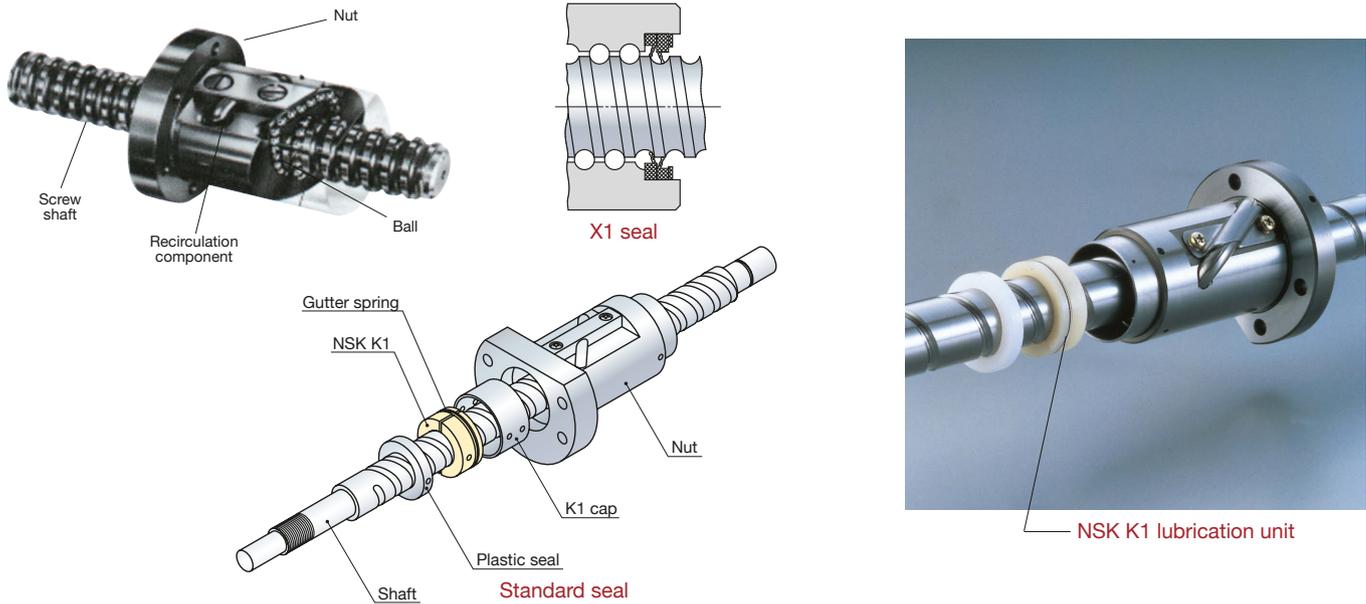
② Operating conditions													③ Price comparison	③ Dimensions (availability)	④ Specifications · Operating instructions · Technical data	
Temperature °C			Cleanliness ⁽¹⁾ (ISO/US Fed. Std. Class)			Limiting rotational speed <i>d</i> - <i>n</i> value ⁽²⁾			Limiting speed of linear guide m/min							
≤100	≤200	≤300	Classes 5-6 (100-1000)	Class 5 (100)	Class 4 (10)	≤50 000	≤100 000	≤150 000	≤100	≤200	≤300					
≤70 °C			●			→ ≤70 000			→ ≤100				Low	Ball screws (B9)	B15-B16, B19-B20, B23-B25	
→ ≤120 °C			●			→ ≤70 000			→ ≤100				High			
fluorine grease-packed products (upper right) a			●			→ ≤70 000			→ ≤100				Low			B13-B14
for E-DFO products (upper right) b				●		→ ≤70 000			→ ≤100				High		B17-B18	
→ ≤150 °C						→ ≤70 000			→ ≤100				-			
→ ≤80 °C						→ ≤70 000			→ ≤100				Low		Support units (B10)	B13-B14, B23-B24
→ ≤80 °C						→ ≤70 000			→ ≤100				High			
→ ≤80 °C						→ ≤70 000			→ ≤100				Low		Linear guides (B11-B12)	B13-B14
→ ≤150 °C						→ ≤70 000			→ ≤100				High			
→ ≤80 °C						→ ≤70 000			→ ≤100				-			B25-B26
→ ≤80 °C						→ ≤70 000			→ ≤100				Low		B13-B14, B23-B24, B27-B30	
→ ≤150 °C						→ ≤70 000			→ ≤100				High			
→ ≤150 °C						→ ≤70 000			→ ≤100				-		B31-B32	
→ ≤150 °C						→ ≤70 000			→ ≤100				-		-	

Ball Screws/NSK Linear Guides

Selection Guide

Types and Specifications of SPACEA™ Ball

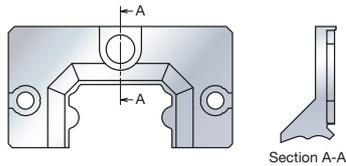
SPACEA™ Series Ball Screws



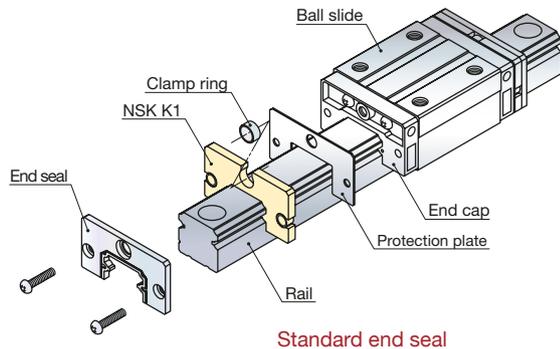
Operating environment			Product name	Ball screw specifications	Shaft, nut
				Linear guide specifications	Rail, ball slides
Vacuum and cleanroom	Cleanroom	Atmospheric pressure (room temperature)	LG2/LGU grease-packed ball screws and linear guides	Standard material	
	Vacuum	From atmospheric pressure up to vacuum (room temperature)	Fluorine grease-packed ball screws and linear guides	Martensite stainless steel	
		From atmospheric pressure up to vacuum (up to 150 °C)	Ball screws and linear guides with NSK Lubricant E-DFO		
Non-magnetic	From atmospheric pressure up to vacuum	Non-magnetic stainless steel ball screws and linear guides	Special austenite stainless steel		
Corrosive	Water	Water vapor, high-humidity environments	Corrosion-resistant coated ball screws and linear guides	Standard material	
		Water-immersed, water-spray	Stainless steel ball screws and linear guides	Martensite stainless steel	
	Weak acid, weak alkali Strong acid, strong alkali		Corrosion-resistant coated ball screws and linear guides	Standard material	
		Stainless steel ball screws and linear guides	Martensite stainless steel		
Sanitary	Food processing environments		Ball screws and linear guides for food processing	Martensite stainless steel	
Contaminated	Dust or wood chips		Ball screws equipped with high-performance X1 seal	Standard material	
			Linear guides equipped with high-performance seal		
High-temperature	Atmospheric pressure (up to 150 °C)		Ball screws and linear guides for high-temperature environments	Martensite stainless steel	
Non-magnetic	From atmospheric pressure up to vacuum		Non-magnetic stainless steel ball screws and linear guides	Special austenite stainless steel	

Note: Under radioactive operating conditions, resins used in standard products may cause distortion and lubricants may deteriorate. Please consult with NSK for appropriate product selection.

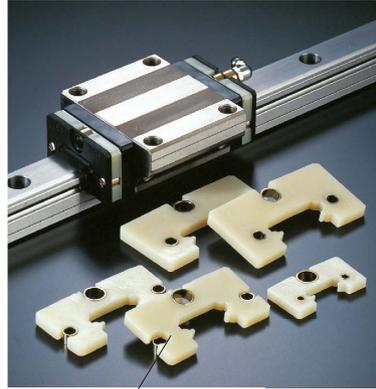
SPACEA™ Series NSK Linear Guides



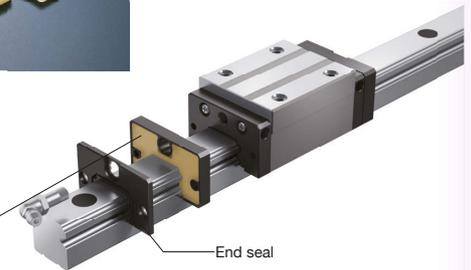
High-performance end seal



Standard end seal



NSK K1 Lubrication unit



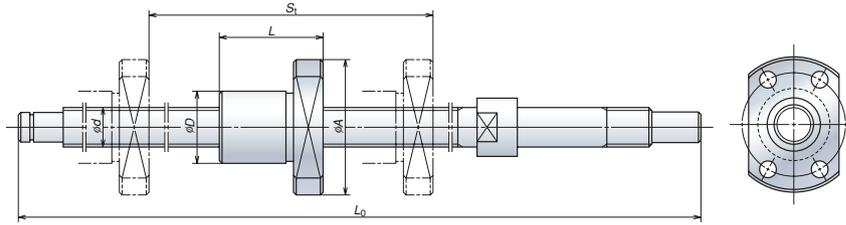
NSK K1-L Lubrication unit

Component specifications

Ball	Recirculation components	Seal	Corrosion-Resistant coating	Lubricant	Specifications · Operating instructions · Technical data
	End cap				
Standard material	Standard material	Standard seal	Fluoride Low-Temperature chrome plating	LG2 "Clean" grease, NSK K1/NSK K1-L	B15–B16, B19–B20, B23–B24
Martensite stainless steel	Austenite stainless steel			–	
		–	E-DFO (+ DLC) or Molybdenum disulfide	B17–B18	
Ceramics	Austenite stainless steel	Standard seal	–	Standard grease, Fluorine grease	–
Standard material	Standard material	Standard seal	Fluoride Low-Temperature chrome plating	Standard grease + NSK K1/NSK K1-L	B13–B14, B23–B24
Martensite stainless steel	Austenite stainless steel				
Standard material		Austenite stainless steel	(High dust-resistant seal)	–	Grease for food processing applications, NSK K1 for food processing applications and medical devices
Martensite stainless steel	Austenite stainless steel				
Standard material		Standard material	X1 seal	Fluoride Low-Temperature chrome plating	Standard grease + NSK K1/NSK K1-L
Martensite stainless steel	Austenite stainless steel	(High dust-resistant seal)	–	Heat-resistant grease, Fluorine grease	B31–B32
Ceramics	Austenite stainless steel	Standard seal	–	Standard grease, Fluorine grease	–

D Dimensions and Availability of SPACEA™

1. Ball Screw Dimensions



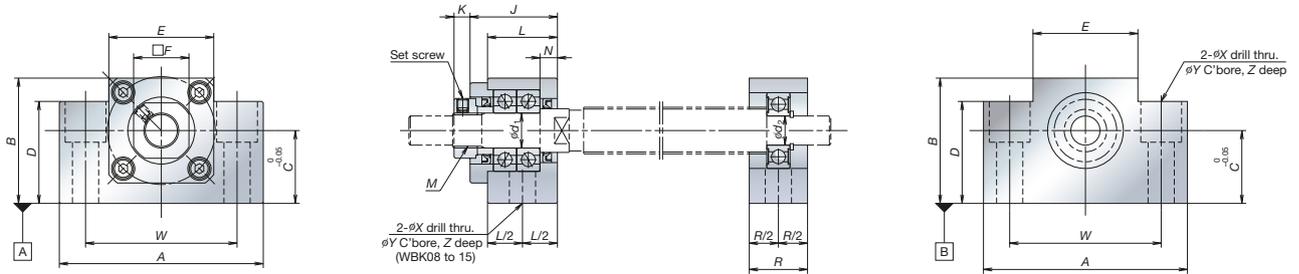
Model	Dimensions (mm)										Suitability for special environments (availability)					
	Shaft diameter	Lead	Effective turns of balls	Number of starts	Nut outer diameter	Flange outer diameter	Nut length	Maximum shaft length	Stroke	Dynamic load rating (N)	Cleanroom	Vacuum	Corrosive	Sanitary	Contaminated	High-temperature
	<i>d</i>				<i>D</i>	<i>A</i>	<i>L</i>	<i>L</i> _{max}	<i>S</i> ₁	(N)						
KA	6	1	1×3	1	12	24	21	174	100	555	<input type="checkbox"/>		<input type="checkbox"/>			
	8	1	1×3	1	14	27	21	248	150	645	<input type="checkbox"/>		<input type="checkbox"/>			
		2	1×3	1	16	29	28	248	150	1 270	<input type="checkbox"/>		<input type="checkbox"/>			
	10	2	1×3	1	18	35	29	308	200	1 470	<input type="checkbox"/>		<input type="checkbox"/>			
		4	2.5×1	1	26	46	34	430	300	2 630	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	12	2	1×3	1	20	37	29	380	250	1 600	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
		5	2.5×1	1	30	50	40	580	450	3 590	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
		10	2.5×1	1	30	50	50	580	450	3 620	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	15	10	2.5×1	1	34	57	51	1 161	1 000	6 660	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
		20	1.7×1	1	34	55	45	1 161	1 000	4 630	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
16	2	1×4	1	25	44	40	461	300	3 400	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>			
20	20	1.5×1	1	46	74	63	1 208	1 000	6 700	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>			
CS	10	5	2.7×1	1	23	43	29	521	433	3 420	<input type="checkbox"/>					
	12				24	44	30	621	530	3 750	<input type="checkbox"/>					
	15				28	51	30	761	653	6 410	<input type="checkbox"/>					
Production on demand	10	2	1×3	1	22	39	29	308		1 470	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		4	2.5×1	1	26	46	34	430		2 630	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	12	2	1×3	1	24	41	29	380		1 600	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		5	2.5×1	1	30	50	40	580		3 590	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		10	2.5×1	1	30	50	50	580		3 620	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	15	10	2.5×1	1	34	57	51	1 161		6 660	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		20	1.7×1	1	34	55	45	1 161		4 630	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	16	2	1×4	1	30	49	40	461		3 400	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	20	20	1.5×1	1	46	74	63	1 208		6 700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	25	5	2.5×2	1	50	73	55	1 800		16 000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		25	1.5×1	1	44	71	90	1 800		9 610	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	32	5	2.5×2	1	58	85	106	2 400		17 800	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		10	2.5×2	1	74	108	125	2 400		44 500	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		20	2.5×1	1	78	105	107	2 400		16 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		25	2.5×1	1	78	105	120	2 400		16 700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		32	1.5×1	1	51	85	109	2 400		10 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	40	32	1.7×2	2	56	86	109	2 800		32 100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		25	2.5×1	1	100	133	136	3 000		27 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		32	1.5×2	2	100	133	122	3 000		32 100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		40	1.5×1	1	64	106	133	3 000		17 400	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		10	2.5×2	1	82	124	173	2 900		61 200	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		12	2.5×2	1	86	128	197	2 900		71 700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		16	3.7×1	1	86	128	172	2 900		66 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	20	2.7×2	2	86	128	164	2 900		77 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
	45	8	2.5×4	1	82	120	162	3 300		65 300	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		10	2.5×2	1	88	132	117	3 300		53 800	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		8	2.5×2	1	82	124	146	2 900		44 000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		16	3.7×1	1	92	134	173	2 900		69 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	50	20	2.7×2	2	92	134	164	2 900		83 200	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
		8	2.5×4	1	90	129	149	3 500		67 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
10		2.5×4	1	93	135	163	3 500		101 000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
25		2.5×1	1	120	156	140	3 300		42 000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
32		2.5×1	1	120	156	158	3 300		41 600	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
40		1.5×2	2	120	156	140	3 300		48 000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
50		1.5×1	1	80	126	161	3 500		25 900	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
50		1.5×2	2	120	156	158	3 500		47 100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
10		2.5×2	1	93	135	174	2 900		68 100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
12		2.5×2	1	100	146	200	2 900		91 500	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
16	3.7×1	1	98	140	173	2 900		72 700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		
20	2.7×2	2	98	140	164	2 900		85 700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		

○Contact NSK for the details of availability

Note: The dynamic load ratings listed are for martensite stainless steel screws, with the internal clearance as a reference. These may vary depending on materials or internal specifications.

2. Dimensions of Support Units for Cleanrooms

● Square type



Unit: mm

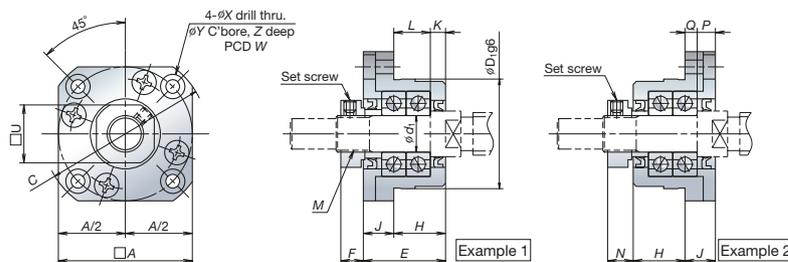
Fixed support side unit (square type)									
Reference No. (for use in clean environments)	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]	d_1	F	J	K	L	N	M
WBK08-01C	230	69 (M3)	8	14	23	7	—	4	M8 × 1
WBK10-01C	280	147 (M4)	10	17	30	5.5	24	6	M10 × 1
WBK12-01C	630	147 (M4)	12	19	30	5.5	24	6	M12 × 1
WBK15-01C	790	147 (M4)	15	22	31	12	25	5	M15 × 1

Unit: mm

Simple support side unit		Dimensions common with square type									
Reference No. (for use in clean environments)	d_2	R	A	B	C	D	E	W	X	Y	Z
WBK08S-01C	6	15	52	32	17	26	25	38	6.6	11	12
WBK10S-01C	8	20	70	43	25	35	36	52	9	14	11
WBK12S-01C	10	20	70	43	25	35	36	52	9	14	11
WBK15S-01C	15	20	80	50	30	40	41	60	11 9	17 14	15 11

Note: For dimensions X, Y, and Z for WBK15S-01C, the upper number indicates dimensions of the fixed support side unit, and the lower number shows dimensions of the simple support side unit.

● Round type



Unit: mm

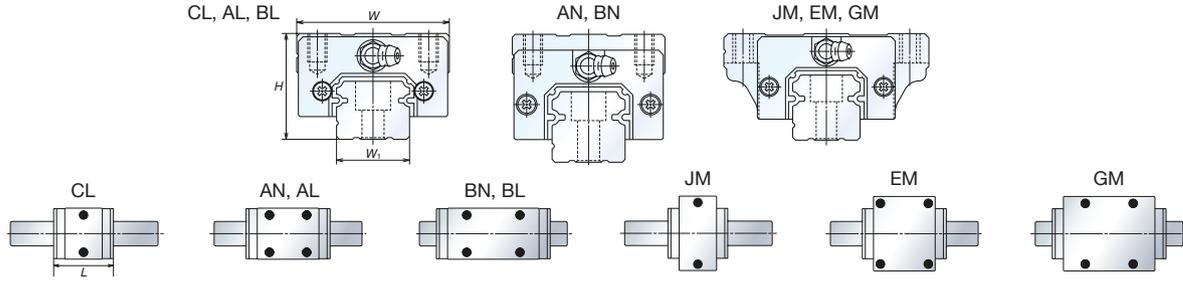
Reference No. (for use in clean environments)	Fixed support side unit (round type)																		
	d_1	A	C	U	W	X	Y	Z	D_1	E	F	H	J	K	L	N	P	Q	M
WBK08-11C	8	35	43	14	35	3.4	6.5	4	28	23	7	14	9	4	10	8	5	4	M8 × 1
WBK10-11C	10	42	52	17	42	4.5	8	4	34	27	7.5	17	10	5	12	8.5	6	4	M10 × 1
WBK12-11C	12	44	54	19	44	4.5	8	4	36	27	7.5	17	10	5	12	8.5	6	4	M12 × 1
WBK15-11C	15	52	63	22	50	5.5	9.5	6	40	32	12	17	15	6	11	14	8	7	M15 × 1

Note: Refer to the dimensions of square type support units for tightening torque of locknuts and setscrews.

D Dimensions and Availability of SPACEA™

3. NSK Linear Guide Dimensions

NH, VH, NS, LH Models



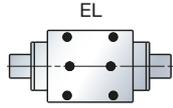
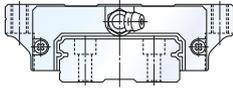
Model	Model No.	Dimensions (mm)						Suitability for special environments (availability)					
		Height H	Overall width W	Ball slide length (L)		Rail width W ₁	Dynamic load rating (N)	Cleanroom	Vacuum	Corrosive	High-temperature	Sanitary	Contaminated
				Standard	With NSK K1								
NH	NH15AN	28	34	55	65.6	15	14 200	○		○			○
	NH15BN	28	34	74	84.6	15	18 100	○		○			○
	NH15EM	24	47	55	65.6	15	14 200	○		○			○
	NH15GM	24	47	74	84.6	15	18 100	○		○			○
	NH20AN	30	44	69.8	80.4	20	23 700	○	○	○	○		○
	NH20BN	30	44	91.8	102.4	20	30 000	○	○	○	○		○
	NH20EM	30	63	69.8	80.4	20	23 700	○	○	○	○		○
	NH20GM	30	63	91.8	102.4	20	30 000	○	○	○	○		○
	NH25AN	40	48	79	90.6	23	33 500	○		○	○		○
	NH25BN	40	48	107	118.6	23	45 500	○		○	○		○
	NH25AL	36	48	79	90.6	23	33 500	○		○	○		○
	NH25BL	36	48	107	118.6	23	45 500	○		○	○		○
	NH25EM	36	70	79	90.6	23	33 500	○		○	○		○
	NH25GM	36	70	107	118.6	23	45 500	○		○	○		○
	NH30AN	45	60	85.6	97.6	28	41 000	○		○	○		○
	NH30BN	45	60	124.6	136.6	28	61 000	○		○	○		○
	NH30AL	42	60	85.6	97.6	28	41 000	○		○	○		○
	NH30BL	42	60	124.6	136.6	28	61 000	○		○	○		○
	NH30EM	42	90	98.6	110.6	28	47 000	○		○	○		○
	NH30GM	42	90	124.6	136.6	28	61 000	○	○	○	○		○
	NH35AN	55	70	109	122	34	62 500	○		○	○		○
	NH35BN	55	70	143	156	34	81 000	○		○	○		○
	NH35AL	48	70	109	122	34	62 500	○		○	○		○
	NH35BL	48	70	143	156	34	81 000	○		○	○		○
	NH35EM	48	100	109	122	34	62 500	○		○	○		○
	NH35GM	48	100	143	156	34	81 000	○		○	○		○
	NH45AN	70	86	139	154	45	107 000	○		○	○		○
	NH45BN	70	86	171	186	45	131 000	○		○	○		○
	NH45AL	60	86	139	154	45	107 000	○		○	○		○
	NH45BL	60	86	171	186	45	131 000	○		○	○		○
NH45EM	60	120	139	154	45	107 000	○		○	○		○	
NH45GM	60	120	171	186	45	131 000	○		○	○		○	
NH55AN	80	100	163	178	53	158 000	○		○	○		○	
NH55BN	80	100	201	216	53	193 000	○		○	○		○	
NH55AL	70	100	163	178	53	158 000	○		○	○		○	
NH55BL	70	100	201	216	53	193 000	○		○	○		○	
NH55EM	70	140	163	178	53	158 000	○		○	○		○	
NH55GM	70	140	201	216	53	193 000	○		○	○		○	
NH65AN	90	126	193	211	63	239 000	○		○	○		○	
NH65BN	90	126	253	271	63	310 000	○		○	○		○	
NH65EM	90	170	193	211	63	239 000	○		○	○		○	
NH65GM	90	170	253	271	63	310 000	○		○	○		○	
VH	VH15AN	28	34	70.6		15	14 200	○		○			○
	VH15BN	28	34	89.6		15	18 100	○		○			○
	VH15EM	24	47	70.6		15	14 200	○		○			○
	VH15GM	24	47	89.6		15	18 100	○		○			○
	VH20AN	30	44	87.4		20	23 700	○		○			○
	VH20BN	30	44	109.4		20	30 000	○		○			○
	VH20EM	30	63	87.4		20	23 700	○		○			○
	VH20GM	30	63	109.4		20	30 000	○		○			○
	VH25AN	40	48	97		23	33 500	○		○			○
	VH25BN	40	48	125		23	45 500	○		○			○
	VH25AL	36	48	97		23	33 500	○		○			○
	VH25BL	36	48	125		23	45 500	○		○			○
	VH25EM	36	70	97		23	33 500	○		○			○
	VH25GM	36	70	125		23	45 500	○		○			○
	VH30AN	45	60	104.4		28	41 000	○		○			○
	VH30BN	45	60	143.4		28	61 000	○		○			○
	VH30AL	42	60	104.4		28	41 000	○		○			○
	VH30BL	42	60	143.4		28	61 000	○		○			○
	VH30EM	42	90	117.4		28	47 000	○		○			○
	VH30GM	42	90	143.4		28	61 000	○		○			○
	VH35AN	55	70	128.8		34	62 500	○		○			○
	VH35BN	55	70	162.8		34	81 000	○		○			○
	VH35AL	48	70	128.8		34	62 500	○		○			○
	VH35BL	48	70	162.8		34	81 000	○		○			○
	VH35EM	48	100	128.8		34	62 500	○		○			○
	VH35GM	48	100	162.8		34	81 000	○		○			○
	VH45AN	70	86	161.4		45	107 000	○		○			○
	VH45BN	70	86	193.4		45	131 000	○		○			○
	VH45AL	60	86	161.4		45	107 000	○		○			○
	VH45BL	60	86	193.4		45	131 000	○		○			○
VH45EM	60	120	161.4		45	107 000	○		○			○	
VH45GM	60	120	193.4		45	131 000	○		○			○	
VH55AN	80	100	185.4		53	158 000	○		○			○	
VH55BN	80	100	223.4		53	193 000	○		○			○	
VH55AL	70	100	185.4		53	158 000	○		○			○	

○ : Made to Order (If blank, consult with NSK)

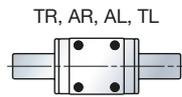
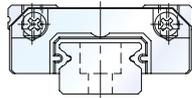
Series NSK Linear Guides



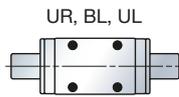
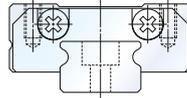
LW Model



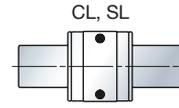
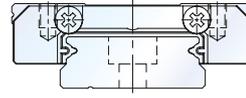
PU Model



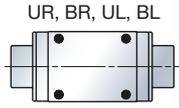
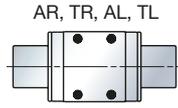
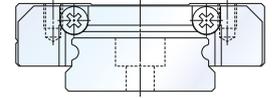
LU Model



PE Model



LE Model



Model	Model No.	Dimensions (mm)						Suitability for special environments (availability)					
		Height H	Overall width W	Ball slide length (L)		Rail width W ₁	Dynamic load rating (N)	Cleanroom	Vacuum	Corrosive	High-temperature	Sanitary	Contaminated
				Standard	With NSK K1								
VH	VH55BL	70	100	223.4		53	193 000	○		○			○
	VH55EM	70	140	185.4		53	158 000						○
	VH55GM	70	140	223.4		53	193 000	○		○			○
NS	NS15CL	24	34	40.4	50	15	7 250	○	○		○	○	
	NS15AL	24	34	56.8	66.4	15	11 200	○	○		○	○	
	NS15JM	24	52	40.4	50	15	7 250	○	○		○	○	
	NS15EM	24	52	56.8	66.4	15	11 200	○	○		○	○	
	NS20CL	28	42	47.2	57.8	20	10 600	○	○		○	○	
	NS20AL	28	42	65.2	75.8	20	15 600	○	○		○	○	
	NS20JM	28	59	47.2	57.8	20	10 600	○	○		○	○	
	NS20EM	28	59	65.2	75.8	20	15 600	○	○		○	○	
	NS25CL	33	48	59.6	70.2	23	17 700	○	○		○	○	
	NS25AL	33	48	81.6	92.2	23	26 100	○	○		○	○	
	NS25JM	33	73	59.6	70.2	23	17 700	○	○		○	○	
	NS25EM	33	73	81.6	92.2	23	26 100	○	○		○	○	
	NS30CL	42	60	67.4	79.4	28	24 700	○	○		○*	○	
	NS30AL	42	60	96.4	108.4	28	38 000	○	○		○*	○	
	NS30JM	42	90	67.4	79.4	28	24 700	○	○		○*	○	
NS30EM	42	90	96.4	108.4	28	38 000	○	○		○*	○		
NS35CL	48	70	77	90	34	34 500	○	○		○	○		
NS35AL	48	70	108	121	34	52 500	○	○		○	○		
NS35JM	48	100	77	90	34	34 500	○	○		○	○		
NS35EM	48	100	108	121	34	52 500	○	○		○	○		
LW	LW17EL	17	60	51.4	61.6	33	5 600	○	○		○*	○	
	LW21EL	21	68	58.8	71.4	37	6 450	○	○		○*	○	
	LW27EL	27	80	74	86.6	42	12 800	○	○		○*	○	
	LW35EL	35	120	108	123	69	33 000	○	○		○	○	
	LW50EL	50	162	140.6	155.6	90	61 500	○	○		○	○	
PU	PU09TR	10	20	30	36.4	9	1 490	○	○		○	○	
	PU09UR	10	20	41	47.4	9	2 100	○	○		○	○	
	PU12TR	13	27	35	42	12	2 830	○	○		○	○	
	PU12UR	13	27	48.7	55.7	12	4 000	○	○		○	○	
	PU15AL	16	32	43	51.2	15	5 550	○	○		○	○	
	PU15BL	16	32	61	69.2	15	8 100	○	○		○	○	
LU	LU05TL	6	12	18	24.4	5	545	○	○		○	○	
	LU07AL	8	17	20.4	29.4	7	1 090	○	○		○	○	
	LU09AL,TL	10	20	26.8	34.2	9	1 760	○	○		○	○	
	LU09AR,TR	10	20	30	36.4	9	1 490	○	○		○	○	
	LU09BL,UL	10	20	41	47.4	9	2 600	○	○		○	○	
	LU12AL,TL	13	27	34	41	12	2 830	○	○		○	○	
	LU12AR,TR	13	27	35.2	42.2	12	2 830	○	○		○	○	
	LU12BL,UL	13	27	47.5	54.5	12	4 000	○	○		○	○	
	LU15AL	16	32	43.6	51.8	15	5 550	○	○		○*	○	
LU15BL	16	32	61	69.2	15	8 100	○	○		○*	○		
PE	PE09TR	12	30	39.8	46.8	18	3 000	○	○		○	○	
	PE09UR	12	30	51.2	58.2	18	4 000	○	○		○	○	
	PE12AR	14	40	45	53	24	4 350	○	○		○	○	
	PE12BR	14	40	60	68	24	5 800	○	○		○	○	
	PE15AR	16	60	56.6	66.2	42	7 600	○	○		○	○	
	PE15BR	16	60	76	85.6	42	10 300	○	○		○	○	
LE	LE05CL	6.5	17	20	-	10	595	○	○		○	○	
	LE05AL	6.5	17	24	-	10	725	○	○		○	○	
	LE07SL	9	25	22.4	28.4	14	980	○	○		○	○	
	LE07TL	9	25	31	37	14	1 580	○	○		○*	○	
	LE07UL	9	25	42	48	14	2 180	○	○		○*	○	
	LE09CL,SL	12	30	26.4	33.4	18	1 860	○	○		○*	○	
	LE09AL,TL	12	30	39	46	18	3 000	○	○		○*	○	
	LE09AR,TR	12	30	39.8	46.8	18	3 000	○	○		○	○	
	LE09BL,UL	12	30	50.4	57.4	18	4 000	○	○		○*	○	
	LE12CL	14	40	30.5	38.5	24	2 700	○	○		○	○	
	LE12AL	14	40	44	52	24	4 350	○	○		○	○	
	LE12AR	14	40	45	53	24	4 350	○	○		○	○	
	LE12BL	14	40	59	67	24	5 800	○	○		○	○	
	LE15CL	16	60	41.4	51	42	5 000	○	○		○	○	
	LE15AL	16	60	55	64.6	42	7 600	○	○		○	○	
LE15AR	16	60	56.6	66.2	42	7 600	○	○		○	○		
LE15BL	16	60	74.4	84	42	10 300	○	○		○	○		
LH	LH08AN	11	16	24	31	8	1 240	○	○		○	○	
	LH10AN	13	20	31	40	10	2 250	○	○		○	○	
	LH12AN	20	27	45	54	12	5 650	○	○		○*	○	

*Seals are not applicable in high-temperature environments. Contact NSK for details. ○ : Made to Order (If blank, consult with NSK)

Ball Screws/NSK Linear Guides

Dimensions and Availability of Linear Guides

1. Corrosion-Resistant Ball Screws and NSK Linear Guides (Fluoride Low-Temperature Chrome Plating)

NSK Linear Guides and ball screws are used in industrial machinery, semiconductor production, flat panel display manufacturing equipment, and more. Preventing rust from developing in these applications is crucial, particularly for machines around water such as part/device washers and for semiconductor/FPD manufacturing equipment involved in chemical wet processing.

NSK applies a fluororesin coating to an electrolytic black plating (fluoride low-temperature chrome plating) on these linear guides and ball screws for optimal rust resistance.



Fluoride Low-Temperature Chrome Plating

Electrolytic rust-resistant black plating + fluororesin coating

- Black plating: treated to form a stable thin film (1-2 μm), which is a form of black chrome galvanization
- A fluororesin coating is applied to this film to enhance corrosion resistance
- Low-Temperature treatment with no hydrogen brittleness enables stable, accurate control
- Outstanding durability on rolling surfaces, compared with other surface treatments
- Thin-film and high corrosion-resistance properties reduce factors that might adversely affect the accuracy of parts
- More economical than other surface-treated or stainless steel products

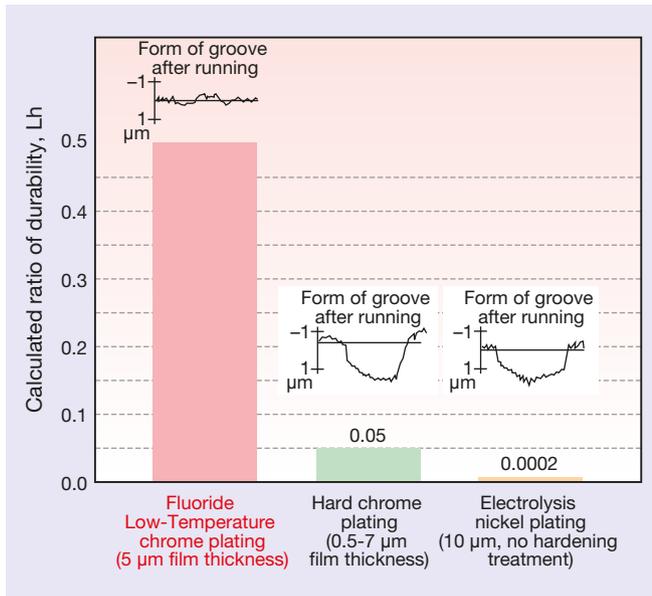
Note: Avoid using organic solvents, which may degrade the treatment's rust prevention properties.

Test results for corrosion resistance to humidity

Characteristics		Type	Fluoride Low-Temperature chrome plating	Hard chrome plating	Electrolysis nickel plating	SUS440C	Standard product
Level of rust	Upper face		(Grinding) B	(Grinding) B	(Grinding) A	(Grinding) C	(Grinding) D
	Side face		(Grinding) A	(Grinding) A	(Grinding) A	(Grinding) C	(Grinding) E
	Bottom face		(Grinding) A	(Grinding) A	(Grinding) A	(Grinding) C	(Grinding) E
	End face		(Cutting) A	(Cutting) C	(Cutting) A	(Cutting) C	(Cutting) E
	Chamfer, Grinding off		(Drawing) A	(Drawing) D	(Drawing) A	(Drawing) C	(Drawing) E
Rust prevention	Test conditions						
	Time to/from target temperature and humidity conditions. To target: 5 hours After target: 2 hours						
Film thickness			5 μm	0.5-7 μm	10 μm	—	—

Level of rust A: No rust B: No rust, but slight discoloration C: Spot rust D: Slightly rusted E: Completely rusted

● **Surface treatment durability test results for linear guides**



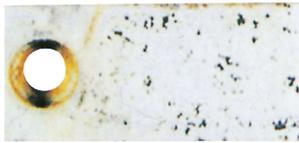
● **Comprehensive evaluation**

	Available length	Rust resistance	Stable quality	Durability	Cost
Fluoride Low-Temperature chrome plating	◎ (4 m)	◎	○	◎	Low
Hard chrome plating	△ (2 m)	○	×	△	High
Electrolysis nickel plating	◎ (4 m)	◎	△	×	High
SUS440C	○ (3.5 m)	○	◎	◎	High

◎ : Superior ○ : Good
 △ : Not ideal × : Problem—restricted use

● **Test results for corrosion resistance to chemical exposure**

Test conditions— Base material of rail: equivalent to SUS440C
 Chemical concentration: 1 normal (1N)

Fluoride Low-Temperature chrome plating	Exposure type	Hard chrome plating	No surface treatment
	24-hour soaking Nitric acid		
	24-hour soaking Hydrofluoric acid		
	72-hour vapor Hydrochloric cleansing liquid HCl : H ₂ O ₂ : H ₂ O = 1 : 1 : 8		
○	Hydrochloric liquid (soaking)	○	▲
○	Sulfuric acid (soaking)	○	×
○	Ammonia or sodium hydroxide	○	△

○ : No damage △ : Partial damage to surface ▲ : Damage to entire surface × : Corrosion

2. LG2/LGU "Clean" Grease

LG2 and LGU "clean" greases are utilized for low-dust specifications of NSK products such as linear guides, ball screws, Monocarriers, Megatorque Motors, XY modules and XY tables. These greases are excellent for cleanrooms thanks to their lower particle emissions and better resistance to corrosion than fluorine greases. Their proven track record makes them particularly suitable for semiconductor production equipment.



Features

- Low-dust characteristics that outperform fluorine greases
- Low torque—less than 20% that of fluorine greases
- Over ten times more durable than fluorine greases
- Superior rust prevention superior to fluorine greases

Note: LG2/LGU greases are for use at atmospheric pressure.
Fluorine greases or other NSK greases are recommended for vacuum applications.

● Properties

Operating environment	For use exclusively at atmospheric pressure		From atmospheric pressure up to vacuum
	LG2	LGU	Commercially available fluorine grease K
Product	Mineral oil and synthetic hydrocarbon oil	Synthetic hydrocarbon oil	Fluorine oil
Base oil	Lithium soap	Diurea	PTFE
Thickener	32	95.8	270
Kinematic viscosity (mm ² /s, 40 °C)	199	201	280 ± 15
Consistency	up to 70	up to 120	up to 200
Maximum operating temperature, °C			

- LG2 and LGU are NSK-developed greases.
- LGU grease is free of metallic elements.

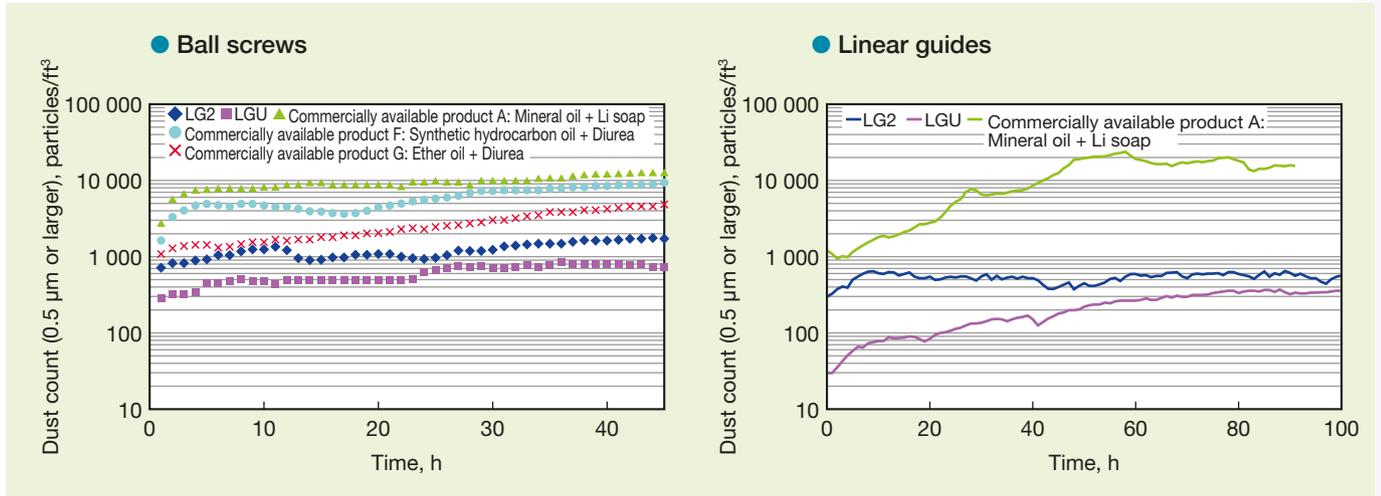
● Comprehensive evaluation

Characteristics	LG2/LGU	Fluorine grease	Ordinary grease
Low particle emission	○	○/△	△/×
Torque	○	×	○/△
Durability	○	△/×	○
Rust prevention	○	△/×	○

○: Excellent △: Poor ×: Not recommended

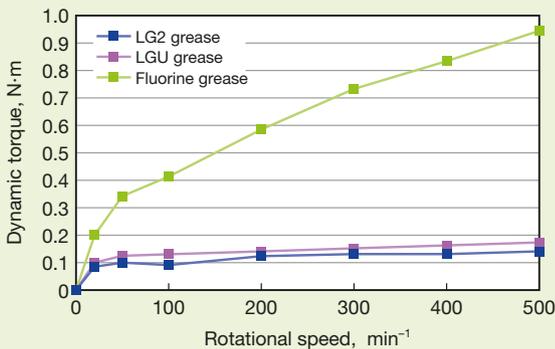
● Extremely low particle emissions

LG2/LGU greases offer stable low-dust characteristics over a longer period than fluorine greases.



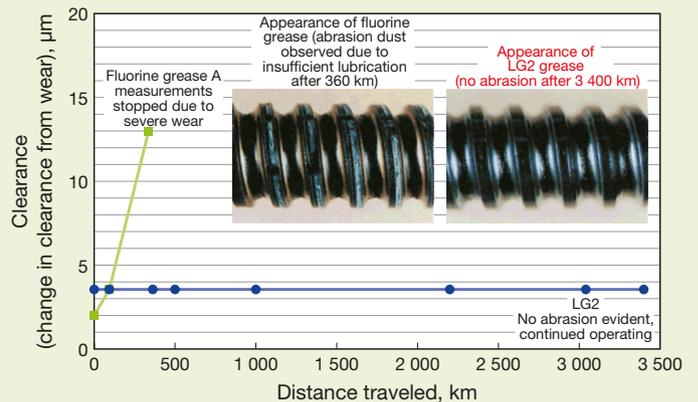
● Stable low-torque characteristics

LG2/LGU greases significantly reduce the burden on motors running at high speeds by achieving torque less than 20% that of fluorine greases (ball screws, at 500 min⁻¹).



● Long life

LG2/LGU greases not only have the same durability as ordinary greases, they last over 10 times longer than fluorine grease, reducing maintenance needs.



● Superior rust prevention

LG2/LGU greases provide high reliability by preventing rust.



NSK "Clean" grease

No rust



Fluorine grease

Rusting

3. NSK Lubricant E-DFO

In a world first, E-DFO lubricant forms a hydrocarbon oil film directly on the raceway surfaces of ball screws, linear guides, and rolling elements. In vacuum environments, this results in lower outgassing than with other lubricants like fluorine grease and lower particle emissions and longer life than with existing fluoro-resin coatings or solid lubricants.

Features

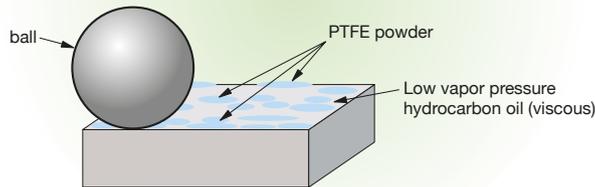
Better retains lubrication through low-vapor-pressure oil and adsorbent thin-lubricant film technology.

- Low particle emissions and superior outgassing compared to conventional fluoro-resin-coated and solid lubricant products
- Far more durable than fluoro-resin-coated products



● Structural illustration

- **Low-vapor-pressure hydrocarbon oil coating that exhibits the properties of liquids and solids**



- **Flake-shaped PTFE powder increases the surface area for adhered lubricant, increasing lubricant retention.**

Notes:

The E-DFO coating is a clear, low-vapor-pressure hydrocarbon-based, semi-dry coating that is viscous on the surface.

1. **Handling:** Open the package immediately before use in a clean space with the lowest possible humidity (less than 60%). Handle with cleanroom gloves; do not touch the product with bare hands.
2. **Storage:** If the sealed product is not used for a long period or is not used immediately after opening, store in a clean, dry container such as a desiccator or vacuum chamber to prevent rust and deterioration. Do not use slushing oil or anti-tarnish paper on the product.
3. **Do not clean:** E-DFO coated products do not require cleaning. Do not clean or wipe the coating on the rolling surface—this will directly affect the lubricating function.
4. **Do not apply new lubricant:** E-DFO coated ball screws and linear guides do not require additional lubricant. Do not use with the NSK K1 lubrication unit, as this will degrade E-DFO's lubricating properties.
5. **Installation position:** When using ball screws and linear guides vertically, use an oil receiver under the screw shafts and rails as the E-DFO coating may drip.

● Comprehensive evaluation

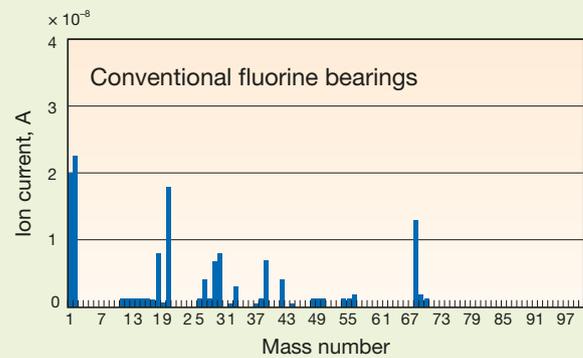
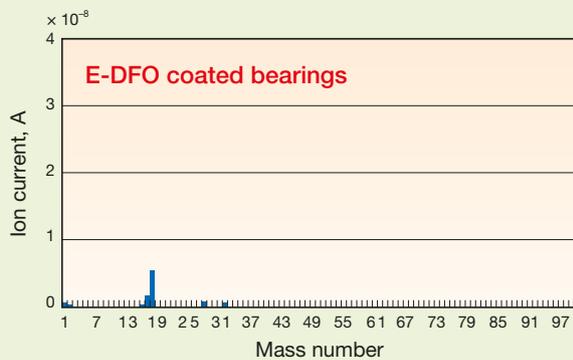
Lubricant	Performance			Compatible operating environment		
	Durability	Particle emissions	Outgassing	Operating environment	Ball screws	Linear guides
E-DFO	○	○	◎	Atmospheric pressure, vacuum	●	●
Fluororesin	△	△	○	Atmospheric pressure, vacuum	—	—
MoS ₂	○	△/○	○	Atmospheric pressure, vacuum	●	●
Commercially available fluorine grease	◎	◎	△	Atmospheric pressure, vacuum	●	●

◎: Excellent ○: Good △: Satisfactory ●: Applicable

● Low outgassing

● Outgassing in high-temperature environments (example bearing measurements)

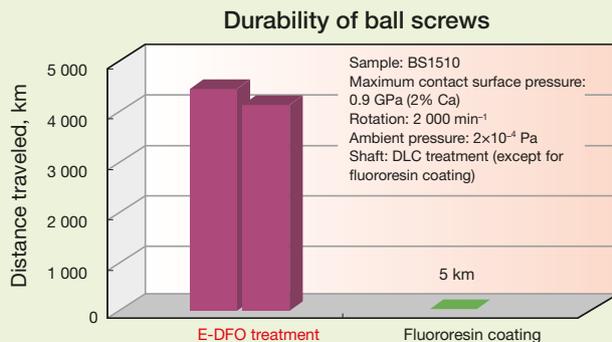
Outperforms conventional fluorine-coated bearings.



● Long life

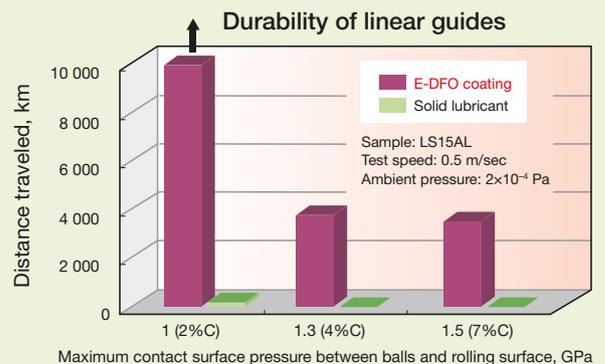
● Durability of ball screws

E-DFO coating extends the operating life of ball screws compared to fluororesin coating.



● Durability of linear guides

E-DFO coating extends the operating life of linear guides compared to solids lubricants.



4. Compact FA-USS Model: High-Accuracy type for Cleanrooms

A precision Model ideal for semiconductor and flat panel display manufacturing equipment, inspection equipment, and other applications with clean needs.



Applications

Applications where cleanliness is required, such as semiconductor manufacturing equipment, flat panel display manufacturing equipment, inspection equipment etc.

Specifications

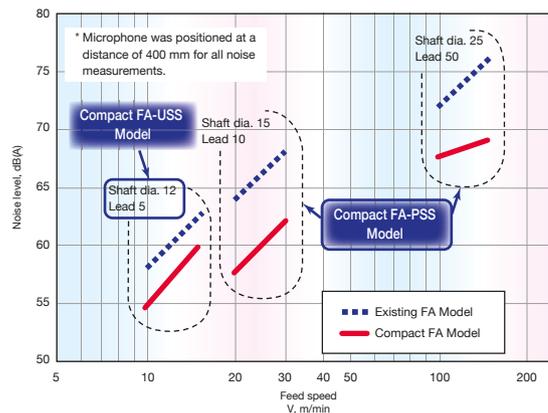
- Accuracy grade : C3 (JIS)
- Axial play : 0 (Oversize ball preload)

Features of the USS Model

- High-speed, low-noise, and compact .. Thanks to end-deflector recirculation system.
- Low dust emissions..... NSK LG2 grease comes standard and reduces dust particles by 90% compared to general lithium grease.

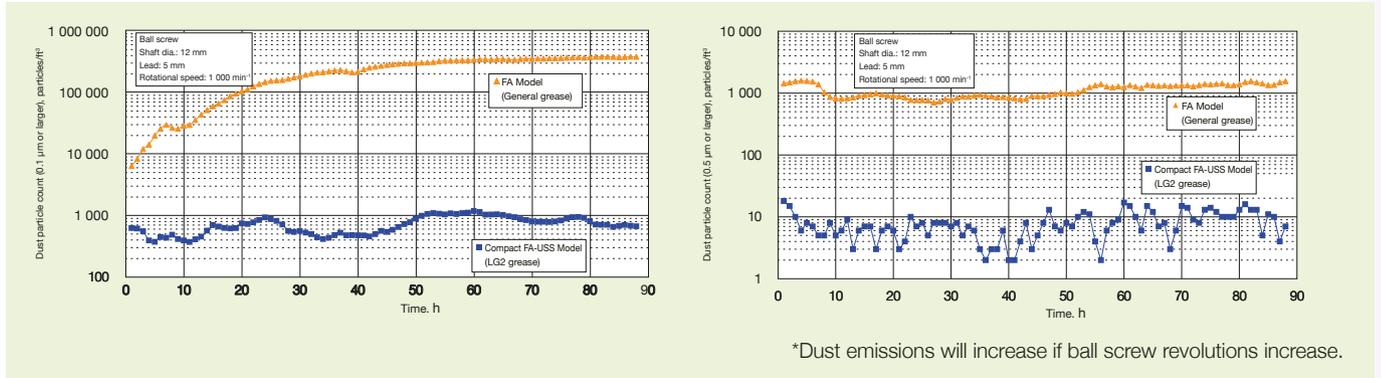
● Low-noise

Uses an end-deflector recirculation system to reduce noise by 6 dB compared to tube recirculation while also reducing vibration.



● Low-dust emissions

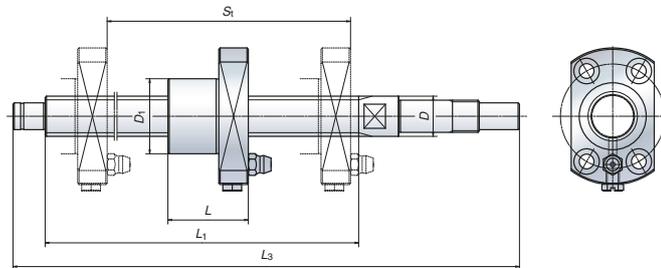
The USS Model with NSK LG2 Grease achieves a dust count 1/100 that of the FA Model with general lithium-based grease.



● Compact FA-USS Model reference number

Example : **USS 15 05 N1D 0361**

Compact FA-USS Model Screw Shaft diameter (mm) Screw Shaft length (mm) NSK control code Lead (mm)



● Specifications/Performance

Unit: mm

Reference no.	Screw Shaft dia. <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke St		Nut dimensions		Screw Shaft dimensions		Lead accuracy			Dynamic preload torque *1 (N·cm)	Permissible rotational speed (min ⁻¹) *2 Fixed-Simple
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	Nominal	Max.	Diameter <i>D1</i>	Overall length <i>L</i>	Threaded length <i>L1</i>	Shaft length <i>L3</i>	Travel compensation <i>T</i>	Deviation <i>e_p</i>	Variation <i>V_u</i>		
USS1005N1D0221	10	5	3 420	4 840	100	133	23	29	162	221	0	0.010	0.008	0.2 ~ 1.8	5 000
USS1005N1D0321					200	233			262	321		0.012	0.008	0.2 ~ 2.0	
USS1005N1D0521					400	433			462	521		0.015	0.010	0.2 ~ 3.0	
USS1205N1D0221	12	5	3 750	5 810	100	130	24	30	160	221	0	0.010	0.008	0.2 ~ 1.8	
USS1205N1D0321					200	230			260	321		0.012	0.008	0.2 ~ 2.0	
USS1205N1D0621					500	530			560	621		0.016	0.012	0.2 ~ 3.0	
USS1505N1D0261	15	5	6 410	10 100	100	159	28	30	189	261	0	0.010	0.008	0.2 ~ 5.0	
USS1505N1D0361					200	259			289	361		0.012	0.008	0.2 ~ 5.0	
USS1505N1D0561					400	459			489	561		0.015	0.010	0.2 ~ 6.0	
USS1505N1D0761					600	653			689	761		0.018	0.013	0.2 ~ 6.0	4 130

*1. Indicates ball screw preload control value. Approximately 0.5 N·cm of torque is added due to thin plastic seals.

*2. Contact NSK if permissible rotational speed will be exceeded.

Caution Operating temp. range: 0 – 70 °C

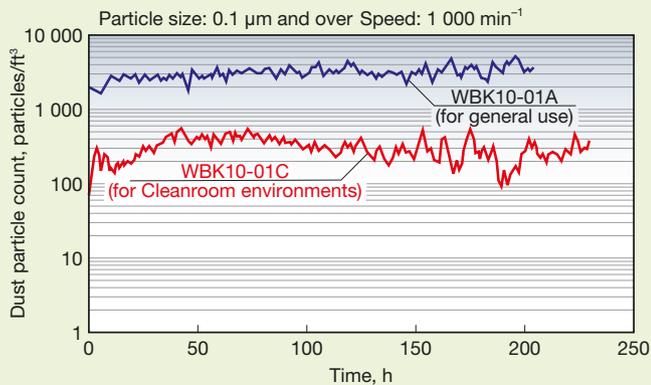
5. Support Units for Cleanroom Environments

Support units for cleanroom environments come equipped with all required parts such as locknuts so that they can be mounted as is with NSK ball screws with machined shaft ends. (Refer to the tables for details on ball screws with unfinished shaft ends.)

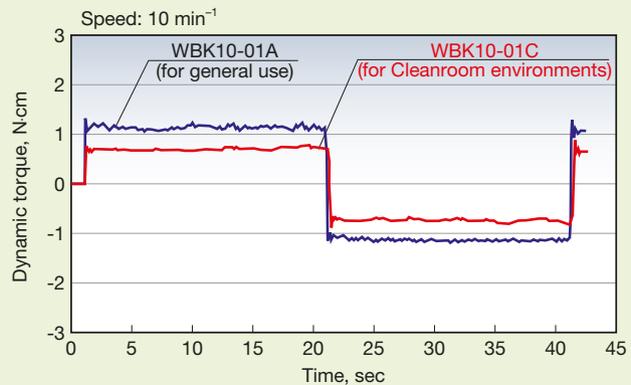
Features of Support Units for Cleanroom Environments

- **Extremely low particle emissions** Uses LG2 grease to achieve proven low particle emissions 1/10 those of general support units.
- **Low torque** Special low torque bearings reduce torque by 50% compared to general units.
- **High rust prevention** Adopts Low-Temperature chrome plating for the housing surfaces and stainless steel for small parts

● Low particle emissions



● Low-torque characteristics



● Reference numbers

Example: **WBK 08 S - 01 C**

Product code for support unit

Nominal size code (bearing bore diameter)*

Mounting code

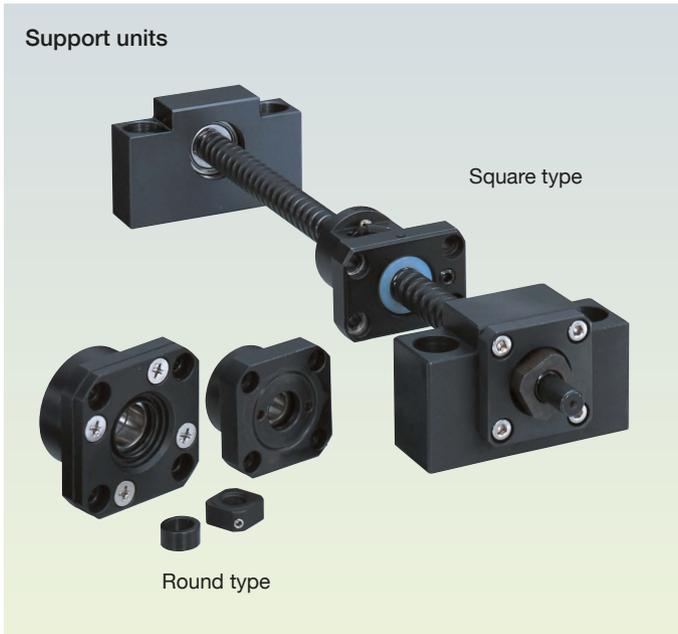
No code: Fixed support unit
S: Simple support unit

C: For cleanroom environments

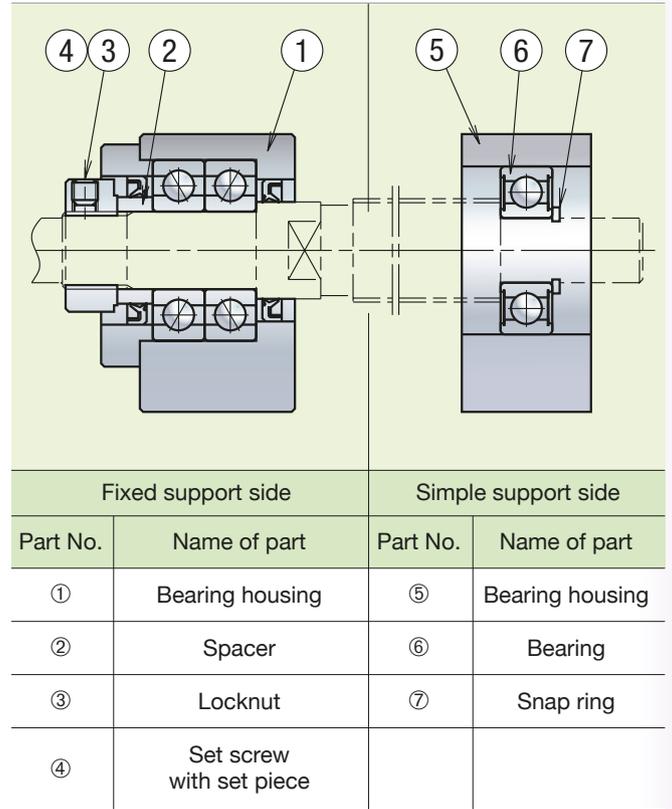
01: Square type
11: Round type

* For simple support units, please note that size codes of 12 or less do not represent bearing bore diameters.

● Structure



- Two types are available: a square floor-mounted type for surface mounting and a round type for fitting into the body.
- While the square type consists of a fixed support side unit (motor side) for the ball screw shaft and the opposing simple support side, the round type has no simple support side housing.



● Bearing type, grease, housing surface treatment, and small parts material

Bearing, grease	Surface treatment	Set screw and snap ring material
Special bearings, LG2	Low-Temperature chrome plating	Stainless steel

● Specifications

Reference No.	Fixed support side unit				Simple support side support unit		
	Axial direction			Maximum starting torque (N·cm)	Reference No.	Bearing Reference No.	Radial direction
	Basic dynamic load rating C_a (N)	Load limit (N)	Stiffness (N/μm)				Basic dynamic load rating C (N)
WBK08-01C (square) WBK08-11C (round)	3 100	1 100	36	0.52	WBK08S-01C	606VV	2 260
WBK10-01C (square) WBK10-11C (round)	4 250	1 364	50	1.1	WBK10S-01C	608VV	3 300
WBK12-01C (square) WBK12-11C (round)	4 700	2 443	57	1.2	WBK12S-01C	6000VV	4 550
WBK15-01C (square) WBK15-11C (round)	5 100	2 757	63	1.3	WBK15S-01C	6002VV	5 600

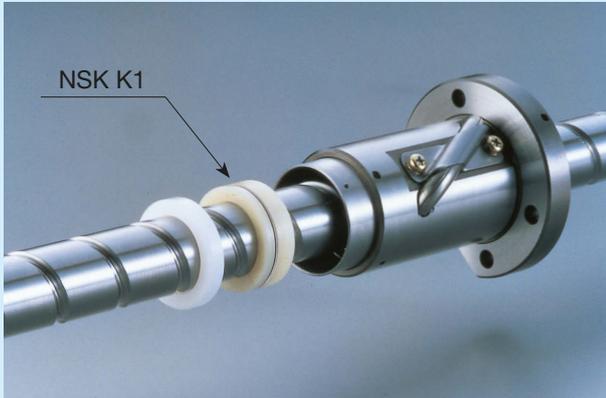
6. NSK K1™/NSK K1-L™ Lubrication Unit

(1) Ball screws equipped with NSK K1™ and linear guides equipped with NSK K1™/NSK K1-L™ for general industry

NSK has developed specialized lubrication units for ball screws and linear guides. Ball screws with NSK K1 and linear guides with NSK K1/NSK K1-L offer maintenance-free performance over a long period.

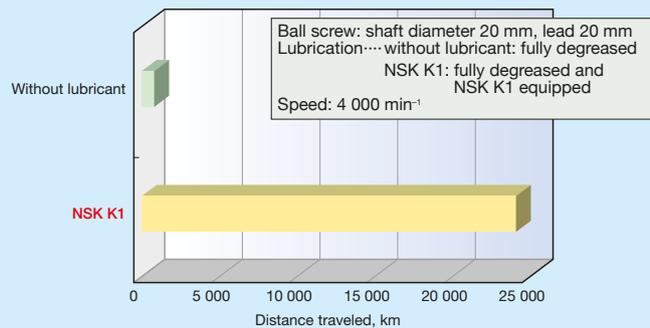
(See pages B25–26 for details on NSK K1 in linear guides for food processing machinery/medical devices.)

Features of Ball Screws with NSK K1



● Durability tests without lubricant

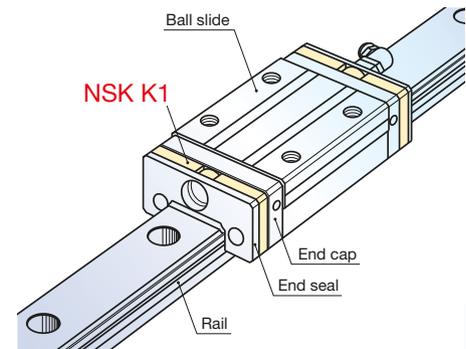
A ball screw without lubricant was damaged after operating over 8.6 km, but the ball screw equipped with NSK K1 operated for more than 20 000 km.



Notes at bottom page also apply to ball screws with NSK K1.

Features of Linear Guides with NSK K1

- The NSK K1 lubrication unit greatly enhances lubrication in NSK Linear Guides.
- A newly developed porous synthetic resin contains ample lubricant to ensure extended maintenance-free performance
- Easy installation: mounts to the inside of the standard-end seal



NSK K1-L for improved performance

- NSK K1-L improves on the original NSK K1 with a higher capacity supply of lubricating oil, enabling even longer maintenance-free operation.
- NSK K1-L is applied to NH, VH, NS, and HS models.

Notes:

To maintain optimal performance of NSK K1/NSK K1-L note the following:

1. Operating temperatures: Maximum operating temperature: 50°C
Maximum momentary operating temperature: 80°C
2. Avoid contact with: Organic solvents with degreasing properties, such as hexane and immersion in white kerosene thinner or anti-corrosive oil (containing white kerosene)

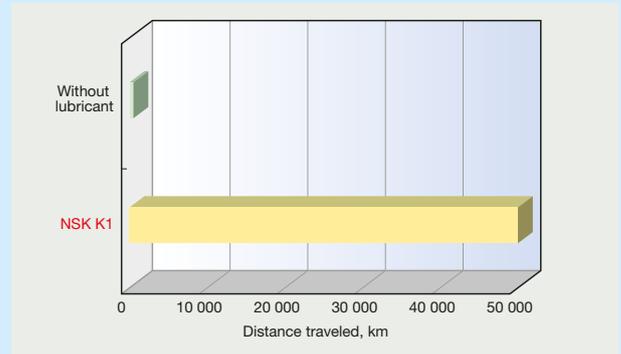


● Performance

● Durability test without lubricant

A linear guide without lubricant was damaged after a short period, but the K1-equipped linear guide covered a distance exceeding 50 000 km.

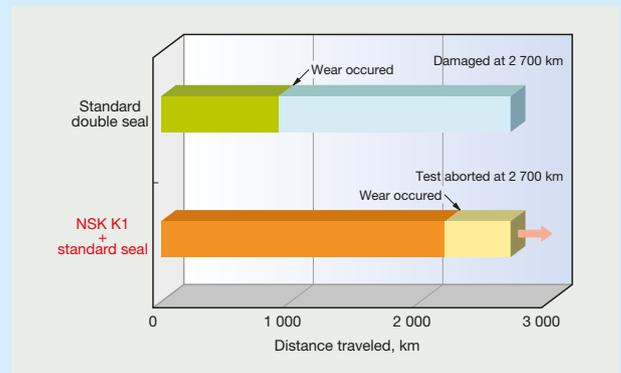
Conditions
 Linear guide: LH30AN (preload Z1)
 Lubrication: without lubricant: fully degreased
 NSK K1: fully degreased and NSK K1 equipped
 Speed: 60 m/min



● Water-immersion test

In a water-immersion test run once a week for 24 hour intervals, the ball groove of a linear guide fitted with standard double seals quickly showed wear and damage at 2 700 km. By comparison, the linear guide equipped with NSK K1 showed only 1/3 as much wear, confirming significant lubricating efficacy.

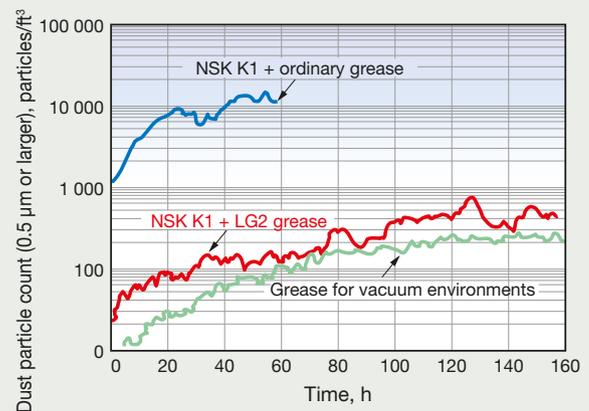
Conditions
 Linear guide: LS30 stainless steel (preload Z1)
 Water immersion: Run once a week for 24 hours, fully immersed in water
 Lubrication: Fully grease-packed for food processing machinery
 Speed: 24 m/min



● Dust generation

The combination of NSK K1 and LG2/LGU "clean" greases (low-particle-emission grease) produced no more dust than conventional grease for vacuum environments.

Conditions
 Linear guide: LS20
 Speed: 36 m/min



Notes: Compatibility of NSK K1 with oils and chemicals

The table on the right shows test results after immersing NSK K1 in chemicals and oils at 40° C. NSK K1 was found to be stable when in contact with grease and cutting lubricants, and use in combination with these substances presents no problems. However, exposure to chemicals with degreasing properties, such as white kerosene and hexane, quickly removed oil content from the surface of the seals, suggesting that the lubricating effect may deteriorate under these conditions.

Chemicals/Oil	Compatibility
Cutting lubricants (water-based, oil-based)	A
Grease (mineral oil-based, ester-based)	A
Rust preventives (without solvents)	A
Rust preventives (with solvents)	B
White kerosene	B
Hexane	C

A: Compatible B: Use sparingly, for brief periods only C: Incompatible

6. “NSK K1™” Lubrication Unit

(2) Linear guides equipped with NSK K1™ for food processing and medical equipment

Thanks to a new material seal, NSK K1 for food processing and medical equipment is safe and FDA-compliant. In NSK K1, a newly developed, porous synthetic resin provides continuous and abundant lubricant. The unit is also easy to install inside standard end seals made of rubber. After success in general industry (see Pages B23-B24), we utilized special materials to allow use in food processing and medical equipment.

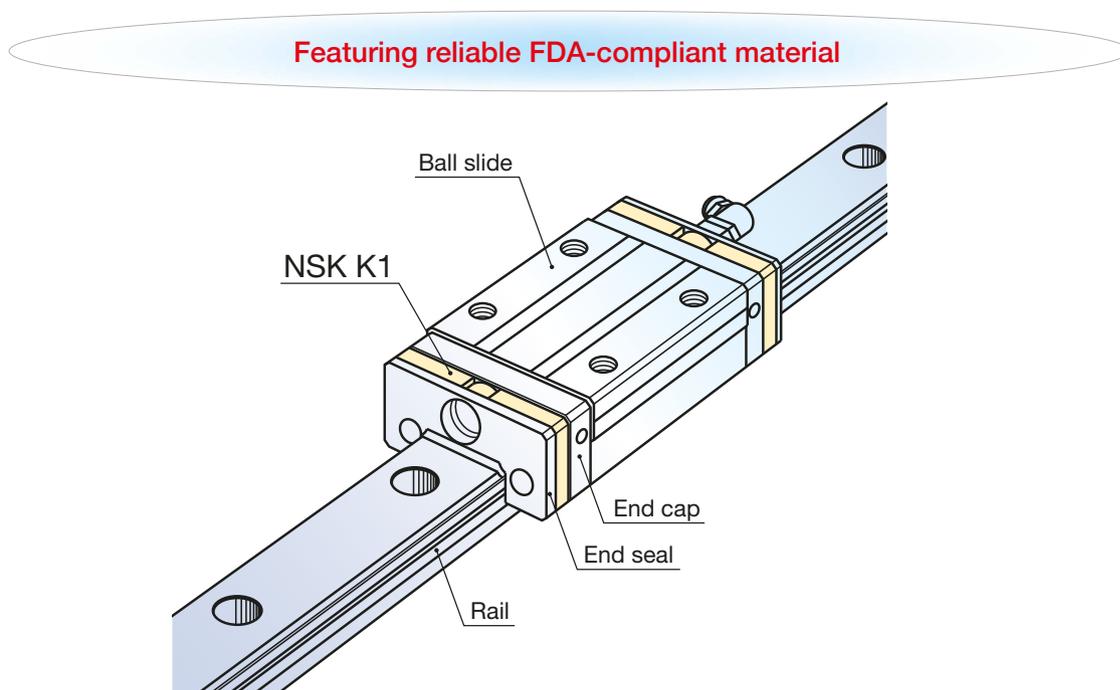
Features

- **Safe to handle**

Uses highly safe materials that are compliant with the US Food and Drug Administration’s (FDA) hygiene standards for food additives

- **Environmentally sound**

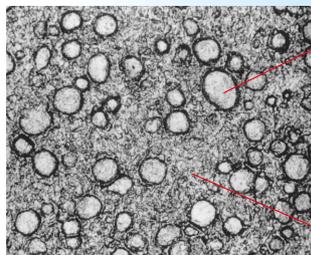
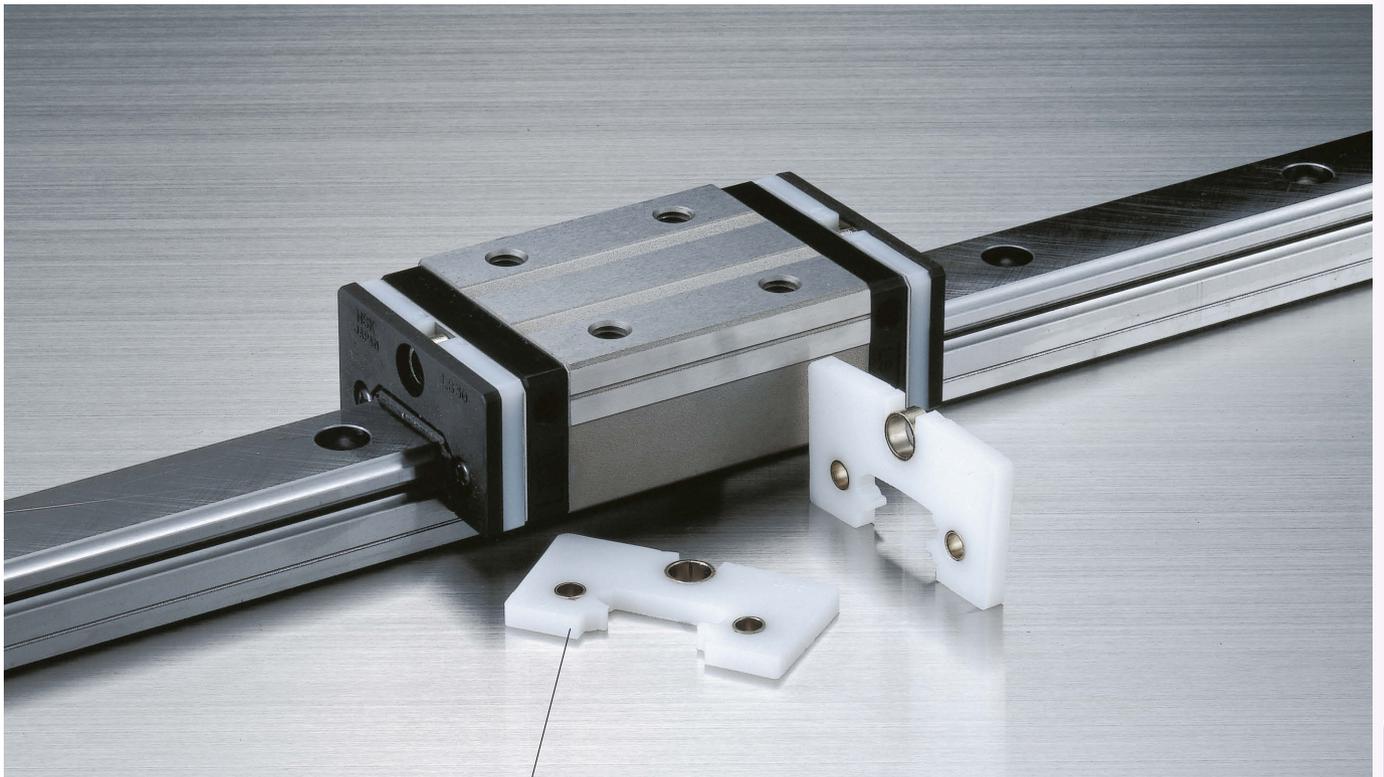
A newly developed porous synthetic resin provides a controlled supply of lubricant, preventing the spread of oil in sanitary environments



Notes:

To maintain optimal performance of NSK K1 in linear guides, note the following:

1. Operating temperatures: Maximum operating temperature: 50 °C
Maximum momentary operating temperature: 80 °C
2. Avoid contact with: Organic solvent with degreasing properties, such as hexane and thinner
Immersion in white kerosene or anti-corrosive oil (with white kerosene ingredients)



Magnification of
NSK K1

100 μ m

Portion containing high proportion of polyolefin

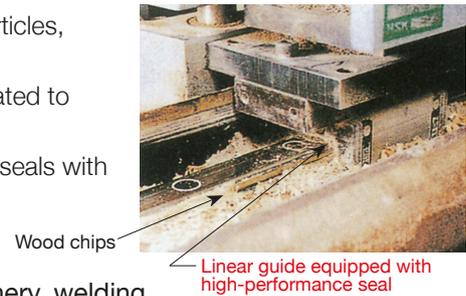
Polyolefin is used for packaging food in supermarkets, replacing dioxin-generating vinyl chloride.

Portion containing high proportion of lubricating oil

7. NSK High-Performance Seals

Ball screws and linear guides face tough environments contaminated by wood particles, rubber fragments, graphite/ceramic powders, welding spatter, and more. Recently, dust resistance has become increasingly significant as covers are eliminated to reduce costs and make equipment more compact.

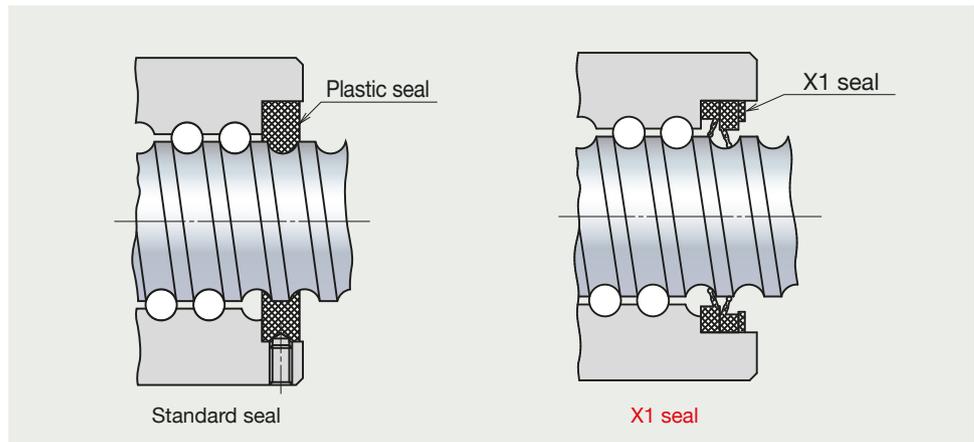
Though our conventional seals resist dust, NSK has developed high-performance seals with even better resistance to dust to respond to this need.



- **Applications:** Woodworking machinery (photo at right), tire buffing machinery, welding lines, graphite processing machinery, laser machinery

Features of Ball Screws Equipped with X1 Seals

- **High dust-resistance** A specialized seal design improves sealing performance to better resist contaminants and increase durability.
- **Superior grease retention** ... Ball screws with X1 seals have a double seal structure combining a dust-resistant seal and grease-retaining seal to improve grease retention.
- **Low torque design** An optimized seal shape and low-friction materials achieve low torque and low heat generation.

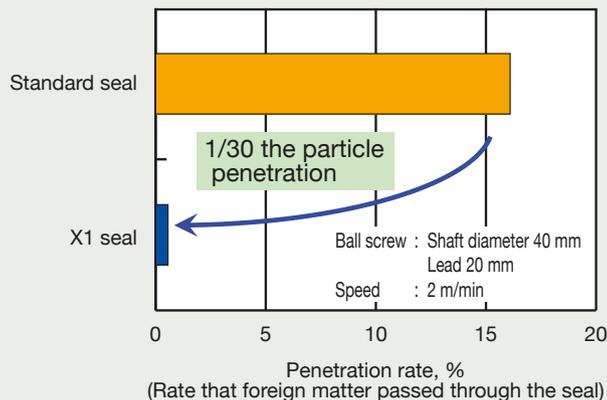


Note: The nut with an X1 seal is slightly longer than the standard.

● Performance

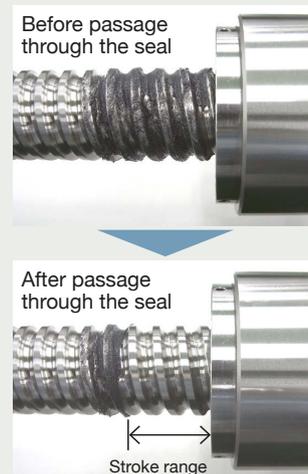
● Particle penetration rate test

Iron powder 37- 148 μm in article was mixed with AS2 grease on the screw shaft. After the nut completed a stroke, particle penetration through the X1 seal was found to be less than 1/30 that through a standard seal.



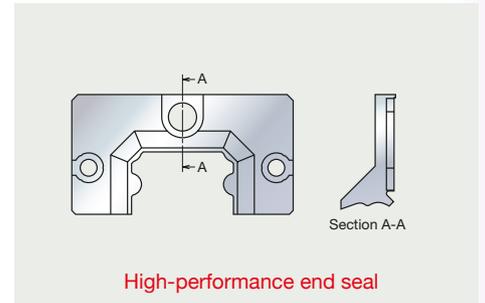
● Appearance after particle penetration rate test

All contaminants adhering to the screw shaft are swept away after passage through the X1 seal.



Features High-Performance Seals for Linear Guides

- **High dust-resistance** Sealed with three lips that extend from the main body of the seal
- **Long life**..... Incorporates the NSK K1-L lubrication unit to enhance dust-resistance and durability

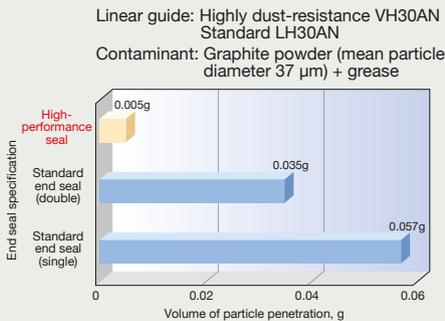


Note: Linear guides with high-performance seals come standard with the NSK K1-L lubrication unit. The seals will jut out slightly, making slide length slightly longer than with standard seals. See the table below for details.

● Performance

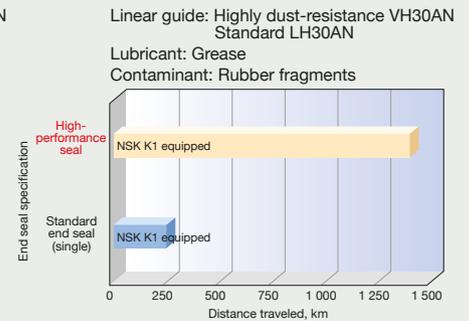
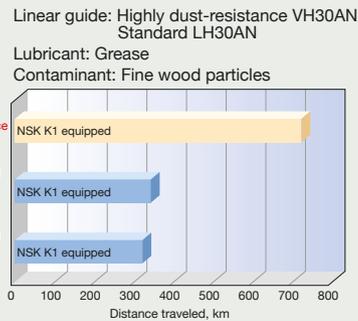
● High dust-resistance

Particle penetration through the high-performance seal is less than 1/10 that through a standard end seal (single).



● Long life

Improved resistance to contaminants achieves durability twice that of standard seals in an environment with fine wood particles and over five times that in an environment with rubber fragments.



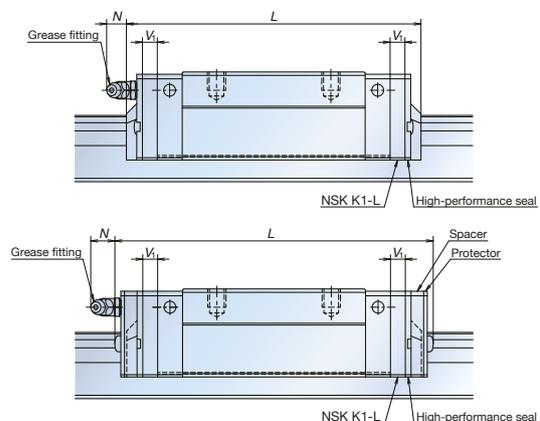
● Specifications

Unit: mm

Model No.		Ball slide length <i>L</i>	Grease fitting extrusion <i>N</i>
VH15	AN/EM	70.6 (77)	1 (8.2)
	BN/GM	89.6 (96)	
VH20	AN/EM	87.4 (94.2)	11.1 (12.3)
	BN/GM	109.4 (116.2)	
VH25	AL/AN/EM	97 (104.4)	9.6 (12.9)
	BL/BN/GM	125 (132.4)	
VH30	AL/AN	104.4 (114.8)	11.4 (14.2)
	EM	117.4 (127.8)	
VH35	AL/AN/EM	128.8 (139.2)	10.9 (13.7)
	BL/BN/GM	162.8 (173.2)	
VH45	AL/AN/EM	161.4 (174.2)	12.5 (14.1)
	BL/BN/GM	193.4 (206.2)	
VH55	AL/AN/EM	185.4 (198.2)	12.5 (14.1)
	BL/BN/GM	223.4 (236.2)	

Dimensions in parentheses apply when equipped with a protector.

Dimensions of a linear guide equipped with high-performance seals and NSK K1-L

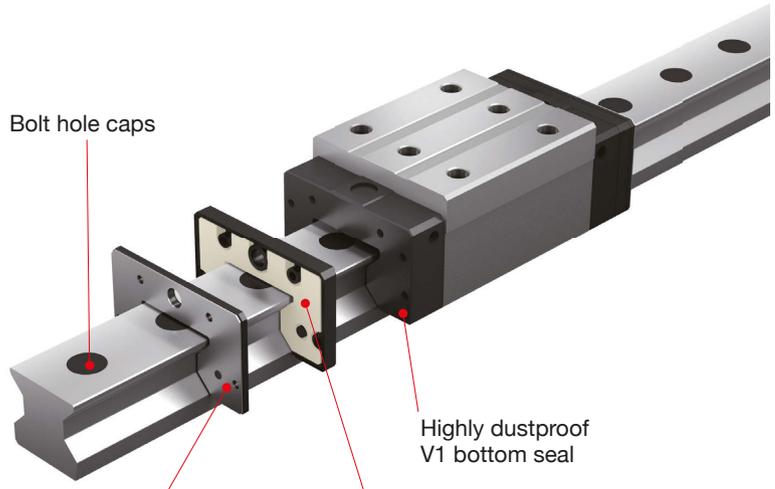
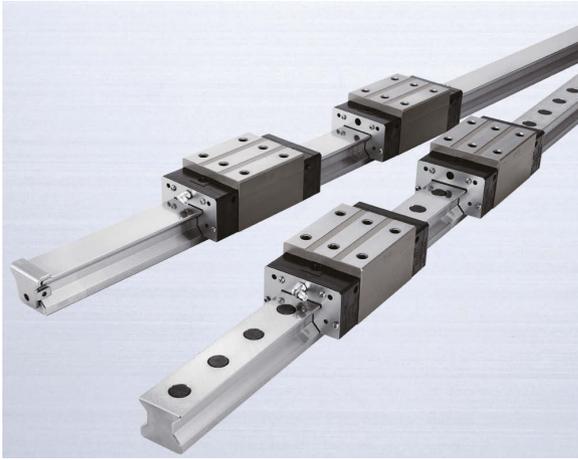


Data shown reflect test results. NSK offers no warranty for seal performance in actual machinery. Since performance is affected by the usage environment and lubrication conditions, we highly recommend using covers or other measures to protect machinery from contaminants.

Features of Roller Guides Equipped with Highly Dustproof V1 Seals and V1 Bottom Seals

- **Excellent for machine tools** Built on the RA Series, with a proven track record in the industry.
- **Abrasion resistance** Uses the V1 highly dustproof seal made of new materials and a shape optimized to resist dust. A bottom V1 seal is also available for some models (RA35, RA45, RA55, RA65).
- **Long life**..... Outstanding lubrication by NSK K1 further improves durability

Roller guides equipped with highly dustproof V1 Seal

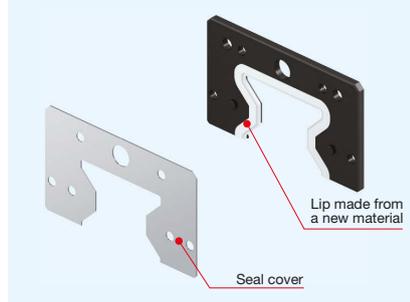


Bolt hole caps



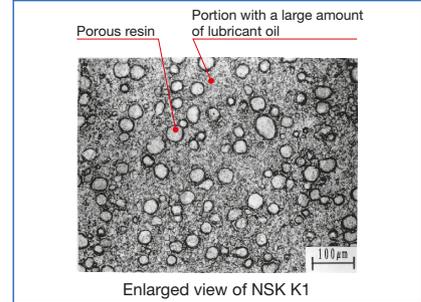
The shape is partly changed
These caps prevent foreign matter from building up inside the rail mounting holes. These are standard parts.

Highly dustproof V1 seal



Thanks to new materials and optimized shapes, V1 seals achieve better abrasion resistance and prevent foreign matter from entering the slide for long periods.

NSK K1™ lubrication unit



Made of porous synthetic resin containing a large amount of lubrication oil. When moved to contact the raceway surface, NSK K1 supplies fresh lubricating oil.

Rail cover (optional)



Covers the top surface of the rail and prevents foreign matter from entering the rail mounting bolt holes.

Note: Linear guides with V1 seals come standard with the NSK K1 lubrication unit. This makes the slide length slightly longer with standard seals. See the table on Page B30 for details.

● Performance

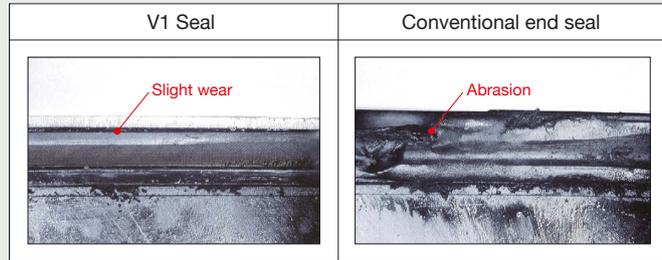
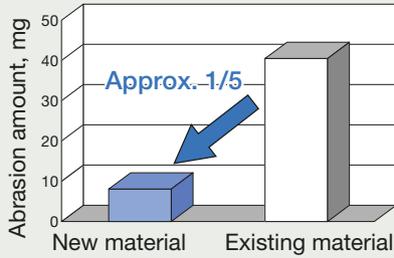
● Abrasion resistance

Highly abrasion-resistant material is used for the seal lip.

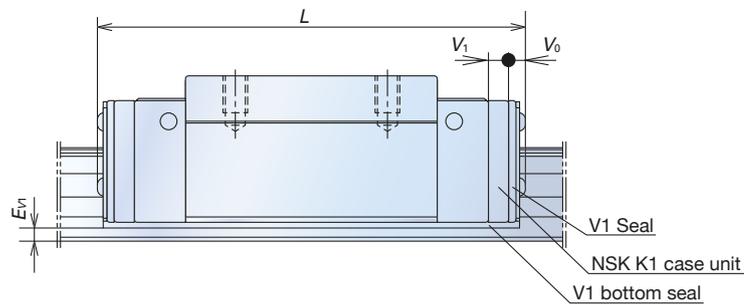
The durability of the seal lip has been greatly improved by adopting new materials and optimizing the seal lip shape.

Taper abrasion test (ASTMD1044)
 Load: 9.8 N
 Average speed: 29.7 m/min,
 Approx. 40 km/day

Durability test under extreme conditions - no lubrication
 Test sample: RA35
 Lubrication: No lubrication (on the seal)
 Travel speed: 30 m/min Travel distance: 40 km



● Dimensions



Unit : mm

Model No.	Roller slide length	Roller slide type	Standard roller slide length L	Roller slide length equipped with V1 seal and NSK K1 L	Slide bottom face height equipped with V1 bottom seal E_{V1}	Thickness of V1 seal V_0	Thickness of K1 case unit V_1
RA25	Standard	AN, AL, EM	97.5	111.3	-	5.1	5
	Long	BN, BL, GM	115.5	129.3			
RA30	Standard	AN, AL, EM	110.8	126.8	-	5.4	6
	Long	BN, BL, GM	135.4	151.4			
RA35	Standard	AN, AL, EM	123.8	140.8	min 3.7	5.4	6.5
	Long	BN, BL, GM	152	169			
RA45	Standard	AN, AL, EM	154	173.2	min 5.2	6.6	7
	Long	BN, BL, GM	190	209.2			
RA55	Standard	AN, AL, EM	184	203.2	min 6.2	6.6	7
	Long	BN, BL, GM	234	253.2			
RA65	Standard	AN, EM	228.4	251.2	min 10.2	8.9	7.5
	Long	BN, GM	302.5	325.3			

Since sealing (resistance to foreign matter) is affected by usage and the lubrication environment, please conduct an evaluation test for your particular application.

8. Ball Screws and NSK Linear Guides for High-Temperature Environments

NSK has developed heat-resistant ball screws and linear guides in response to high-temperature operating environments. Our products serve a variety of high-temperature applications, such as semiconductor and flat panel display production, glassware manufacturing, and automobile assembly lines.

Features Linear Guides for High-Temperatures

- **Maximum operating temperature:** 150 °C; maximum momentary temperature: approximately 200 °C (Standard models: 80 °C; maximum momentary temperature: approximately 100 °C)
- **All-stainless-steel specification:** All-stainless-steel products are excellent at resisting not only heat, but also corrosion and chemicals. These can also be used in vacuum environments.

● Applicable models and sizes

Models and model numbers not listed are also available upon request.

Applicable Model	Size codes*	
	Standard material specification	All-stainless-steel specification (except for seals)
NH (high load capacity/aligning)	20, 25, 30, 35, 45, 55	20, 25, 30
NS (compact low type)	15, 20, 25, 30	15, 20, 25, 30
LW (broad type)	17, 21, 27	—
LU (miniature)	09, 12, 15	09, 12, 15
LE (miniature broad type)	—	09, 12, 15

Note: *Example of a basic code



 Model Size code.....Indicates the rail width or assembly height.

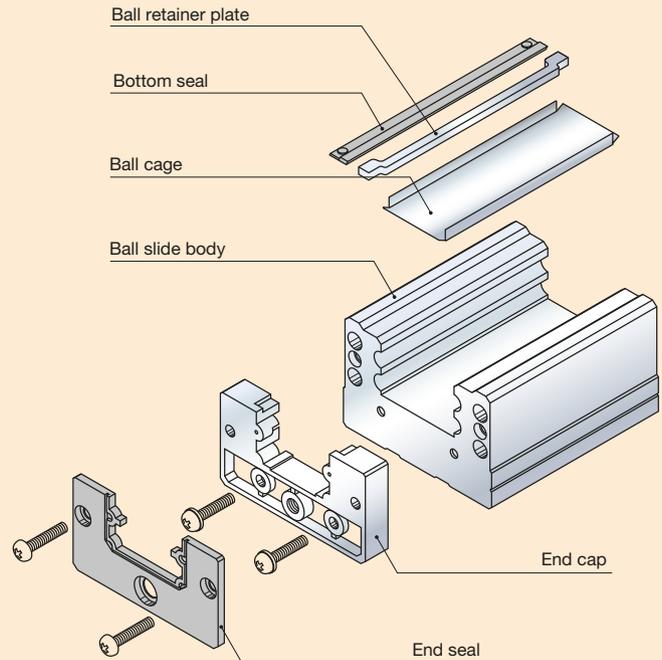
For details, see our "Precision Machine Components" catalog (No. E3162)

● Structure

Special high-carbon steel with excellent rolling durability or martensite stainless steel with high cleanliness are used for the rails, ball slide, and balls. A heat- and chemical-resistant fluororubber is used for the seal, while corrosion-resistant austenite stainless steel is used for the remaining components.



Heat-resistant linear guides



● Materials used for components

Linear guide component	Material specification
Rail, ball slide	Martensite stainless steel
Ball	SUS440C
End cap, recirculation components of cage, small screws	Austenite stainless steel
Seal	Fluororubber, etc.

Features of Ball Screws for High Temperatures

- Maximum operating temperature: 150 °C maximum momentary temperature: approximately 200 °C

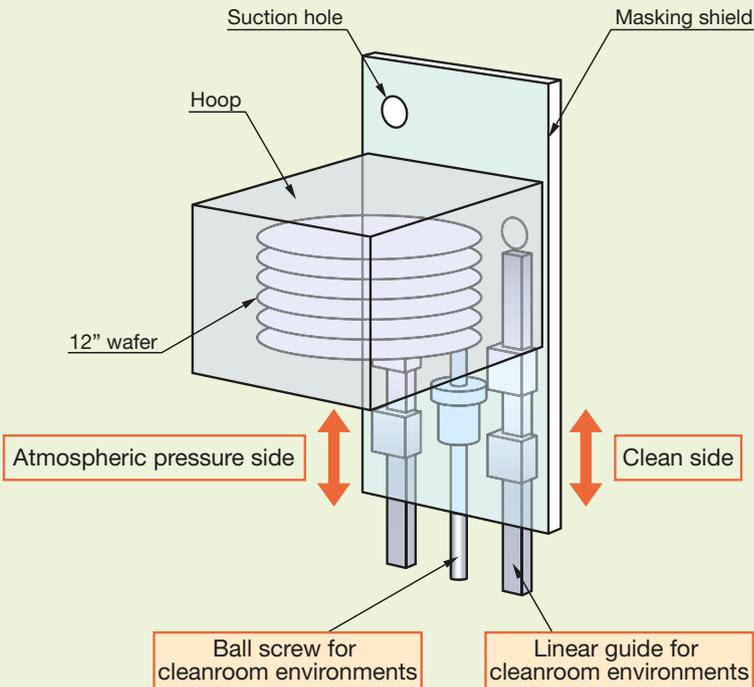
● Materials used for components

Ball screw component	Material specification
Shaft, nut	Martensite stainless steel
Ball	SUS440C
Recirculation components	Austenite stainless steel

F Applications for SPACEA™ Series Ball Screws

1. Semiconductor Manufacturing Equipment/Flat Panel Display Manufacturing Equipment

Wafer Conveyor



Operating Conditions

Cleanroom environments

- Cleanliness: Class 5 (ISO14644-1)
- Temperature: Room temperature
- Speed: 5 m/min
- Load: Pitching moment included

Feature

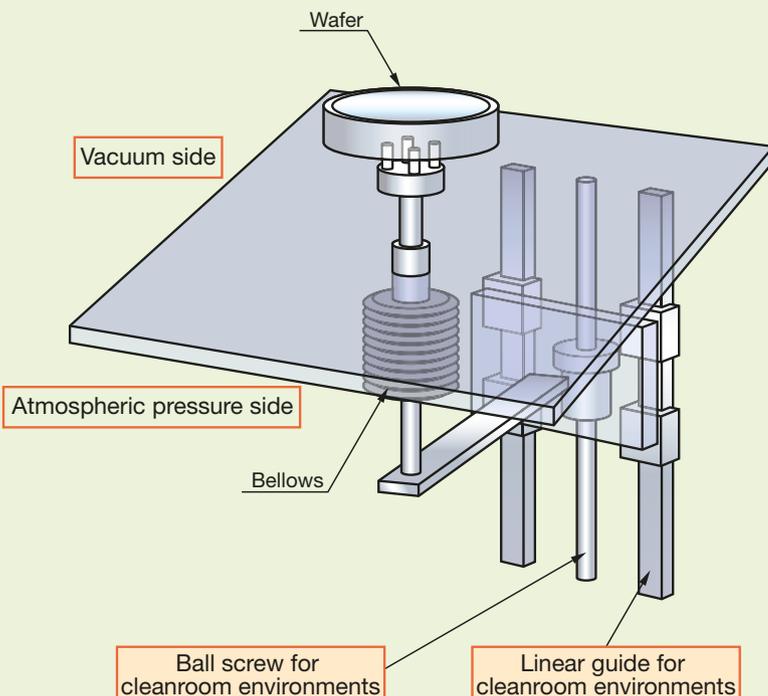
- Change from a commercially available vacuum grease to NSK "clean" grease

SPACEA™ Series

Ball screws and linear guides for cleanroom environments

- Reduces costs and maintenance

Wafer Lift



Operating Conditions

Cleanroom environments

- Cleanliness: Class 5 (ISO14644-1)
- Temperature: Room temperature
- Speed: 20 m/min
- Load: Pitching moment included

Feature

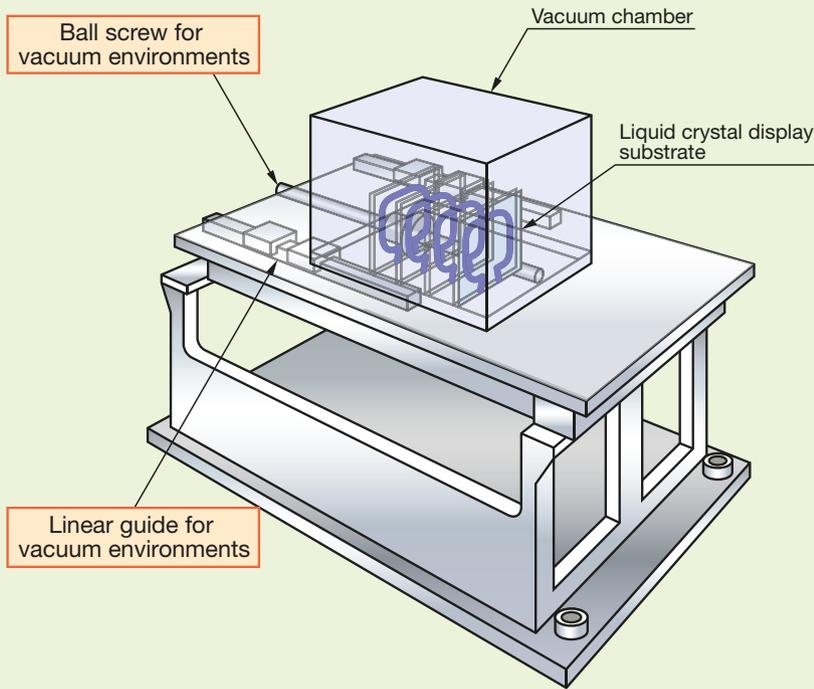
- Change from a commercially available vacuum grease to NSK "clean" grease

SPACEA™ Series

Ball screws and linear guides for cleanroom environments

- Reduces costs and maintenance

Liquid Crystal Filling Machine



Operating Conditions

Vacuum/Cleanroom environments

- Degree of vacuum: 10^{-1} Pa
- Temperature: 100–150 °C
- Speed: 10 m/min
- Load: Minimal

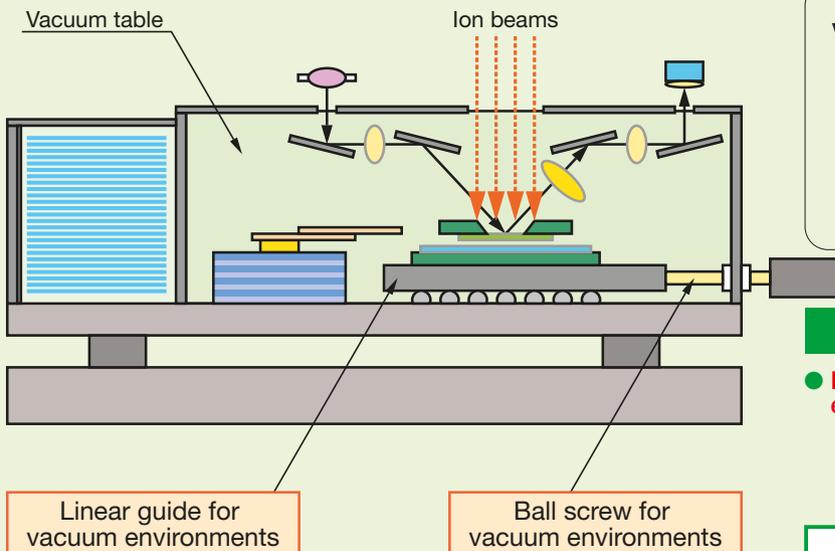
Feature

- Heat-resistant

SPACEA™ Series

Ball screws and linear guides for vacuum environments

Ion Implanting Equipment



Operating Conditions

Vacuum/Cleanroom environments

- Degree of vacuum: 10^{-5} Pa
- Temperature: 100 °C
- Speed: 1 m/min
- Load: Minimal

Feature

- Improved durability in vacuum environments, with E-DFO lubrication

SPACEA™ Series

Ball screws and linear guides for vacuum environments

This section provides descriptions of the physical properties of lubricants and materials used in SPACEA™ Series bearings, ball screws, and linear guides. Reference values for physical characteristics are provided for your convenience.

Please use the "Specification Inquiry" page at the back of catalog when contacting NSK. We will do everything possible to find a SPACEA product that suits your needs.

● Appendices ●

Physical Properties of Materials..... C3-C11

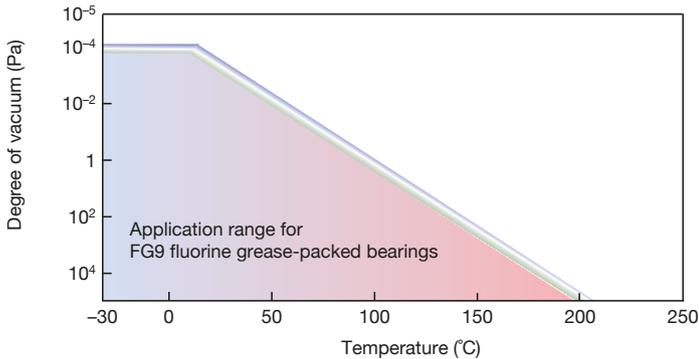
1. Properties of SPACEA™ Series Greases
2. Characteristics of Representative Solid Lubricants
3. Characteristics of Metallic Materials
4. Characteristics of Ceramic Materials
5. Physical Properties of Plastic Materials
6. Properties of Commercially Available Fluorine Lubricants (Krytox)
7. Properties of Commercially Available Fluorine Lubricants (Fomblin oil, Klübertemp / Klüberalfa grease)
8. Properties of Commercially Available Fluorine Lubricants (Barrierta, NOXLUB, Demnum)
9. Specification Inquiry for SPACEA Series Bearings

Appendices

1. Properties of SPACEA™ Series Greases

Operating environment	Grease	Atmospheric pressure, vacuum	Maximum operating temperature °C	Cleanliness ⁽¹⁾	Base oil	Thickener	Kinematic viscosity mm ² /s, 40 °C
Atmospheric pressure	NS7	Atmospheric pressure	100	—	Polyol ester oil + Diester oil	Lithium soap	26
Atmospheric pressure, Cleanroom	LG2	Atmospheric pressure	70	Class 5-6 (100-1 000)	Mineral oil and synthetic hydrocarbon oil	Lithium soap	32
	LGU		120		Synthetic hydrocarbon oil	Diurea	96
From atmospheric pressure up to vacuum, Cleanroom	FG9	See the application range for FG9 Grease-Packed Bearings below.			Fluorine oil	PTFE	200
Atmospheric pressure, high-temperature	KPM	Atmospheric pressure	230		—	Fluorine oil	PTFE
Atmospheric pressure, sanitary	RLS	Atmospheric pressure	120	—	Synthetic hydrocarbon oil	Aluminum alloy soap	150
	BLS		200	—	Fluorine oil	PTFE	415

Note (1) Cleanliness is indicated per ISO 14644-1 (values in parentheses refer to former US FED-STD-209E Classes). Cleanliness may vary depending on operating conditions, surrounding structures, and other factors.



2. Characteristics of Representative Solid Lubricants

⊙: Excellent ○: Good △: Satisfactory

Solid lubricant	Relative density g/cm ³	Molecular mass	Crystal structure	Electric resistance Ω · cm	Maximum operating temperature °C		Coefficient of friction		Particle emissions	Outgassing
					Atmospheric pressure	Vacuum	Atmospheric pressure	Vacuum		
Molybdenum disulfide MoS ₂	4.8	160.07	Hexagonal crystal system	8.33 (-60 °C)	350	650	0.006-0.25	0.001-0.2	△	○
Tungsten disulfide WS ₂	7.4	248.02	Hexagonal crystal system	0.40 (92 °C)	425	750	0.05-0.28	0.001-0.2	△	○
Graphite C	2.24	12.011	Hexagonal crystal system	2.6 × 10 ⁻³	550	—	0.05-0.3	0.4-1.0	△	○
Polytetrafluoroethylene PTFE	2.2	—	Long-chain	10 ¹⁴	260	260	0.04-0.2	0.04-0.2	⊙	△
Polyimide	1.4	—	Long-chain	—	300	300	0.12	0.10	○	△
Gold Au	19.3	196.97	Face-centered cubic	2.2 × 10 ⁻⁶	200	200	0.2-0.5	—	△	⊙
Silver Ag	10.5	107.87	Face-centered cubic	1.6 × 10 ⁻⁶	—	600	—	0.2-0.3	△	⊙
Lead Pb	11.3	207.2	Face-centered cubic	2.08 × 10 ⁻⁶	100	350	0.05-0.5	0.05-0.5	△	⊙

3. Characteristics of Metallic Materials

Metallic material	Thermal expansion coefficient $\times 10^{-6} / ^\circ\text{C}$	Young's modulus GPa	Hardness ⁽¹⁾ HV	Relative permeability
Bearing steel SUJ2	12.5	208	700–800	Ferromagnetic
Highly corrosion-resistant stainless steel ES1	10.8	206	650–750	
Martensite stainless steel SUS440C	10.1	200		
Highly corrosion-resistant, high hardness stainless steel ESZ	10.6	202	580–650	
Precipitation-hardened stainless steel SUS630	10.8	200	390	
Austenite stainless steel SUS304	16.3	193	150	1.04 or less

Note (1) Converted to HV (Vickers hardness) for comparison

4. Characteristics of Ceramic Materials

◎ : Excellent ○ : Good △ : Satisfactory × : Unsatisfactory

Item	Unit	Silicon nitride ceramics	Oxide-based ceramics	Bearing steel
Density	g/cm^3	3.23	5.9	7.8
Young's modulus	GPa	330	210	208
Fracture toughness	$\text{MPa} \cdot \text{m}^{1/2}$	6	7.5	18
Hardness (HV)	—	1 500	1 300	700
Thermal expansion coefficient	$\times 10^{-6} / ^\circ\text{C}$	2.8	10.5	12.5
Thermal conductivity	$\text{W} / \text{m} \cdot \text{k}$	31	3	50
Bending strength	MPa	900	1 100	$\geq 2 500$
Rotating capability in water	—	◎	○	×
Rotating capability in acid solvents	—	△	○	×

5. Physical Properties of Plastic Materials

Plastic materials used for the cages of bearings for special environments are generally reinforced with carbon fibers, solid lubricants such as MoS_2 , and wear-resistant additives.

Plastic	Classification ⁽¹⁾	Elasticity coefficient GPa	Strength GPa	Density g/cm^3	T_m ⁽²⁾ $^\circ\text{C}$	Heat distortion temperature ⁽³⁾ $^\circ\text{C}$
Polyphenylene sulfide (PPS)	M, C	1.4	0.155	1.64	285	>260
Polyetheretherketone (PEEK)	M, C	3.9	0.1	1.3	335	152
Heat reversible polyimide (TPI)	M, C	2.94	0.092	1.33	388	238
Tetrafluoroethylene-ethylene copolymer (ETFE)	M, C	0.88–1.37	0.04–0.046	1.7–1.76	260	74 (104)
Polyvinylidene fluoride (PVDF)	M, C	1.6	0.045	1.76	170	90 (150)
Polytetrafluoroethylene (PTFE)	C	0.40	0.028	2.16	327	– (120)
Polyamide (nylon 6-6)	M, C	3.0	0.08	1.14	264	60 (180)
Nylon 4-6	M, C	3.14	0.1	1.18	295	220

Notes (1) Classification M: Moldable C: Crystalline

(2) T_m : Melting point

(3) Heat distortion temperature values in parentheses are at 454 kPa, all other values are at 181 MPa.

Appendices

6. Properties of Commercially Available Fluorine Lubricants (Krytox)

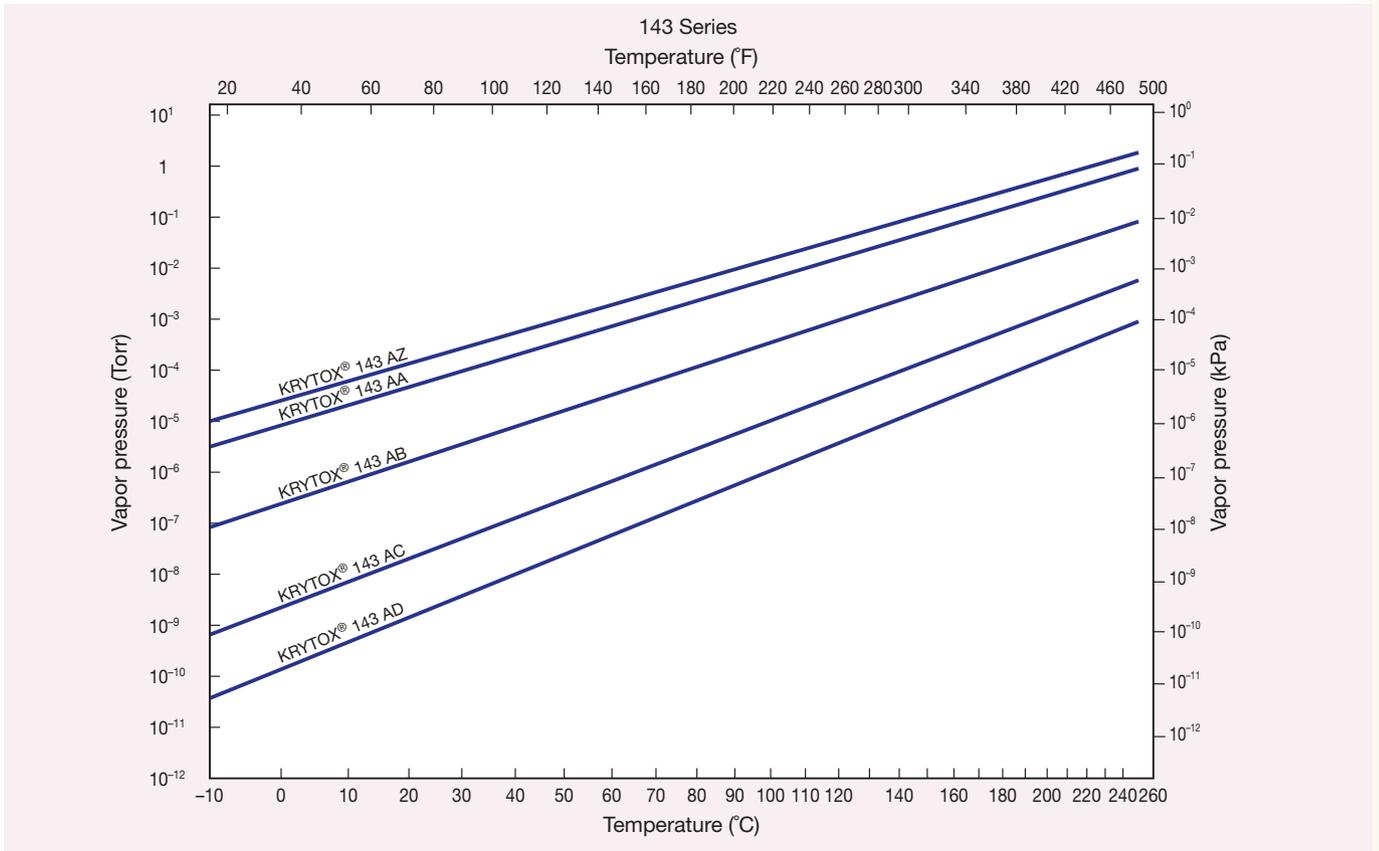
● Krytox oil (Chemours)

Product	Average molecular weight	Kinematic viscosity mm ² /s				Viscosity index	Pour point °C	Vapor pressure (Knudsen number) Pa				Evaporation wt % (Temperature, 22 hours)	Density g/cm ³ (0 °C)	Range of operating temperatures (°C)	
		20 °C	38 °C	50 °C	100 °C			20 °C	38 °C	50 °C	260 °C				
143 Series	AZ	2 060	60	24.7	—	4.1	60	-55	—	5×10 ⁻⁵	—	0.2	18 (149 °C)	—	—
	AA	2 210	88	35	—	5.3	96	-50	—	1×10 ⁻⁵	—	0.1	15 (t)	—	—
	AB	3 800	240	86	—	10.2	113	-40	—	7×10 ⁻⁷	—	4×10 ⁻³	1.9 (t)	—	—
	AC	5 940	800	270	—	25.4	134	-35	—	1×10 ⁻⁸	—	3×10 ⁻⁴	4 (260 °C)	—	—
	AD	7 480	1 540	502	—	42.4	146	-30	—	8×10 ⁻¹⁰	—	4×10 ⁻⁵	2 (260 °C)	—	—
1500 Series	1506	2 160	60	—	15.5	4.1	—	-60	4×10 ⁻⁷	—	1×10 ⁻⁵	—	6.5 (121 °C)	1.88	—
	1514	2 840	140	—	32	7.2	—	-54	2×10 ⁻⁷	—	3×10 ⁻⁶	—	1.3 (t)	1.89	—
	1525	3 470	250	—	52	10.6	—	-48	1×10 ⁻⁷	—	1×10 ⁻⁶	—	0.6 (t)	1.9	—
1600 Series	16256	9 400	2 560	—	437	64.6	—	-15	3×10 ⁻¹⁴	—	2×10 ⁻¹²	—	0.2 (t)	1.92	—
GPL Series	100	—	12.4	—	—	—	—	<-70	—	—	—	—	90 (121 °C)	—	-70/66
	101	—	17.4	—	—	2	—	<-70	—	—	—	—	75 (t)	—	-70/104
	102	—	38	—	—	3	29	<-63	—	—	—	—	35 (t)	—	-63/132
	103	—	82	—	—	5	92	-60	—	—	—	—	7 (t)	—	-60/154
	104	—	177	—	—	8.4	111	-51	—	—	—	—	3 (t)	—	-51/179
	105	—	522	—	—	18	124	-36	—	—	—	—	7 (204 °C)	—	-36/204
	106	—	822	—	—	25	134	-36	—	—	—	—	<3 (t)	—	-36/260
	107	—	1 535	—	—	42	145	-30	—	—	—	—	<1 (t)	—	-30/288

● Krytox grease

Product	Base oil	Kinematic viscosity mm ² /s (38 °C)	Thickener	Consistency NLGI No.	Vapor pressure (Knudsen number) Pa		Oil separation rate wt % (204 °C, 30h)	Evaporation wt % (204 °C, 6.5h)	Density g/cm ³ (25 °C)	Additive
					38 °C	260 °C				
240AZ	143AZ	24.7	PTFE	2	4×10 ⁻⁴	1.5	6	18 (149 °C)	—	None
240AA	143AA	35			1×10 ⁻⁴	0.8	5	15 (149 °C)	—	↑
240AB	143AB	86			5×10 ⁻⁶	3×10 ⁻²	4	1.9 (149 °C)	—	↑
240AC	143AC	270			8×10 ⁻⁸	2×10 ⁻³	3	4 (260 °C)	—	↑
240AD	143AD	502			6×10 ⁻⁹	3×10 ⁻⁴	3	2 (260 °C)	—	↑
250AC	143AC	270	PTFE	2	8×10 ⁻⁸	2×10 ⁻³	3	4 (260 °C)	—	MoS ₂
280AC	143AC	270			↑	↑	3	4 (260 °C)	—	Anti-rust agent
283AC	143AC	270			↑	↑	3	4 (260 °C)	—	Anti-rust agent
283AD	143AD	502			6×10 ⁻⁹	3×10 ⁻⁴	3	2 (260 °C)	—	Anti-rust agent
LVP	16256	740 (40 °C)	PTFE	2	1×10 ⁻¹³ (20 °C)	1×10 ⁻⁵ (200 °C)	—	0.2 (121 °C)	1.94	None
GPL204	GPL104	60 (40 °C)	PTFE	2	—	—	5	3 (121 °C)	—	None
GPL224	GPL104	60 (40 °C)			—	—	5	3 (121 °C)	—	Anti-rust agent
GPL207	GPL107	450 (40 °C)			—	—	4	<1 (204 °C)	—	None
GPL227	GPL107	450 (40 °C)			—	—	4	<1 (204 °C)	—	Anti-rust agent

● Vapor pressure of Krytox oil



Appendices

7. Properties of Commercially Available Fluorine Lubricants (Fomblin oil, Klübertemp / Klüberalfa Grease)

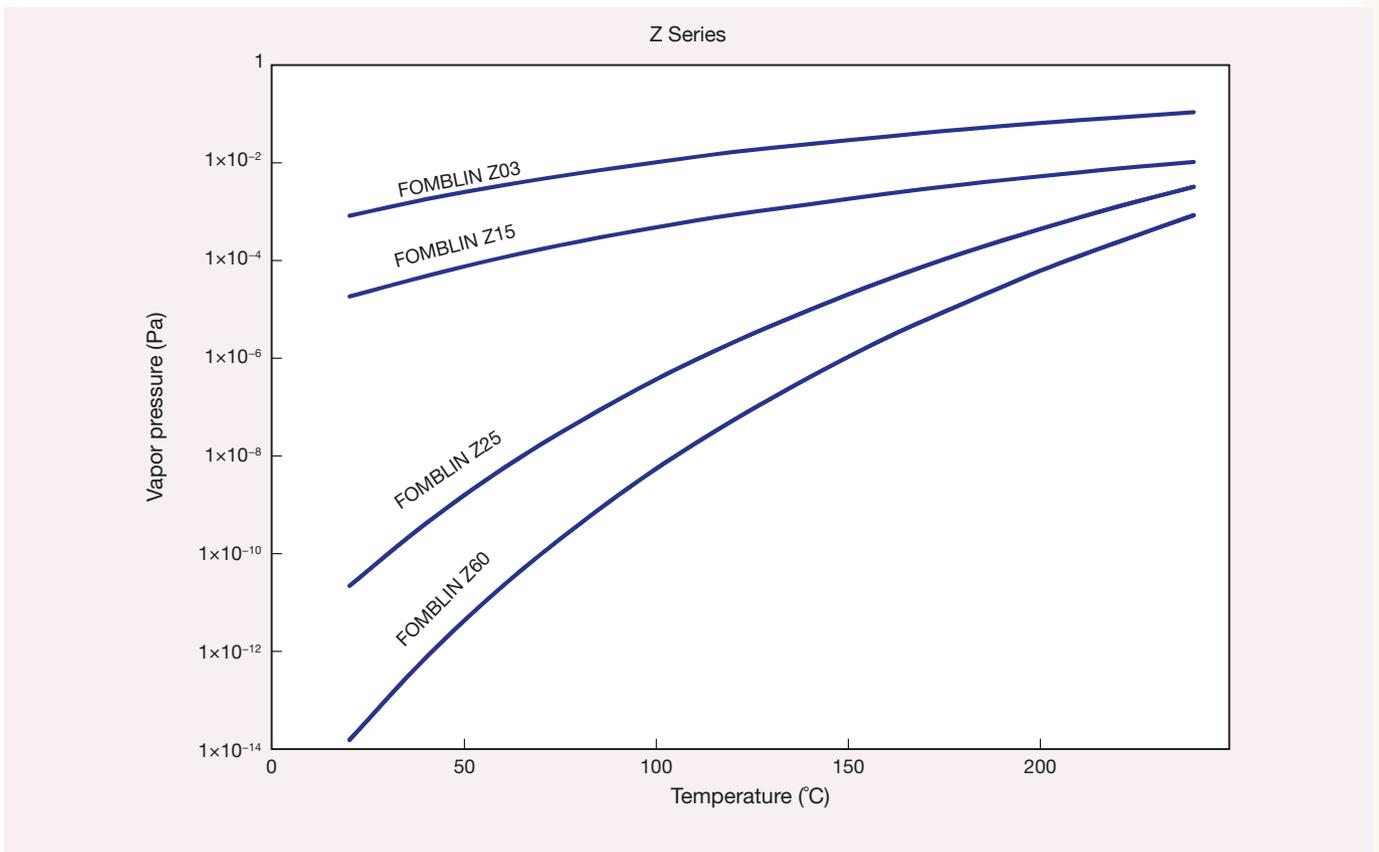
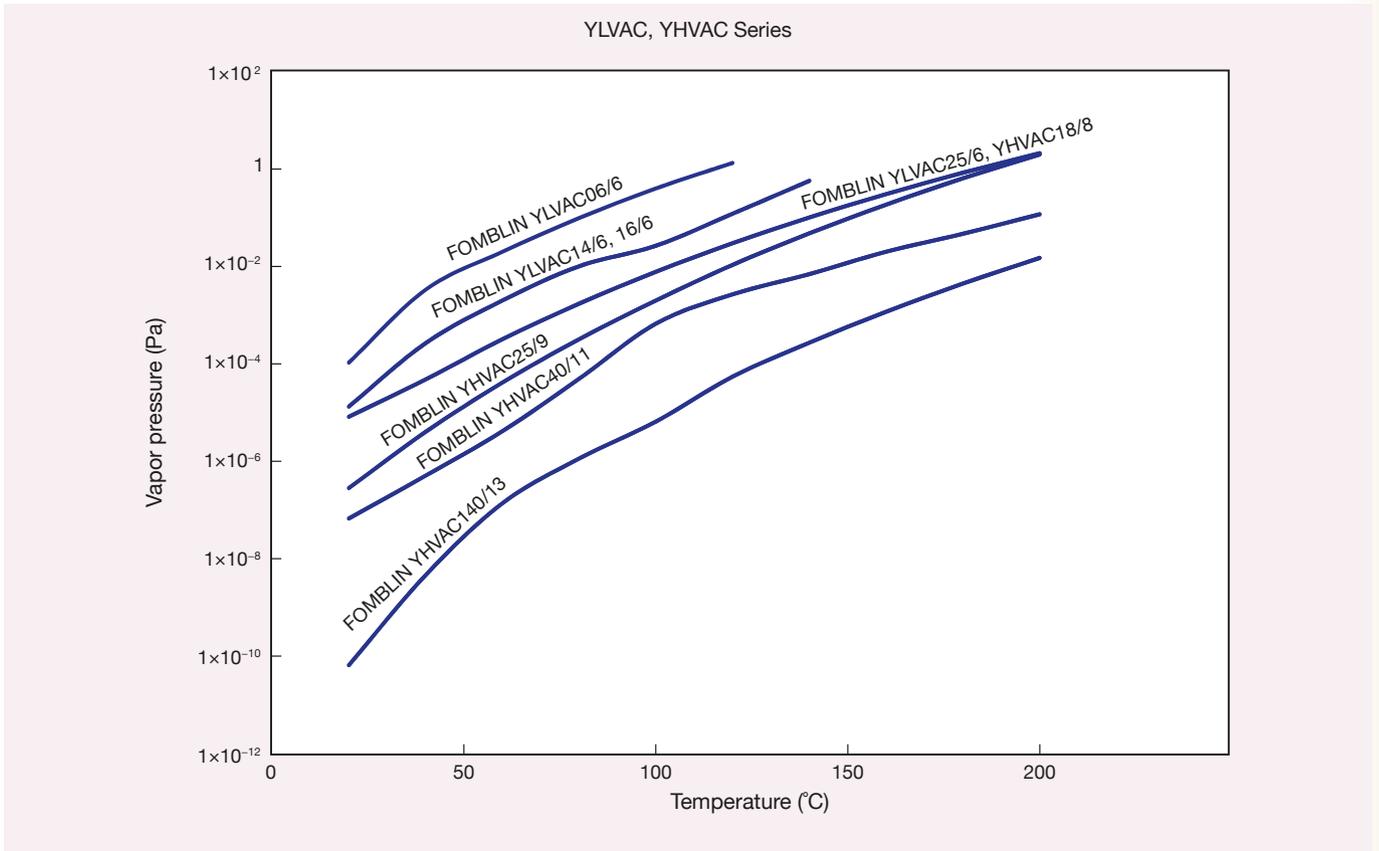
● Fomblin oil (Solvay Specialty Polymers)

Product	Average molecular weight	Kinematic viscosity mm ² /s			Viscosity index	Pour point °C	Vapor pressure (Knudsen number) Pa		Evaporation wt % (Temperature, 22 hours)	Density g/cm ³ (20 °C)	
		20 °C	40 °C	100 °C			20 °C	100 °C			
Y Series	Y04	1 500	38	15	3.2	60	-58	—	—	9 (120 °C)	1.87
	Y06	1 800	60	22	3.9	70	-50	—	—	6 (120 °C)	1.88
	Y25	3 200	250	80	10	108	-35	—	—	15 (204 °C)	1.90
	Y45	4 100	470	147	16	117	-30	—	—	1.7 (204 °C)	1.91
	YR	6 250	1 200	345	33	135	-25	—	—	1.2 (204 °C)	1.91
YLVAC Series	06/6	—	64	—	—	—	-50	≤1.1 × 10 ⁻⁴	≤4.0 × 10 ⁻¹	—	1.88
	14/6	—	148	—	—	—	-45	≤1.3 × 10 ⁻⁵	≤2.7 × 10 ⁻²	—	1.89
	16/6	—	168	—	—	—	-45	≤2.7 × 10 ⁻⁶	≤2.7 × 10 ⁻²	—	1.90
	25/6	—	276	—	—	—	-35	≤8.0 × 10 ⁻⁶	≤8.0 × 10 ⁻³	—	1.90
YHVAC Series	18/8	—	190	—	9	—	-42	≤2.6 × 10 ⁻⁶	≤2.6 × 10 ⁻²	—	1.89
	25/9	—	285	—	12	—	-35	≤2.6 × 10 ⁻⁷	≤2.6 × 10 ⁻³	—	1.90
	40/11	—	474	—	—	—	-32	≤6.6 × 10 ⁻⁸	≤6.6 × 10 ⁻⁴	—	1.91
	140/13	—	1 508	—	—	—	-23	≤6.5 × 10 ⁻¹¹	≤6.5 × 10 ⁻⁶	—	1.92
Z Series	Z03	4 000	30	18	5.6	317	-90	—	—	6.0 (149 °C)	1.82
	Z15	8 000	160	92	28	334	-80	—	—	1.2 (204 °C)	1.84
	Z25	9 500	263	157	49	358	-75	—	—	0.4 (204 °C)	1.85
	Z60	13 000	600	355	98	360	-63	—	—	0.2 (204 °C)	1.85

● Klübertemp / Klüberalfa grease (NOK Klüber)

Product	Thickener	Consistency NLGI No.	Oil separation Rate wt % (204 °C, 30h)	Evaporation wt % (204 °C, 22h)	Density g/cm ³ (20 °C)	Additive	Working Temperature Range °C	
Klübertemp	PTFE	GR OT20N	2	—	—	1.90	Anti-rust agent (solid)	-50/70
		GR UT18N	2	—	—	1.90	Anti-rust agent (solid)	-30/200
		GR RT15N	2	≤12	≤3	1.90	Anti-rust agent (solid)	-20/250
		GR RT2	2	≤12	≤3	1.90	Anti-rust agent (solid)	-20/250
Klüberalfa	PTFE	GR YVAC1	1	≤14	≤1	1.90	None	-20/250
		GR YVAC2	2	≤12	≤1	1.90	None	-20/250
		GR YVAC3	3	≤10	≤1	1.90	None	-20/250

● Vapor pressure of Fomblin oil



Appendices

8. Properties of Commercially Available Fluorine Lubricants (Barrierta, NOXLUB, Demnum)

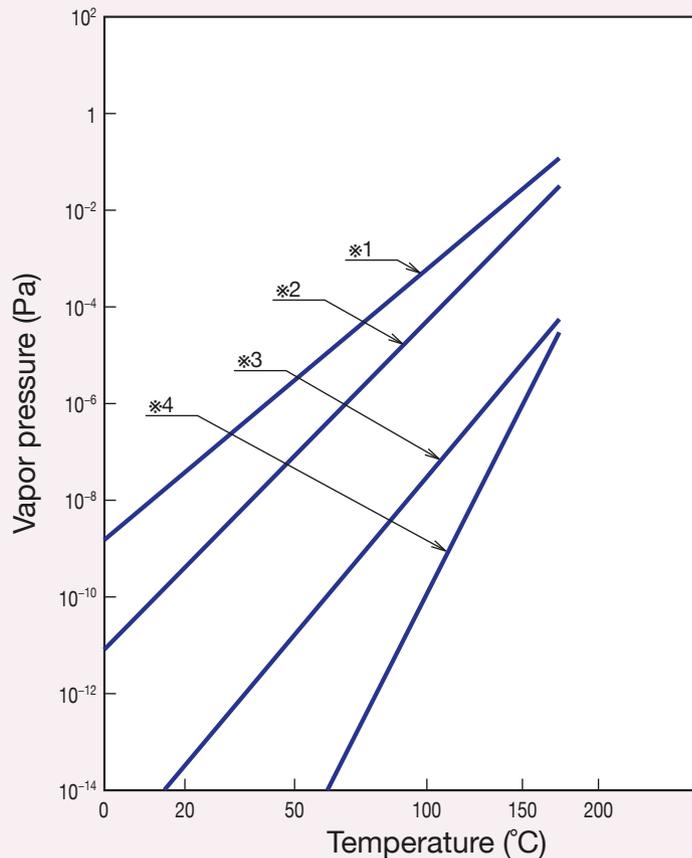
● Barrierta oil (NOK Klüber)

I Series	Average molecular weight	Kinematic viscosity mm ² /s		Viscosity index	Pour point °C	Density g/cm ³ (20 °C)
		20 °C	40 °C			
IEL FLUID	3 500	310	98	≥100	≤-45	1.90
IMI FLUID	4 500	670	205	≥120	≤-30	1.90
IS FLUID	7 500	1 400	425	≥120	≤-30	1.91

● Barrierta grease (NOK Klüber)

Product	Base oil	Kinematic viscosity mm ² /s (40 °C)	Thickener	Consistency NLGI No.	Vapor pressure (Knudsen number) (20 °C)	Oil separation rate wt % (100 °C, 24h)	Evaporation wt % (99 °C, 22h)	Density g/cm ³ (25 °C)	Additive
IEL	*1	95	PTFE	2	6×10 ⁻⁶	-	-	1.95	Anti-rust agent
IMI	*2	180		2	7×10 ⁻⁷	-	-	1.95	Anti-rust agent
IS	*3	390		2	2×10 ⁻⁸	-	-	1.95	Anti-rust agent
L55/2 J	-	390	PTFE	2	2×10 ⁻⁸	6.0	0.1	1.95	Anti-rust agent
IEL/V	-	65	PTFE	2	5×10 ⁻⁶	5.8	0.2	1.95	Anti-rust agent
IMI/V	-	180		2	9×10 ⁻¹⁰	5.4	0.2	1.95	Anti-rust agent
IS/V	-	415		2	5×10 ⁻¹⁴	5.1	0.1	1.95	None
SUPER IS/V	-	415		2	5×10 ⁻¹⁴	5.1	0.1	1.95	None

● Vapor pressure of Barrierta oil



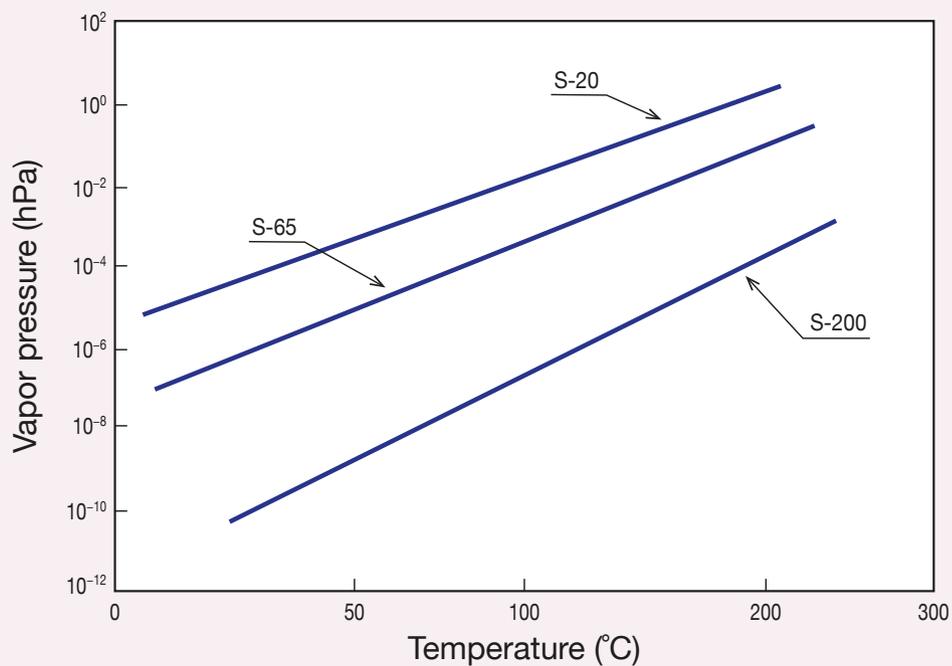
● NOXLUB grease (NOK Klüber)

Product		Base oil	Thickener	Consistency NLGI No.	Vapor pressure (Knudsen number) (20 °C)	Oil separation rate wt % (100 °C, 24h)	Evaporation wt % (99 °C, 22h)	Density g/cm ³ (25 °C)	Additive
KF 0622	–	65	PTFE	2	3×10^{-5}	–	–	1.96	None
KF 2024	–	200		2	3×10^{-9}	–	–	1.95	None
BF 9922	※4	1 200		2	1×10^{-18}	–	–	2	None

● Demnum (Daikin)

Product	Average molecular weight	Kinematic viscosity mm ² /s			Viscosity index	Pour point °C	Density g/cm ³ (20 °C)
		20 °C	40 °C	60 °C			
S-20	2 700	53	25	14	150	–75	1.86
S-65	4 500	150	65	33	180	–65	1.87
S-200	8 400	500	200	95	210	–53	1.89

● Vapor pressure of Demnum



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