MOTION & CONTROL™

NSK



# 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.



SPACEA™

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# NSK *Global Network*

SPACEA™

**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.

- Headquarters.....**6**
- Plants.....**64**
- Sales offices.....**118**
- Technical offices.....**16**
- Representative offices.....**4**

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

| ASIA/OCEANIA | ● | | ■ | □ | ▢ |
|---|---|---|---|---|---|
| Singapore | 1 | | 2 | | |
| Indonesia | | 3 | 2 | | |
| Thailand | | 2 | 5 | 1 | |
| Malaysia | | 2 | 4 | | |
| Philippines | | | | | 1 |
| Vietnam | | | 2 | | |
| India | 1 | 5 | 10 | 1 | |
| Australia | | | 4 | | |
| New Zealand | | | 1 | | |
| Japan | 1 | 20 | 31 | 7 | |
| China | 1 | 11 | 17 | 1 | 1 |
| Hong Kong | | | 1 | | |
| South Korea | | 2 | 2 | 1 | |
| Taiwan | | | 3 | | |

| THE AMERICAS | ● | | ■ | □ | ▢ |
|---|---|---|---|---|---|
| U.S.A. | 1 | 7 | 9 | 1 | |
| Canada | | | 2 | | |
| Mexico | | 2 | 1 | | |
| Brazil | | 1 | 5 | 1 | |
| Peru | | | 1 | | |
| Argentina | | | 1 | | |

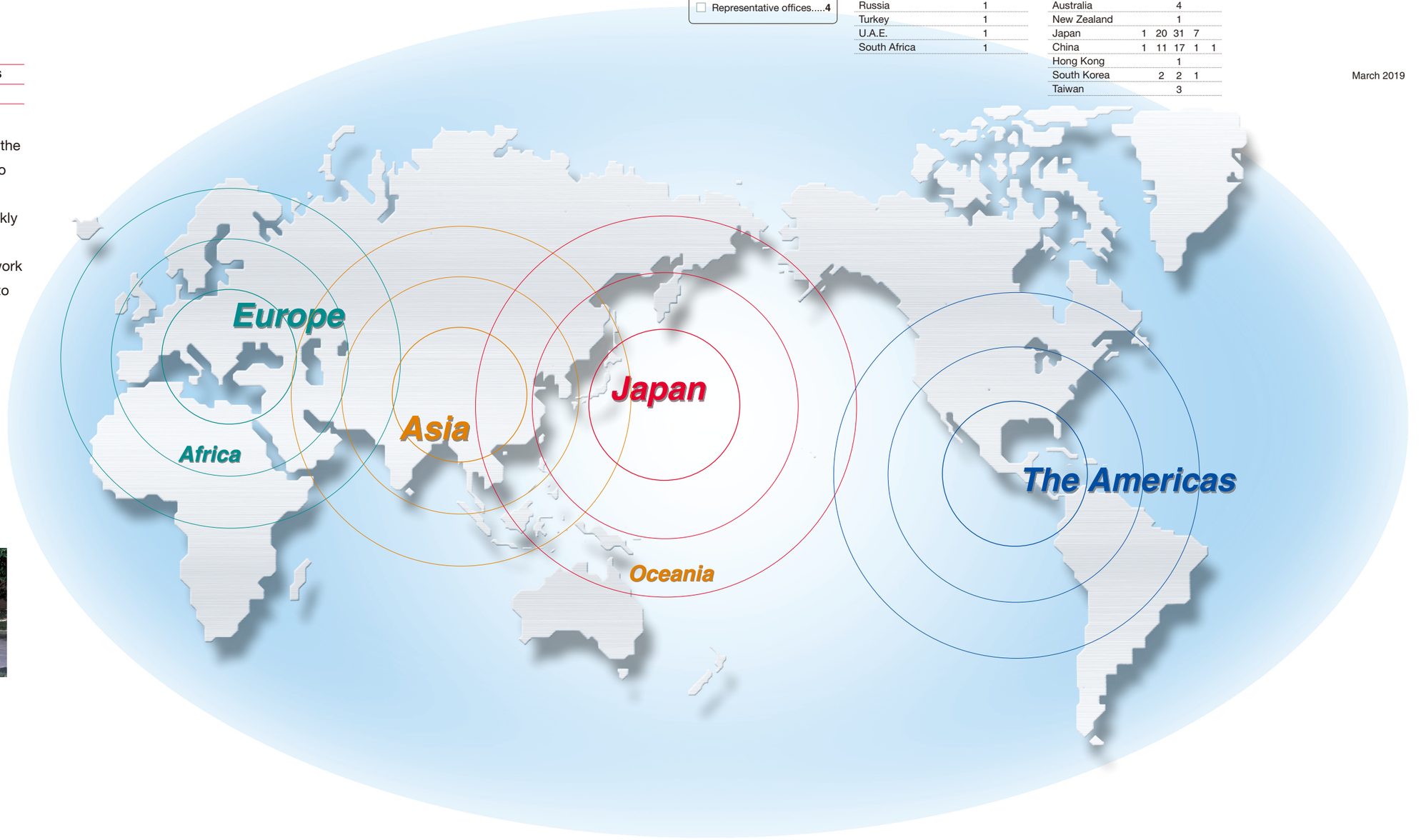
March 2019

## 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.







# NSK *Research and Development*

SPACEA™

**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)

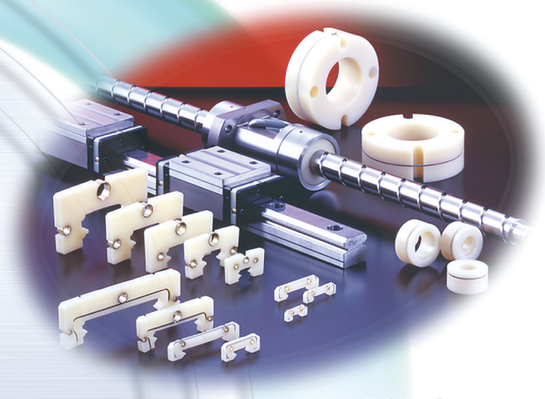


China Technology Center (China)



Bearings for vacuum and high-temperature environments



Lubrication Unit "NSK K1™"



Test rig for bearings for vacuum conditions

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


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C Dimensions, Accuracy, and Availability ····· A9–A28

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# SPACEA™ Series Bearings

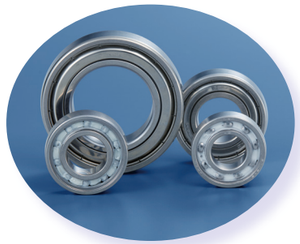


## Inventory

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, hard disk production, food processing, and pharmaceutical/cosmetics and equipment for 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

- **Clean**
  - DL2 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

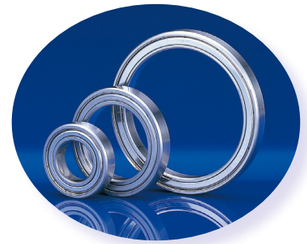


Aqua-Bearing™

SPACEA™ Series Bearings

### Clean environments

- **At atmospheric pressure, room temperature**
  - LG2 grease-packed bearings
  - LGU grease-packed bearings
- **At atmospheric pressure, high-vacuum, medium-temperature**
  - DL2 grease-packed bearings
- **Vacuum, high-temperature**
  - DFO bearings



Clean grease-packed bearings

### High-temperature environments

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



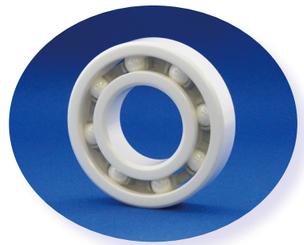
SJ bearings



DFO bearings

### Non-magnetic requirements

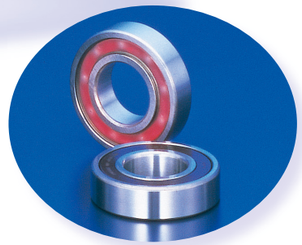
- All-ceramic bearings



All-ceramic bearings

### Contaminated environments

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



Molded-Oil™ bearings

# B SPACEA™ Bearing Selection Guide-I

SPACEA™

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

① Select the group of bearings appropriate for your operating environment and application. → ② Find the bearings that suit your operating conditions. → ③ Select the bearing most appropriate in terms of availability and price. → ④ Check the operating instructions and notes.

| ① Operating environment | | | Product | ② Operating conditions: Degree of vacuum Pa | | | ② Operating conditions: Operating temperature ℃ | | | | ② Operating conditions: Cleanliness[1] | | | ② Operating conditions: Limiting rotational speed $d_m n$ [2] | | | ② Operating conditions: Limiting load $P/C_H$[3] | | | ③ Price comparison | ③ Availability | ④ ·Specifications ·Operating instructions ·Technical data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Atmospheric pressure | ≥$10^{-4}$ | ≥$10^{-8}$ | ≤100 | ≤200 | ≤300 | ≤400 | 100–1 000 | 100 | 10 | ≤20 000 | ≤50 000 | ≤150 000 | ≤1% | ≤2% | ≤5% | | | |
| Vacuum | Clean | Classification of air cleanliness: Classes 100–1 000 | DL2 grease-packed bearings | $10^{-4}$Pa | | | 200 ℃ | | For details, please refer to Page A47. | | ● | | | | 50 000 | | | | 5% | Low ↑ High | Page A21–A22 | Page A47–A48 |
| | | Classification of air cleanliness: Classes 10–100 | V-DFO bearings | | | | 200 ℃ | | For details, please refer to Page A50. | | | | | | | | | 2% | | | Page A23 | Page A49–A50 |
| | | | E-DFO bearings | | $10^{-7}$Pa | | 150 ℃ | | | | | 10 | | 20 000 | | | | | 5% | | | |
| | High-temperature | Up to 400 ℃ | SJ bearings | | $10^{-8}$Pa | | | | 400 ℃ | | | | | | | | For details, please refer to Page A55. | | | Low ↑ High | Page A26 | Page A55–A56 |
| | | Up to 350 ℃ | YS bearings with spacer joints | | | $10^{-8}$Pa | | | 350 ℃ | | | | | 20 000 | | | For details, please refer to Page A53. | | | | Page A25 | Page A53–A54 |
| Corrosive environments | Water | High-humidity | Stainless steel bearings | | | | 80 ℃ | | | | | | | | 150 000 | | | | 5% | Low ↑ High | Page A11–A14 | Page A29–A30 |
| | | Water spray, immersed | Molded-Oil™ bearings | | | | 60 ℃ | | | | ● | | | For details, please refer to Page A33. | | | | 1 to 5% | | | Page A16 | Page A33–A34 |
| | | | Hybrid bearings | | | | | | | | | | | | | | | | | | Page A17 | Page A35–A36 |
| | | Water, sterilization liquid | Corrosion-resistant coated bearings | | | | 150 ℃ | | | | | | | 20 000 | | | | 2% | | | | Page A37–A38 |
| | Weak acid and alkali | | ESZ bearings | ● | | | 150 ℃ | | | | | | | 20 000 | | | | 2% | | High | Page A18 | Page A39–A40 |
| | Strong acid and reactive gas | | Aqua-Bearing™ | | | | 100 ℃ | | | | ● | | | | | | 1% | | | Low ↑ High | Page A20 | Page A43–A44 |
| | | | All-ceramic bearings | | | | 150 ℃ | | | | | | | 20 000 | | | | | 5% | | Page A19 | Page A41–A42 |

Notes
(1) Cleanliness may vary depending on operating conditions, surrounding structures, and other factors.
(2) $d_m n$ = (bearing bore diameter + bearing outer diameter (mm)) ÷ 2 × 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.)

Remarks: Please consult NSK about any unclear beaing specifications.

# B SPACEA™ Bearing Selection Guide-II

SPACEA™

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

① Select the group of bearings appropriate for your operating environment and application. → ② Find the bearings that suit your operating conditions. → ③ Select the bearing most appropriate in terms of availability and price. → ④ Check the operating instructions and notes.

| ① Operating environment | | Product name | ② Operating conditions: Degree of vacuum Pa | | | ② Operating conditions: Operating temperature ℃ | | | | ② Operating conditions: Cleanliness[1] | | | ② Operating conditions: Limiting rotational speed $d_m n$[2] | | | ② Operating conditions: Limiting load $P/C_H$[3] | | | ③ Price comparison | ③ Availability | ④ ·Specifications ·Operating instructions ·Technical data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Atmospheric pressure | ≥$10^{-4}$ | ≥$10^{-8}$ | ≤100 | ≤200 | ≤300 | ≤400 | 100–1 000 | 100 | 10 | ≤20 000 | ≤50 000 | ≤150 000 | ≤1% | ≤2% | ≤5% | | | |
| Cleanroom | For use at atmospheric pressure only | LG2/LGU grease-packed bearings | ● | | | 70 ℃ (LG2) 120 ℃ (LGU) | | | | ● | | | 50 000 | | | | | 5% | Low ↑ High | Page A21–A22 | Page A45–A46 |
| | From atmospheric pressure up to vacuum | DL2 grease-packed bearings | $10^{-4}$Pa | | | 200 ℃ | | For details, please refer to Page A47. | | | | | | | | | | | | | Page A47–A48 |
| | Low outgas and low particle emissions | V-DFO bearings | $10^{-7}$Pa | | | 200 ℃ | | For details, please refer to Page A50. | | | 10 | | 20 000 | | | 2% | | | | Page A23 | Page A49–A50 |
| | | E-DFO bearings | | | | 150 ℃ | | | | | | | | | | | | 5% | | | |
| High-temperature | For use at atmospheric pressure only, up to 230 ℃ | KPM grease-packed bearings | ● | | | 230 ℃ | | | | | | | 50 000 | | | | | 5% | Low ↑ High | Page A24 | Page A51–A52 |
| | From normal atmosphere up to $10^{-8}$ Pa, up to 400 ℃ | SJ bearings | $10^{-8}$Pa | | | 400 ℃ | | | | | | | 20 000 | | | For details, please refer to Page A55. | | | | Page A26 | Page A55–A56 |
| | From normal atmosphere up to $10^{-8}$ Pa, up to 350 ℃ | YS bearings with spacer joints | | $10^{-8}$Pa | | 350 ℃ | | | | | | | | | | For details, please refer to Page A53. | | | | Page A25 | Page A53–A54 |
| Non-magnetic | Completely non-magnetic (relative permeability 1.001 or less) | All-ceramic bearings | ● | | | 150 ℃ | | | | | | | 20 000 | | | | | 5% | – | Page A19 | Page A41–A42 |
| Sanitary environments | In food processing machinery | RLS grease-packed bearings | ● | | | 120 ℃ | | | | | | | 350 000 | | | | | 5% | Low ↑ High | Page A27–A28 | Page A58–A59 |
| | | High-temperature BL2 grease-packed bearings | ● | | | 200 ℃ | | | | | | | 300 000 | | | | | 5% | | | |
| | | Molded-Oil™ bearings with food grade lubricant | ● | | | 60 ℃ | | | | | | | For details, please refer to Page A33. | | | | | 1 to 5% | – | Page A16 | Page A33–A34 |
| Contaminated environments | Dust, wood waste, etc. | Molded-Oil™ bearings | ● | | | 60 ℃ | | | | | | | For details, please refer to Page A59. | | | | | 1 to 5% | – | Page A60 | Page A59–A60 |

Notes
(1) Cleanliness may vary depending on operating conditions, surrounding structures and other factors.
(2) $d_m n$ = (bearing bore diameter + bearing outer diameter (mm)) ÷ 2 × 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.)

Remarks: Please consult NSK about any unclear bearing specifications.

# 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 $\Delta_{dmp}$ | | 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) $\Delta_{Dmp}$ | | 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 $\Delta_{Bs}$ or $\Delta_{Cs}$ | | 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

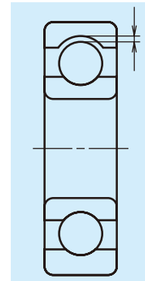
Unit: µm

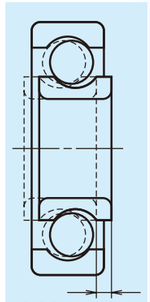
| Nominal bore diameter $d$ (mm) | | Radial runout of assembled bearing inner ring $k_{ia}$ | | Radial runout of assembled bearing outer ring $k_{ea}$ |
|---|---|---|---|---|
| Over | Incl | High | Low | Max |
| **2.5** | **10** | 10 | | 15 |
| **10** | **18** | 10 | | 15 |
| **18** | **30** | 13 | | 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 clearance


Axial clearance

● 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 | | | | |
|---|---|---|---|---|---|---|---|
| Over | Incl | | C2 | CN | C3 | C4 | C5 |
| **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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clearance | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| | 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 |

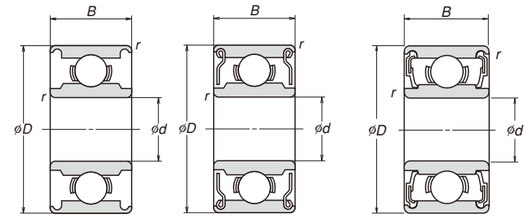
Remarks The measuring load for an extra-small ball bearing is 4.4 N.

# Dimensions, Accuracy, and Availability of SPACEA™ Series Bearings

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

Stocked as standard inventory

Bearings Specifications Tech. Data Page A29–A30




Open (example) Shielded (example) Rubber Sealed (example)

● 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 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | | | Open | Shielded (ZZ) | Rubber sealed (DD) | | | |
| 1 | 3 | 1 | 0.05 | **681** | 81 | ● | ● | | 10 000 | 4 | |
| | 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 | |
| | 7 | 3.5 | 0.15 | **602** | 328 | ● | ● | | 10 000 | 16 | |
| 2.5 | 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 | |
| | 8 | 4 | 0.15 | **602X** | 469 | ● | ● | | 10 000 | 23 | |
| 3 | 6 | 2.5 | 0.1 | **MR63** | 177 | ● | ● | | 10 000 | 8 | (A) |
| | 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 | |
| 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 | |
| | 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 | |
| | 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 | |
| | 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 | 0.15 | **6700** | 729 | ● | | | 10 000 | 36 | |
| | | 4 | | | | | ● | ● | | | |
| | 19 | 5 | 0.3 | ✻ **6800** | 1 460 | ● | ● | ● | 10 000 | 73 | (B) |
| | 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 | (B) |
| | 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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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.

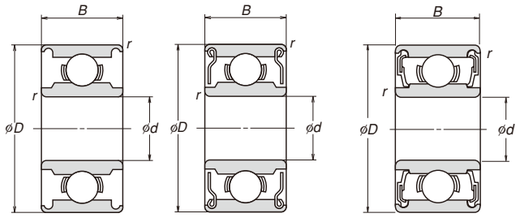
## 1-1. Stainless Steel Bearings (Bore Diameter 15–60 mm)

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 |




Open (example) Shielded (example) Rubber Sealed (example)

| Boundary dimensions: Bore diameter d (mm) | Outside diameter D (mm) | Width B (mm) | Chamfer dimension (min.) r (mm) | Basic designation[2] | Dynamic load rating, $C_H$ (reference value) (N) | Availability: Open | Shielded (ZZ) | Rubber sealed (DD) | Limiting speed (reference value) (min⁻¹) | Limiting load[3] (reference value) (N) | Type of inquiry designation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | |
| | 85 | 19 | 1.1 | ✻ **6209** | 26 600 | | ● | ● | 2 300 | 1 330 | |
| 50 | 80 | 16 | 1 | ✻ **6010** | 18 500 | | ● | ● | 2 300 | 920 | |
| | 90 | 20 | 1.1 | ✻ **6210** | 29 800 | | ● | ● | 2 140 | 1 490 | |
| 55 | 90 | 18 | 1.1 | ✻ **6011** | 24 000 | | ● | ● | 2 060 | 1 200 | |
| | 100 | 21 | 1.5 | ✻ **6211** | 37 000 | | ● | ● | 1 930 | 1 850 | |
| 60 | 95 | 18 | 1.1 | ✻ **6012** | 25 000 | | ● | ● | 1 930 | 1 250 | |
| | 110 | 22 | 1.5 | ✻ **6212** | 44 500 | | ● | ● | 1 760 | 2 220 | |

Mark: ● Stocked as standard inventory.[5]

Notes (1) The actual designation may be 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 load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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.



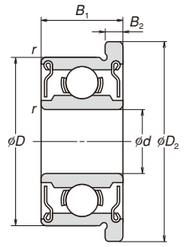
## 1-2. Stainless Steel Bearings (with flanged outer ring)

Stocked as standard inventory

Bearings Specifications Tech. Data Page A29–A30

● Inquiry designation[1]

□□□□ -H-ZZ✻MAZ NS7




Shielded (example)

| Boundary dimensions: Bore diameter d (mm) | Outside diameter D (mm) | Width $B_1$ (mm) | Flanged Outside diameter $D_2$ (mm) | Flanged width $B_2$ (mm) | Chamfer dimension (min.) r (mm) | Basic designation | Dynamic load rating, $C_H$ (reference value) (N) | Availability | Limiting speed (reference value) (min⁻¹) | Limiting load[2] (reference value) (N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| | 7 | 3.5 | 8.5 | 0.9 | 0.15 | **F602** | 328 | ● | 10 000 | 16 |
| 2.5 | 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 |
| | 16 | 5 | 18 | 1 | 0.3 | **F634** | 1 140 | ● | 10 000 | 56 |
| 5 | 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 |
| | 19 | 6 | 22 | 1.5 | 0.3 | **F635** | 1 990 | ● | 10 000 | 99 |
| 6 | 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 |
| | 19 | 6 | 22 | 1.5 | 0.3 | **F626** | 1 990 | ● | 10 000 | 99 |
| 7 | 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 |
| | 22 | 7 | 25 | 1.5 | 0.3 | **F627** | 2 800 | ● | 10 000 | 140 |
| 8 | 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 |
| | 22 | 7 | 25 | 1.5 | 0.3 | **F608** | 2 800 | ● | 10 000 | 140 |
| 9 | 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 |

Mark: ● Stocked as standard inventory.[3]

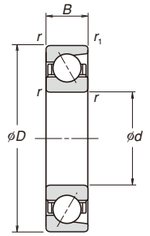
Notes (1) The actual designation may be differ from the inquiry designation. □□□□ indicates the basic designation.
(2) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(3) Orders for standard inventory may be delayed, particularly if shipped 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.

## 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-20TYNSULP5 | ▯▯▯▯ -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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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

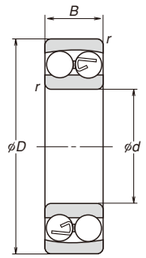
Stocked as standard inventory

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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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

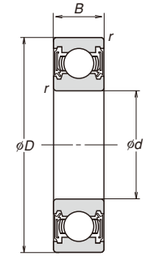
Available on a production-by-order basis

Bearings Specifications Tech. Data Page A33–A34

● Inquiry designation[1]

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

| Boundary dimensions | | | | Basic designation[2] | Availability | | Limiting speed[3] (reference value) (min⁻¹) | Applied load[4] (reference value) (N) |
|---|---|---|---|---|---|---|---|---|
| Bore diameter *d* (mm) | 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 |




Rubber Sealed (example)

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 ℃ operating conditions. Limiting speeds will be slower for operating conditions of 35 ℃ or higher. (Refer to Page A33 for further details.)
(4) The applied load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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.

## 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

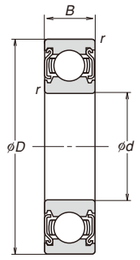
Available on a production-by-order basis

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 |



Shielded (example)

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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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

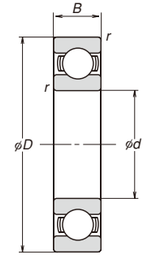
Bearings Specifications Tech. Data Page A39–A40

### 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 *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (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 | **6206** | ○ | 470 | 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 |



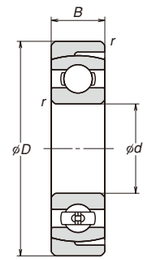
Open (example)

### 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 *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (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 |



Open (example)

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

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

(2) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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

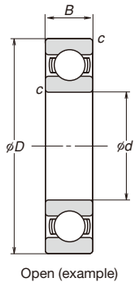
Available on a production-by-order basis

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 |



Open (example)

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

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

(2) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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™

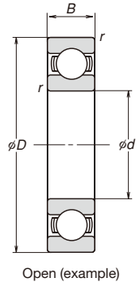
Available on a production-by-order basis

Bearings Specifications Tech. Data Page A43–A44

● Inquiry designation[1]

□□□□ **L-PT3**

| Boundary dimensions[2] | | | | Basic designation | 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 | 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 | |



Open (example)

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

Notes (1) The actual designation may be 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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

Remarks : Open bearings are standard.

## 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<br>Availability ○: □□□□ LZZ-H LG2L | □□□□ L-ZZ-H LGUL |
| (B) | Availability ●: □□□□-H-ZZU76 LG2L<br>Availability ○: □□□□-H-20ZZU76A LG2L | □□□□-H-20ZZU76A LGUL |

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

## 11. DL2 Grease-Packed Bearings

Available on a production-by-order basis

Bearings Specifications Tech. Data Page A47–A48

● Inquiry designation[1]

| Type of inquiry designation | DL2 Grease-Packed Bearing |
|---|---|
| (A) | □□□□ LZZ-H DL2 |
| (B) | □□□□-H-20ZZU552 DL2 |

| Boundary dimensions: Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | Basic designation[2] | Availability: LG2 grease | LGU grease | DL2 grease | Limiting speed (reference value) (min⁻¹) | Limiting load[3] (reference value) (N) | Type of inquiry designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 6 | 2.5 | 0.1 | **MR63** | ● | | | 1 000 | 8 | |
| | 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 | (A) |
| | 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 | |
| | 19 | 6 | 0.3 | **698** | ● | ○ | ○ | 1 000 | 95 | |
| | 22 | 7 | 0.3 | **608** | ● | ○ | ○ | 1 000 | 140 | (A) |
| | 24 | 8 | 0.3 | **628** | ● | ○ | ○ | 1 000 | 140 | |
| 9 | 17 | 5 | 0.2 | **689** | ● | ○ | ○ | 1 000 | 56 | |
| | 20 | 6 | 0.3 | **699** | ○ | ○ | ○ | 1 000 | 100 | |
| | 24 | 7 | 0.3 | ✻ **609** | ○ | ○ | ○ | 1 000 | 140 | |
| | 26 | 8 | 0.6 | ✻ **629** | ○ | ○ | ○ | 1 000 | 190 | (B) |
| 9.525 | 22.225 | 7.142 | 0.4 | ✻ **R6** | ○ | ○ | ○ | 1 000 | 140 | |

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.

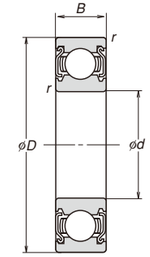
(2) An asterisk (✻) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring. However, stocked as standard inventory items use standard stainless steel.

(3) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

(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)

| Boundary dimensions: Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | Basic designation[2] | Availability: LG2 grease | LGU grease | DL2 grease | Limiting speed (reference value) (min⁻¹) | Limiting load[3] (reference value) (N) | Type of inquiry designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 19 | 5 | 0.3 | ✻ **6800** | ● | ○ | ○ | 1 000 | 73 | |
| | 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 | (B) |
| 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 | (B) |
| | 62 | 16 | 1 | ✻ **6206** | ○ | ○ | ○ | 1 000 | 820 | |
| 35 | 62 | 14 | 1 | ✻ **6007** | ○ | ○ | ○ | 1 000 | 680 | |
| | 72 | 17 | 1.1 | **6207** | ○ | ○ | ○ | 930 | 1 090 | (A) |
| 40 | 68 | 15 | 1 | **6008** | ○ | ○ | ○ | 920 | 710 | |
| | 80 | 18 | 1.1 | **6208** | ○ | ○ | ○ | 830 | 1 240 | |

## 12. DFO Bearings

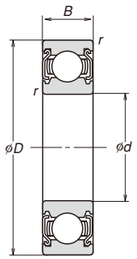
Available on a production-by-order basis

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 | | | | | E-DFO Bearings | | | V-DFO Bearings | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | Basic designation[2] | Availability | Limiting speed (reference value) ($min^{-1}$) | Limiting load[5] (reference value) (N) | Availability | Limiting speed (reference value) ($min^{-1}$) | Limiting load[4] (reference value) (N) | Type of inquiry designation |
| 4 | 9 | 4 | 0.1 | **684** | ○ | 1 000 | 27 | ○ | 1 000 | 10 | |
| | 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 | |
| | 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 | (A) |
| 6 | 13 | 5 | 0.15 | **686** | ○ | 1 000 | 46 | ○ | 1 000 | 18 | |
| | 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 | |
| | 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 | (B) |
| 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 | (B) |
| 9 | 17 | 5 | 0.2 | ✻ **689** | ○ | 1 000 | 56 | ○ | 1 000 | 22 | |
| | 20 | 6 | 0.3 | **699** | ○ | 1 000 | 100 | ○ | 1 000 | 42 | (A) |
| | 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 | |
| | 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 | |
| | 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 | |
| | 28 | 7 | 0.3 | ✻ **6902** | ○ | 930 | 180 | ○ | 930 | 74 | |
| | 32 | 9 | 0.3 | ✻ **6002** | ○ | 850 | 230 | ○ | 850 | 95 | (B) |
| | 35 | 11 | 0.6 | ✻ **6202** | ○ | 800 | 320 | ○ | 800 | 130 | |
| 17 | 26 | 5 | 0.3 | ✻ **6803** | ○ | 930 | 110 | ○ | 930 | 44 | |
| | 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 | |
| | 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 | |
| | 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 | (B) |
| 35 | 62 | 14 | 1 | ✻ **6007** | ○ | 410 | 680 | ○ | 410 | 270 | |
| | 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 | |



Shielded (example)

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 load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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. Shieled bearings are standard.



## 13. KPM Grease-Packed Bearings

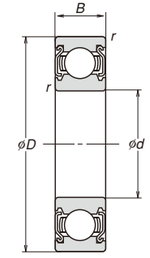
Available on a production-by-order basis

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 |

| Boundary dimensions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | Basic designation[2] | Availability[3] | Limiting speed (reference value) ($min^{-1}$) | Limiting load[4] (reference value) (N) | Type of inquiry designation |
| 4 | 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 | (A) |
| 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 | |
| | 22 | 7 | 0.3 | ✻ **608** | ○ | 1 000 | 140 | |
| | 24 | 8 | 0.3 | ✻ **628** | ○ | 1 000 | 140 | (B) |
| 9 | 17 | 5 | 0.2 | ✻ **689** | ○ | 1 000 | 56 | |
| | 20 | 6 | 0.3 | **699** | ○ | 1 000 | 100 | (A) |
| | 24 | 7 | 0.3 | ✻ **609** | ○ | 1 000 | 140 | |
| | 26 | 8 | 0.6 | ✻ **629** | ○ | 1 000 | 190 | |
| 9.525 | 22.225 | 7.142 | 0.4 | ✻ **R6** | ○ | 1 000 | 140 | |
| 10 | 19 | 5 | 0.3 | ✻ **6800** | ○ | 1 000 | 73 | |
| | 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 | (B) |
| | 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 | |
| | 55 | 13 | 1 | ✻ **6006** | ○(C3) | 1 000 | 560 | |
| | 62 | 16 | 1 | ✻ **6206** | ○(C3) | 1 000 | 820 | (B) |
| 35 | 62 | 14 | 1 | ✻ **6007** | ○(C3) | 1 000 | 680 | |
| | 72 | 17 | 1.1 | **6207** | ○ | 930 | 1 090 | |
| 40 | 68 | 15 | 1 | **6008** | ○ | 920 | 710 | (A) |
| | 80 | 18 | 1.1 | **6208** | ○ | 830 | 1 240 | |



Shielded (example)

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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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. Sheleded bearings are standard.

## 14. YS Bearing with Spacer Joints

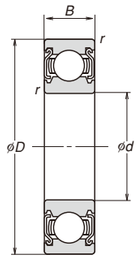
Available on a production-by-order basis

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 *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (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 | |
| | 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 | |
| | 28 | 8 | 0.3 | ✻ **6001** | ○ | 1 000 | 87 | |
| | 32 | 10 | 0.6 | ✻ **6201** | ○ | 900 | 110 | |
| 15 | 24 | 5 | 0.3 | ✻ **6802** | ○ | 1 000 | 35 | |
| | 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 | |
| | 35 | 10 | 0.3 | ✻ **6003** | ○ | 760 | 100 | |
| 20 | 32 | 7 | 0.3 | ✻ **6804** | ○ | 760 | 68 | |
| | 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 | |
| | 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 | (A) |
| | 55 | 13 | 1 | ✻ **6006** | ○ | 470 | 220 | (B) |
| | 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 | |



Shielded (example)

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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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. Shieled bearings are stnadard.

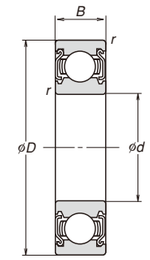
## 15. SJ Bearings

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 | 0.037–0.080 |
| | 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 | |
| 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) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

Remarks: Shielded bearings are standard.

## 16. Food Grade Grease-Packed Bearings

Available on a production by-order basic

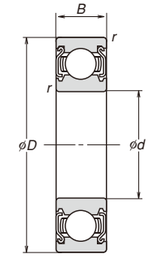
Bearings Specifications Tech. Data Page A57–A58

### ● 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) | Type of inquiry designation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RLS grease | | BL2 grease for high temperature | | | |
| Bore diameter d (mm) | Outside diameter D (mm) | Width B (mm) | Chamfer dimension (min.) r (mm) | | Availability | Limiting speed(3) (reference value) (min⁻¹) | Availability | Limiting speed(3) (reference value) (min⁻¹) | (N) | |
| 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 | (B) |
| 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 | (B) |
| | 24 | 8 | 0.3 | ✻ **628** | ○ | 19,600 | ○ | 16,800 | 140 | |
| 9 | 17 | 5 | 0.2 | ✻ **689** | ○ | 25,200 | ○ | 21,600 | 56 | |
| | 20 | 6 | 0.3 | **699** | ○ | 23,800 | ○ | 20,400 | 100 | (A) |
| | 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 | |
| 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 | (B) |
| | 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) | Type of inquiry designation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RLS grease | | BL2 grease for high temperature | | | |
| Bore diameter d (mm) | Outside diameter D (mm) | Width B (mm) | Chamfer dimension (min.) r (mm) | | Availability | Limiting speed(3) (reference value) (min⁻¹) | Availability | Limiting speed(3) (reference value) (min⁻¹) | (N) | |
| 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 | (A) |
| 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.

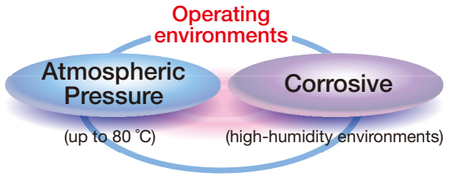
Notes (1) The actual designation may differ from the inquiry designation. ▯▯▯▯ indicates the basic designation.
(2) An asterisk (✻) indicates that NSK's ES1 steel has been adopted for the bearing's inner and outer ring.
(3) The limiting speeds listed are for shielded bearings. Please contact NSK for the limiting speeds of bearings with rubber contact seals.
(4) The limiting load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.

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.

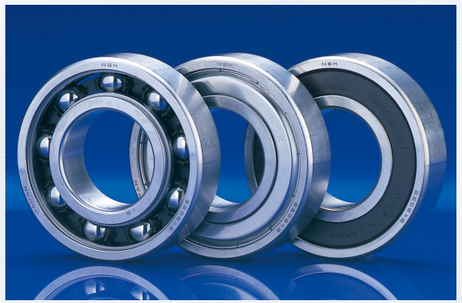
# 1. Stainless Steel Bearings

Pages A11–A14 Dimensions, accuracy and availability of bearings.

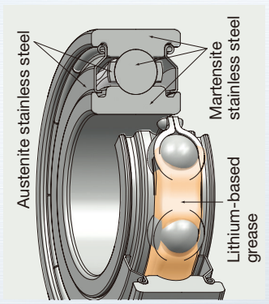
Stainless steel bearings, the standard products of the NSK SPACEA™ Series for special environments, are suitable for high-humidity environments.




## 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 (Open bearings do not come with packed grease.) |
| | 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

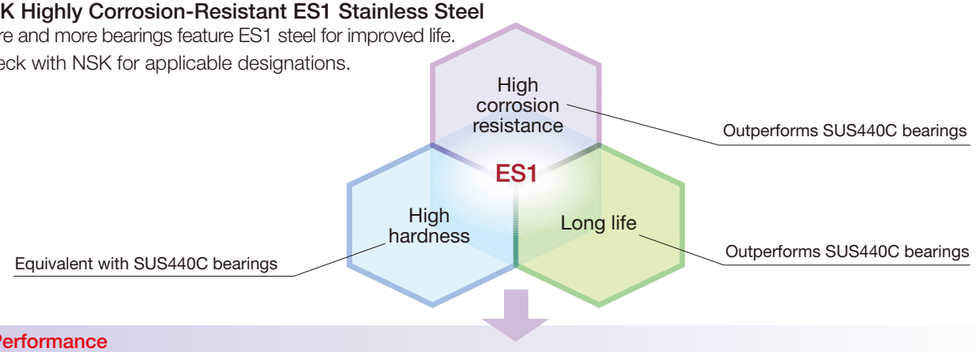
- For use in normal atmospheric conditions only.
- Bearings stocked as standard inventory items are prepacked with NS7 (lithium-based) grease.
- Keep bearings packed until immediately before mounting.
- See the tables on Pages A11 through A14 for limiting loads and limiting rotational speeds.
- Bearings 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

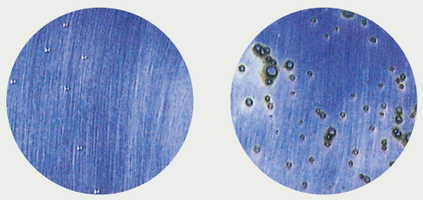
| Material | Hardness, HRC | Corrosion resistance(1) | Features |
|---|---|---|---|
| NSK highly corrosion-resistant ES1 stainless steel | 58–62 | ○ | NSK-developed steel |
| Martensite stainless steel SUS440C | 58–62 | △ | Ordinary stainless steel |
| Bearing steel SUJ2 | 60–64 | × | Ordinary steel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

Note (1) Comparative assessment between three kinds of materials

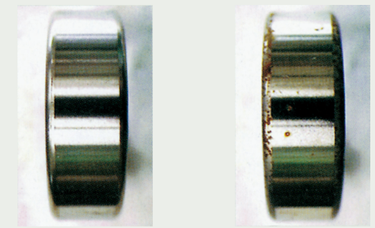
### ● Corrosion resistance of ES1

Outperforms SUS440C in corrosion resistance

Test sample: $\phi 18 \times 10$ mm
(#800 emery paper, passivated)
Test solution: 5% NaCl solution
Immersion time: 8 hours (room temperature)



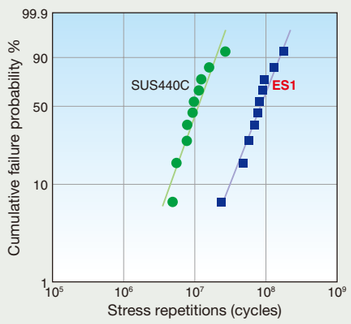

Salt spray test (JIS Z 2371)
Test solution: 5% NaCl solution
Test time: 1 hour
Temperature: 35 °C




### ● Immersion rolling fatigue life

Outperforms SUS440C in durability

Test bearing: 51305
Balls: Ceramic
Speed: 1 000 min$^{-1}$
Load: 980 N



# 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

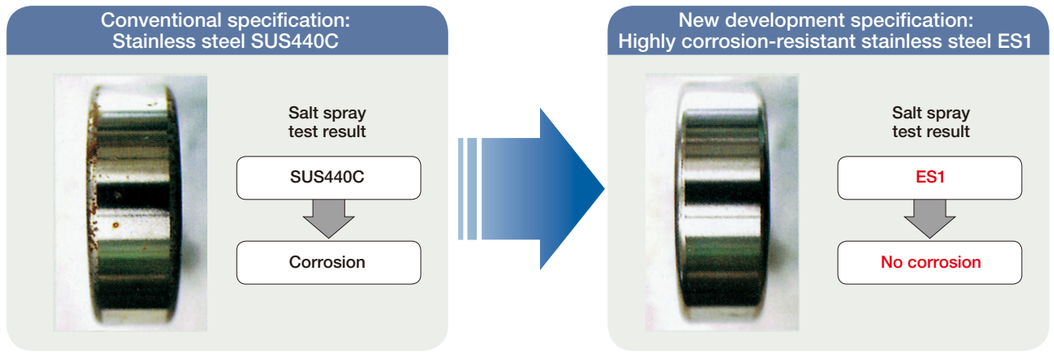
Page A15 Dimensions, accuracy and availability of bearings.



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.



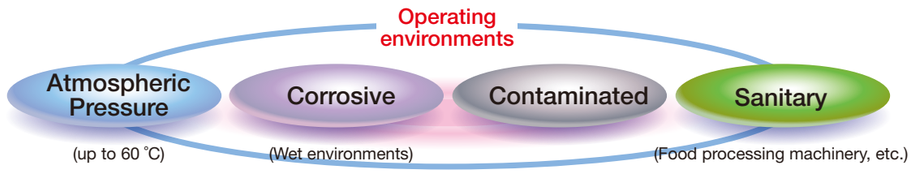

## Operating Instructions and Notes

- 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.

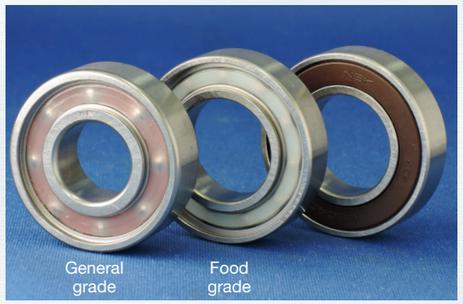
# 4. Molded-Oil™ Bearings

Page A16 Dimensions, accuracy and availability of bearings.

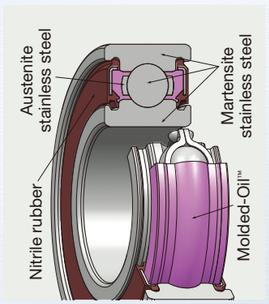
Molded-Oil™ bearings, made of stainless steel, are lubricated with an original oil-containing material, Molded-Oil™, and are suitable for corrosive and contaminated environments at atmospheric pressure.
Food grade lubricants are also available.




## Product Specifications




## Representative Structure




| 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

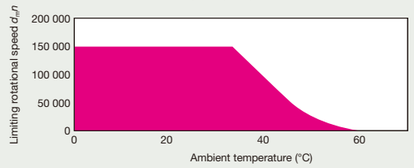
## Operating Instructions and Notes

- 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**

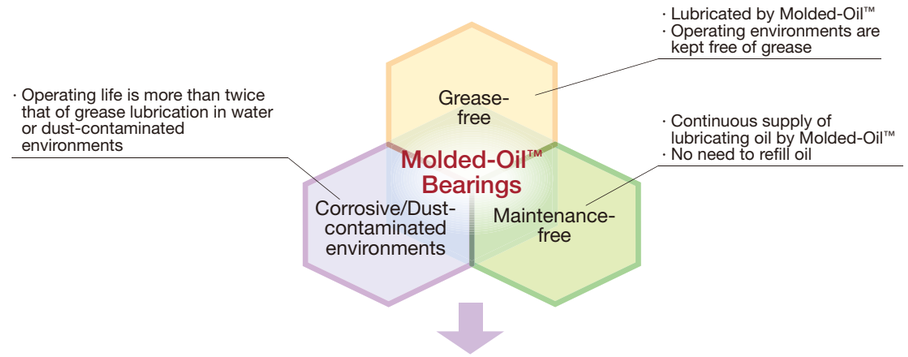
| | |
|---|---|
| Applied load | Between 1% and 5% of the stainless steel bearing dynamic load rating $C_H$ <Load more than 1% is necessary.> |
| Limiting rotational speed, $d_m n$(1) | 150 000<br>Refer to the chart below for temperatures above 35 °C |

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

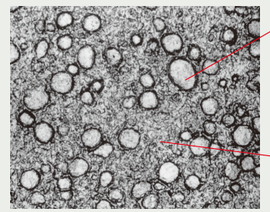



## Features

- 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 avaiable.




## Performance



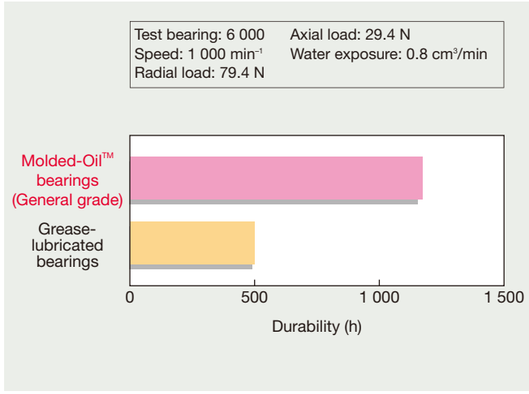
Close-up of Molded-Oil™ 100 µm

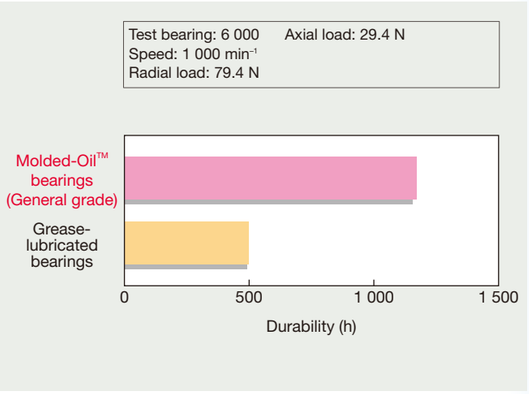
**Portion containing high proportion of polyolefin**
Polyolefin is used for packaging food in supermarkets, replacing dioxin-generating vinyl chloride.

**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

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

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

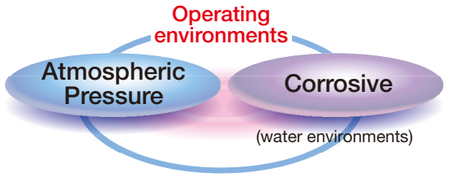


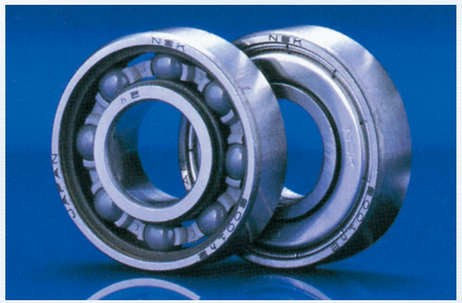
# 5. Hybrid Bearings

Page A17 Dimensions, accuracy and availability of bearings.

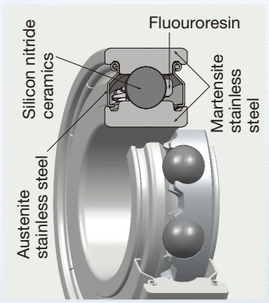
Hybrid bearings, combining ceramic balls and a fluororesin self-lubricating cage, are suitable for corrosive environments at atmospheric pressure.




## Product Specifications



## Representative Structure




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

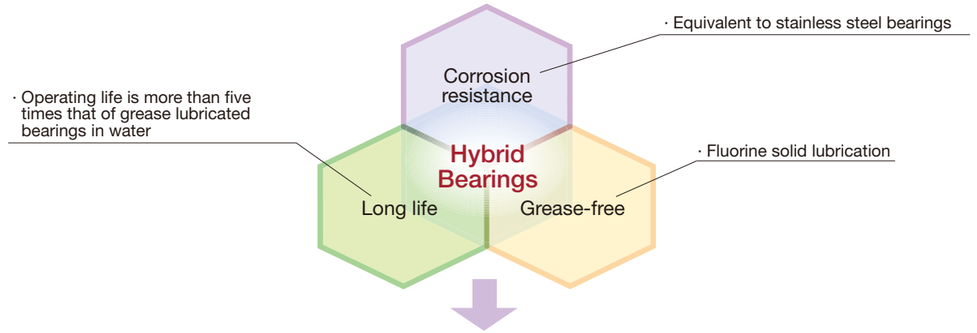
Applications: Devices and conveyor lines used in water-spray or other wet environments such as food processing and fishery equipment

## 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

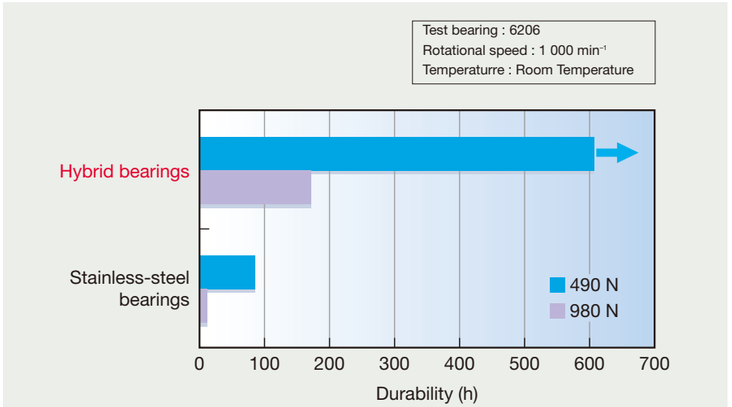
- Grease-free, fluorine-based solid lubricant
- Operating life more than five times that of stainless steel bearings in water-immersed environments




## Performance

### ● Durability in water-immersed environments

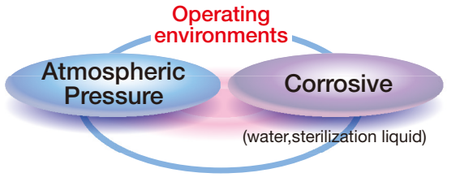
Hybrid bearings have an operating life more than five times that of stainless steel bearings.



# 6. Corrosion-Resistant Coated Bearings

Page A17 Dimensions, accuracy and availability of bearings.

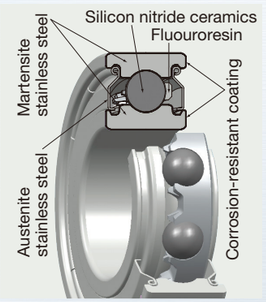
Corrosion-resistant coated bearings are coated with a nickel coating on the outer and inner rings to enhance corrosion resistance and durability, and are suitable for corrosive environments at atmospheric pressure.




## 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 |

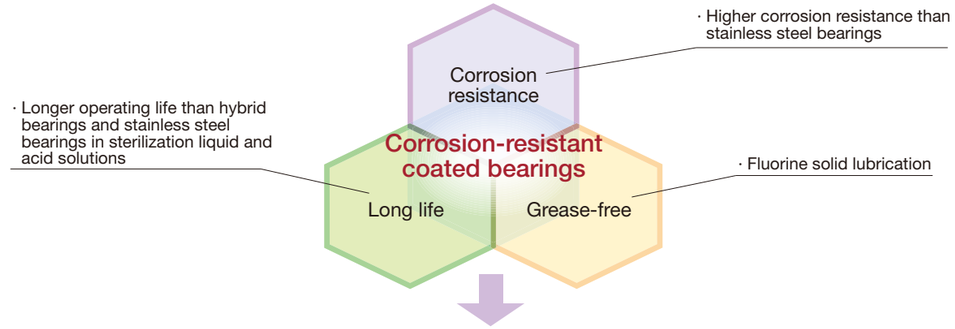
Applications: Semiconductor/FPD/HD cleaning equipment, etching equipment, food processing machinery, various conveyor lines

## 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.

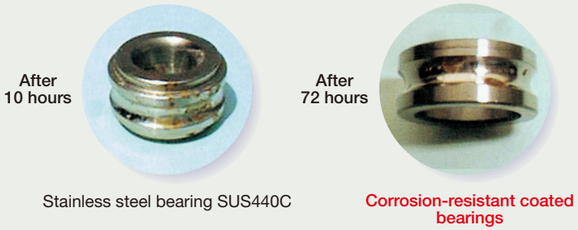
## Features

- 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

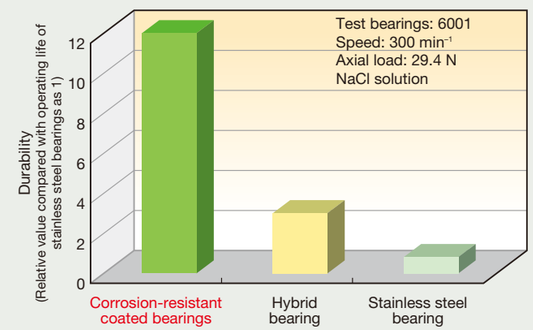



Stainless steel bearing SUS440C

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.



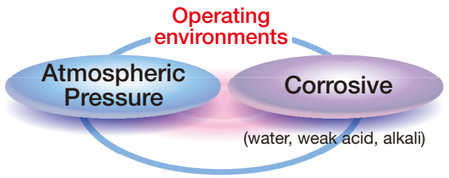

### ● Durability in NaCl solution

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.

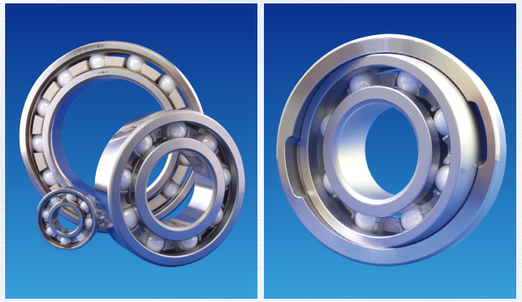
# 7. ESZ Bearings

Page A18 Dimensions, accuracy and availability of 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.

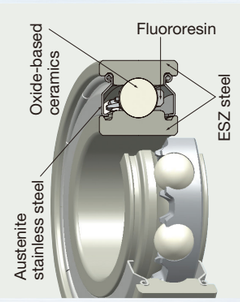



## Product Specifications

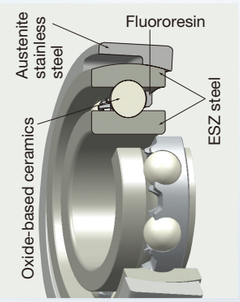




**Representative Structure**




**Representative Structure With Aligning Housing Ring**




| Structure | | Deep groove ball bearings | Deep groove ball bearings with aligning housing ring |
|---|---|---|---|
| | | Shielded (Open) | 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 |

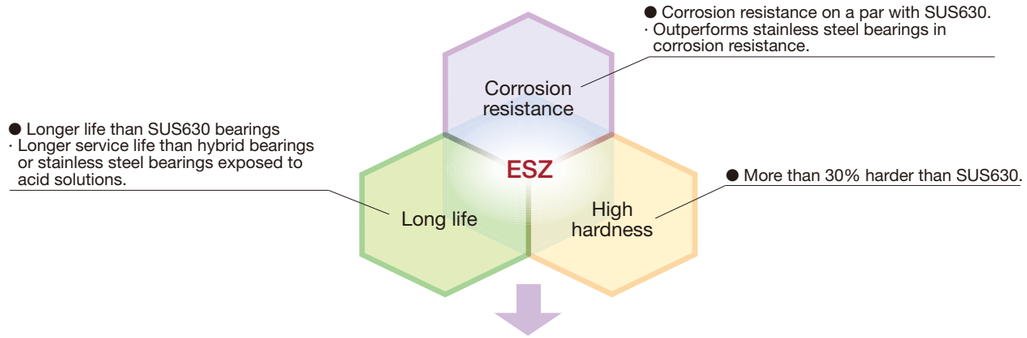
Applications: High function film conveyor, cleaning equipment, food processing machinery, various conveyor lines

## 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.

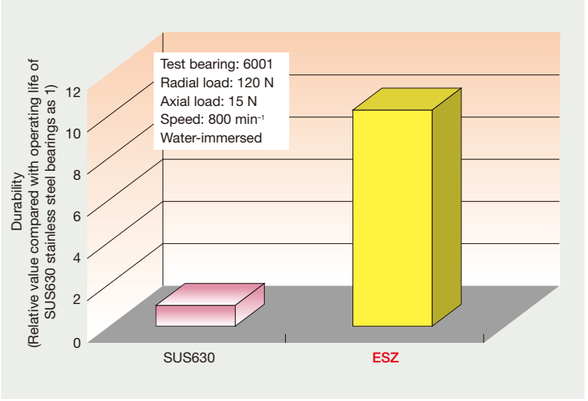
## Features

- 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.

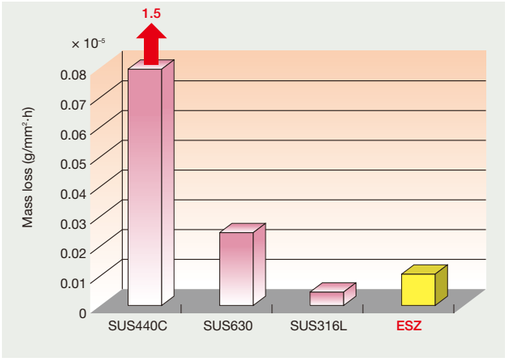



## Performance

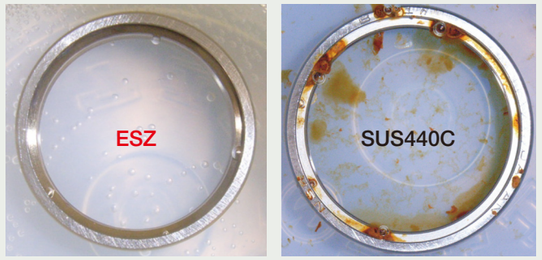
### ● Durability in water-immersed conditions




### ● Results of 5% sulfuric acid immersion test




### ● Results of sodium hypochlorite solution immersion test

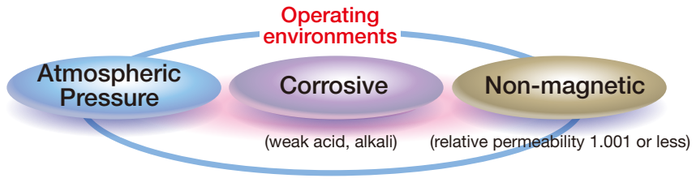



(Density: 120 ppm; photograph 120 hours after operation)

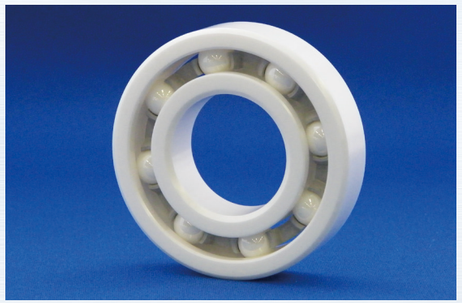
# 8. All-Ceramic Bearings

Page A19 Dimensions, accuracy and availability of bearings.

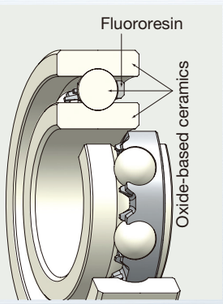
With ceramic outer/inner rings and balls, all-ceramic bearings have self-lubricating fluororesin cages and are suitable for corrosive environments and non-magnetic requirements at atmospheric pressure.




## Product Specifications



## Representative Structure




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

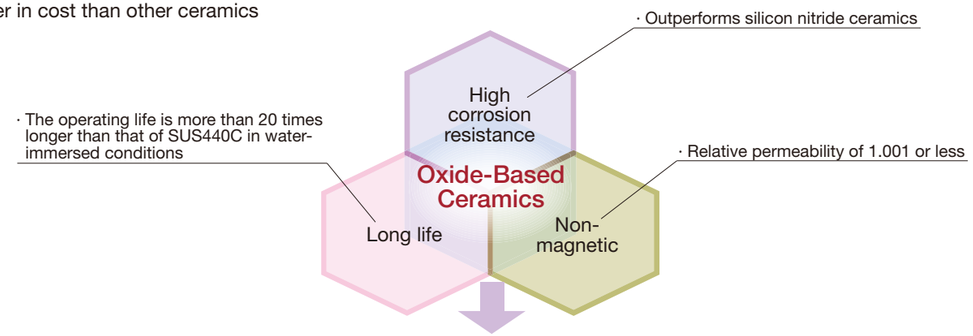
Applications: Corrosive environments: Semiconductor production machinery, chemical processing equipment, metal plating equipment
Non-magnetic requirements: Electron beam drawing devices, electron beam exposure equipment, inspection equipment

## 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

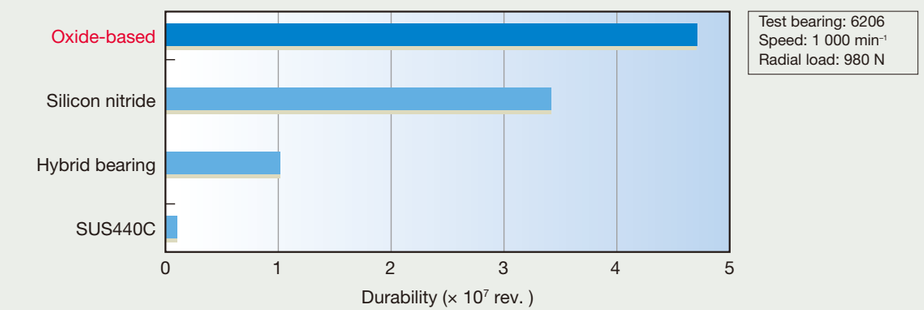
**Oxide-based ceramics are:**
☆More corrosion-resistant than stainless steel SUS440C or silicon nitride ceramics ($Si_3N_4$)
☆Lower in price than other ceramics

| 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

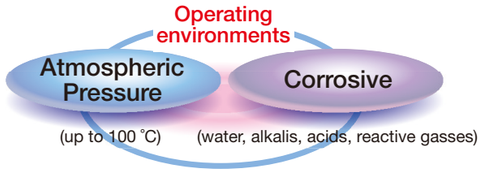
Oxide-based ceramics are 20 times more durable than SUS440C under water-immersed conditions.



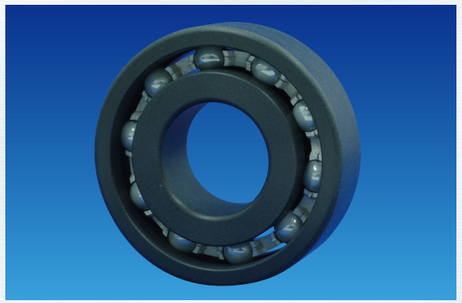
# 9. Aqua-Bearing™

Page A20 Dimensions, accuracy and availability of bearings.

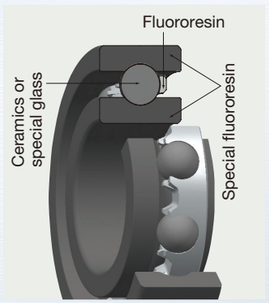
Aqua-Bearing™ features a special fluororesin for outer/inner rings and cage equipped to meet a broad range of applications in water, alkali and strong acid environments. Aqua-Bearing™ is suitable for corrosive environments at normal pressures.




## Product Specifications



## Representative Structure




| | | |
|---|---|---|
| Structure | | Open only |
| Specifications | Outer/Inner rings | Special fluororesin |
| | Balls | Ceramics |
| | Cage | Fluororesin |
| | Lubricant | Fluorine-based solid lubricant |

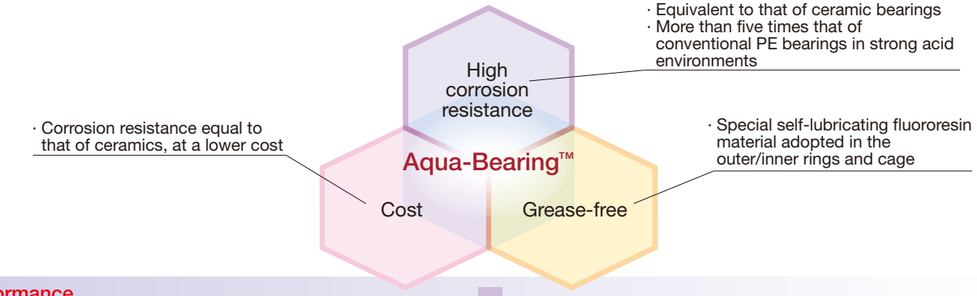
Applications: Semiconductor cleaning equipment, FPD cleaning equipment, hard-disk cleaning equipment, metal plating equipment, etching equipment, food processing machinery

## 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 fluororesin material ($\alpha = 1.7 \times 10^{-4}$/°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 fluororesin eliminates need for grease/oil refilling.




## Performance

### Comparison of corrosion resistance

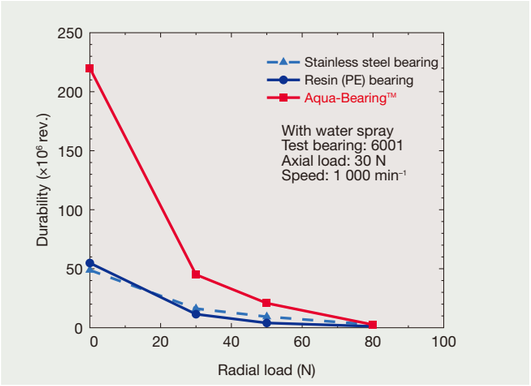
Corrosion resistance equal to or higher than all-ceramic bearings (oxide-based)

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

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

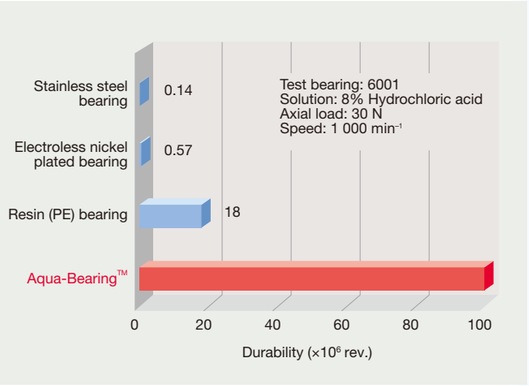
### Results of water-spray durability tests

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.

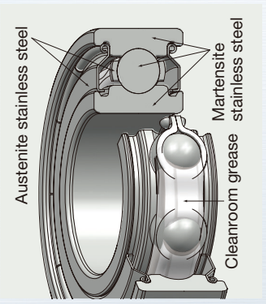
LG2/LGU clean grease-packed stainless steel bearings are suitable for cleanroom environments at atmospheric pressure.




## 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 |

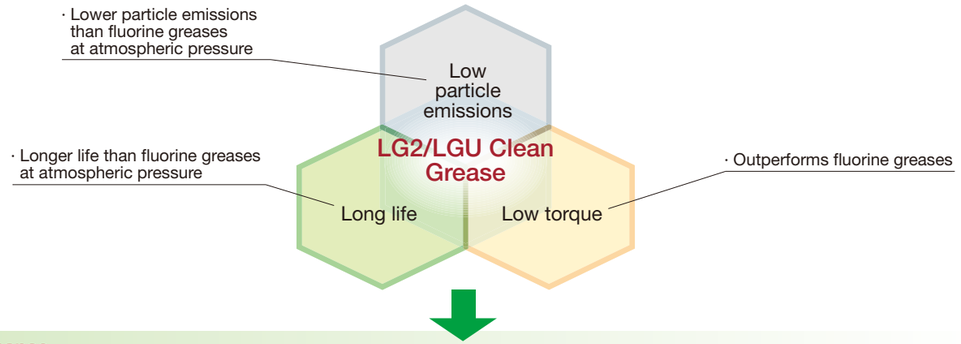
Applications: Equipment in cleanrooms

## 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 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

- Clean 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

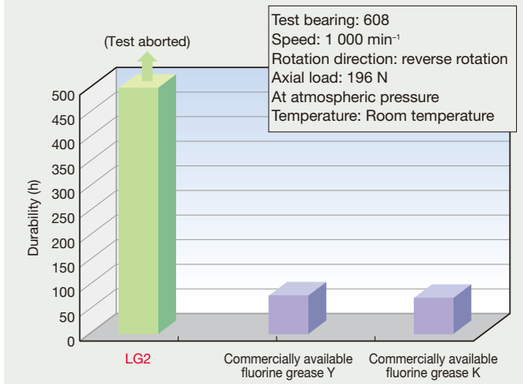
### Properties of grease

| 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

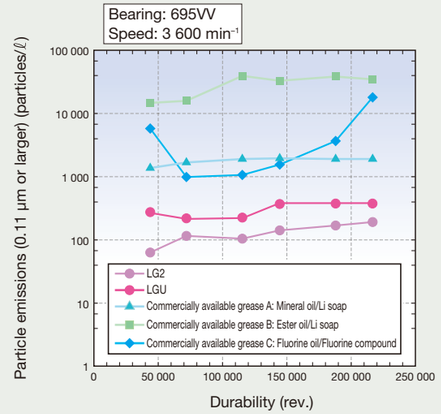
### Results of durability tests in normal atmosphere

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




### Results of particle emission tests in normal atmosphere

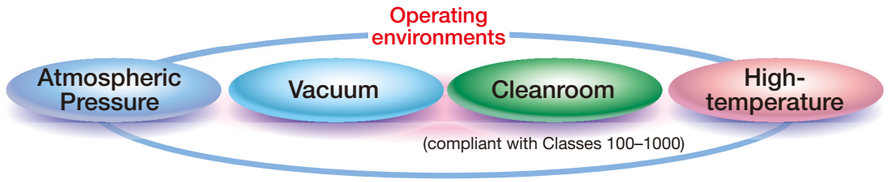
LG2/LGU grease limit particle emissions at atmospheric pressure.



# 11. DL2 Grease-Packed Bearings

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

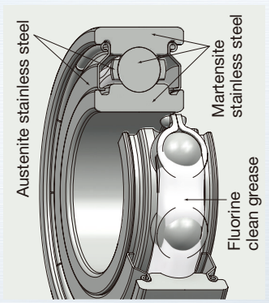
DL2 grease-packed stainless steel bearings are suitable for cleanroom environments at atmospheric pressure up to vacuum.




## Product Specifications



## Representative Structure

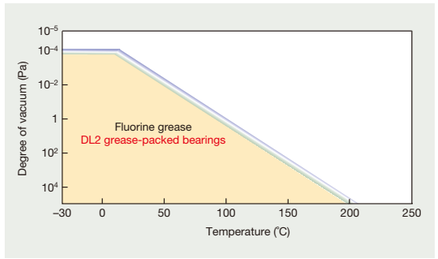



| Structure | | Shielded |
|---|---|---|
| Specifications | Outer/Inner rings | Martensite stainless steel |
| | Balls | Martensite stainless steel |
| | Cage | Stainless steel |
| | Lubricant | DL2 grease |
| | Shields | Austenite stainless steel |

Applications: FPD and semiconductor manufacturing equipment, hard disk manufacturing equipment

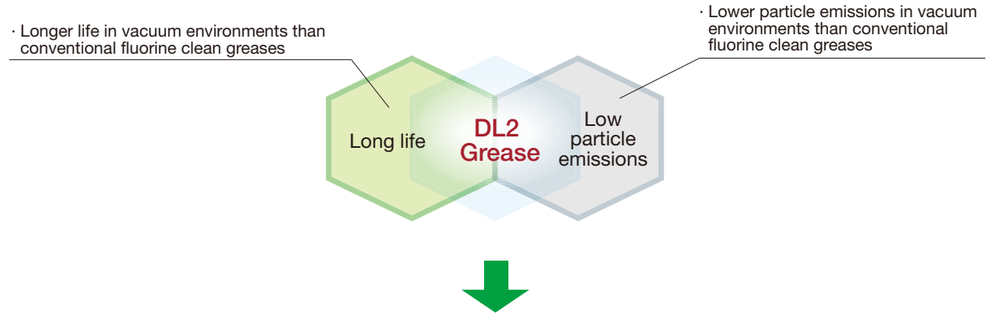
## Operating Instructions and Notes

- 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 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 clean grease lubrication
- More suitable for vacuums and at higher temperatures than LG2/LGU greases
- Lower particle emissions and longer life than conventional fluorine clean greases



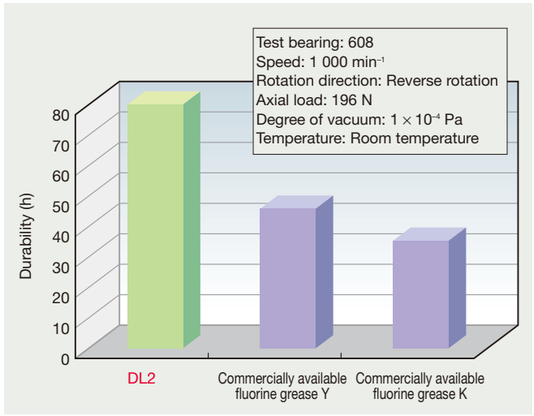

## Performance

### Properties of grease

| Operating environments | From atmospheric pressure to vacuum |
|---|---|
| Name | DL2 |
| Base oil | Fluorine oil |
| Thickener | PTFE |
| Kinematic viscosity ($mm^2/s$, 40 °C) | 200 |
| Consistency | 280 |
| Maximum operating temperature (°C) | up to 200 |

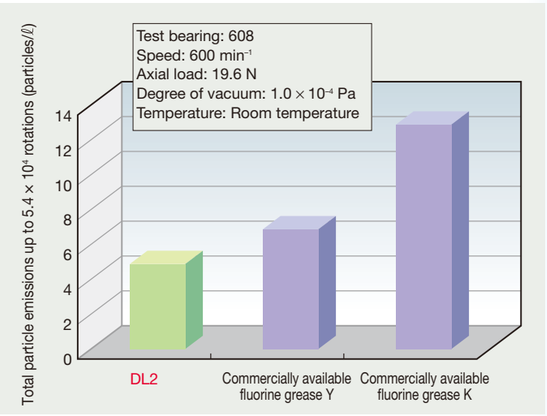
### Results of durability tests in vacuum

DL2 grease has a longer operating life than other grease in vacuum environments.




### Results of particle emission tests in vacuum

DL2 grease limits particle emissions in vacuum environments.

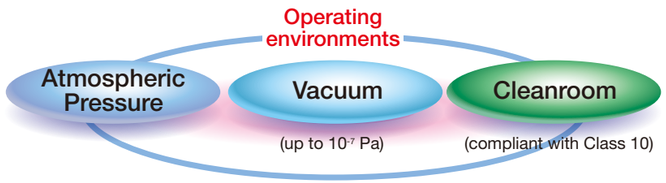


# 12. E-DFO Bearings, V-DFO Bearings

Page A23 Dimensions, accuracy and availability of 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.

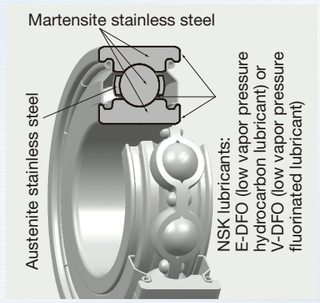
These bearings are suitable for cleanroom environments ranging from atmospheric pressure to vacuum conditions.




### 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 |

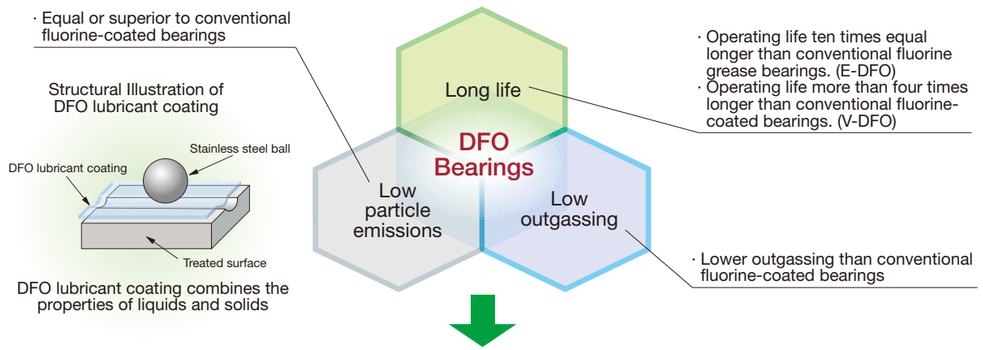
Applications: FPD and semiconductor manufacturing equipment, hard disk manufacturing equipment, solar cell manufacturing equipment, robots for vacuum environments

## 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 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 $MoS_2$ solid lubricated bearings
- Usable in environments where lubricants containing metallic elements such as $MoS_2$ 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

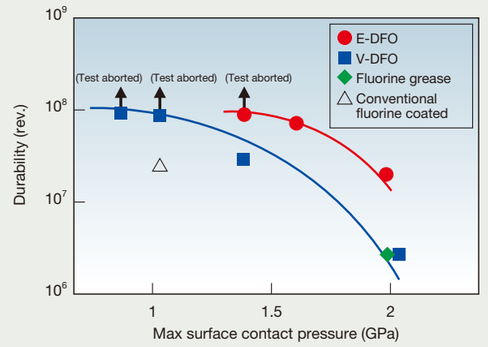
### Comparison of operating environments for NSK lubricant E-DFO and V-DFO:

| 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.

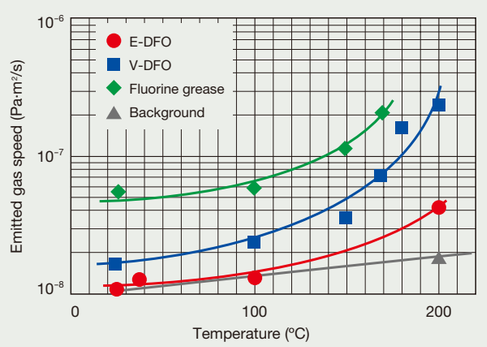
Test conditions
Test bearing: 708
Speed: 3 000 min⁻¹
Degree of vacuum: $2 \times 10^{-4}$ Pa




### Outgassing under high-temperature conditions

Low outgassing characteristics

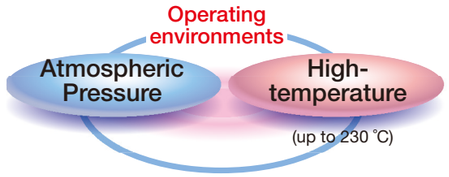
Test conditions
Test bearing: 608
Degree of vacuum: $8 \times 10^{-4}$ Pa



# 13. KPM Grease-Packed Bearings

Page A24 Dimensions, accuracy and availability of bearings.

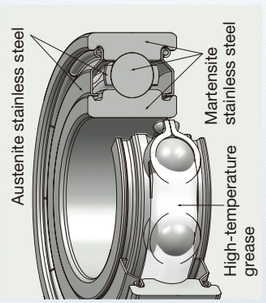
These high-temperature bearings are packed with NSK's long-life, high-temperature KPM grease for use at atmospheric pressure only.




## 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 |

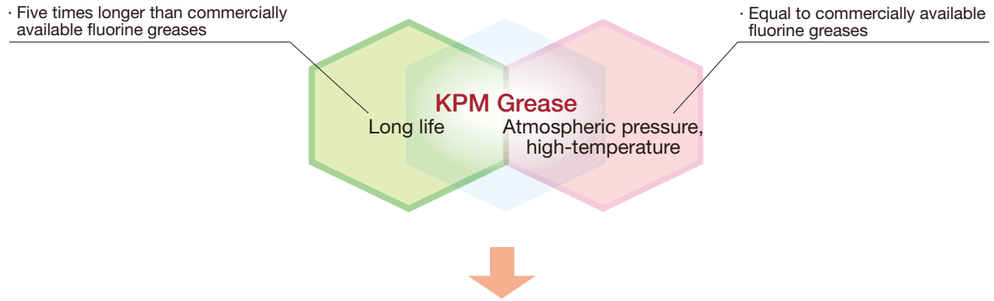
Applications: Copying machines, kilns, high-temperature conveyance equipment, other equipment for high-temperature environments

## 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 conisders 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

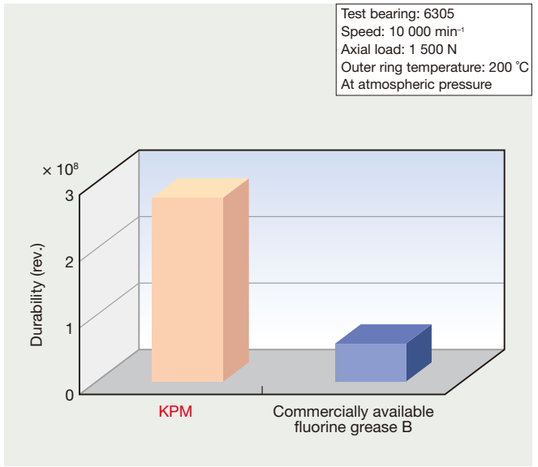
### Properties of grease

| 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

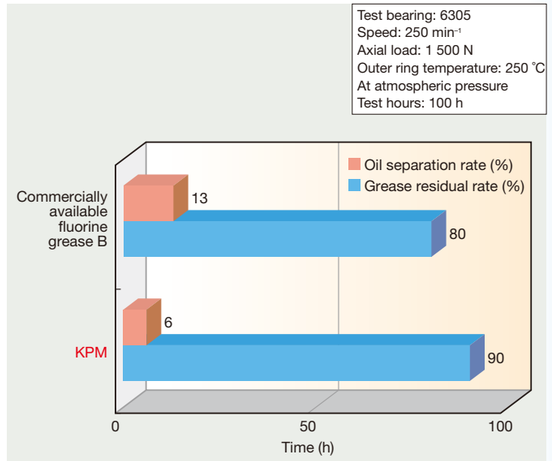
### Durability

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




### Oil separation and grease residual rates

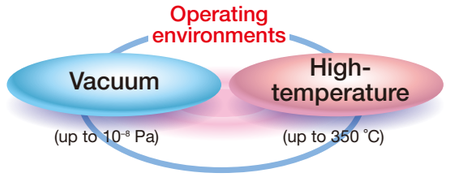
KPM is highly heat resistant, with lower oil separation rates at higher temperatures than commercially available fluorine greases.



# 14. YS Bearings With Spacer Joints

Page A25 Dimensions, accuracy and availability of bearings.

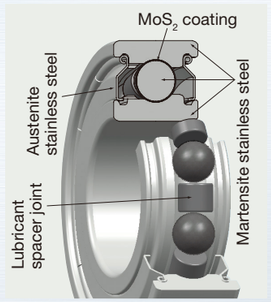
YS bearings with spacer joints are made of an alloy-based self-lubricating material (sintered alloy) between balls.
They are suitable for high-temperature and vacuum environments.




## Product Specifications



## Representative Structure

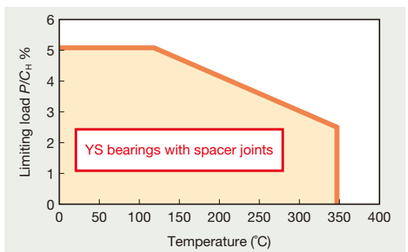



| | | |
|---|---|---|
| Structure | | Shielded |
| Specifications | Outer/Inner rings | Martensite stainless steel |
| | Balls | Martensite stainless steel and $MoS_2$ coating |
| | Cage | Lubricating spacer joints (sintered alloy) |
| | Lubricant | $MoS_2$ solid lubricant |
| | Shields | Austenite stainless steel |

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

## Operating Instructions and Notes

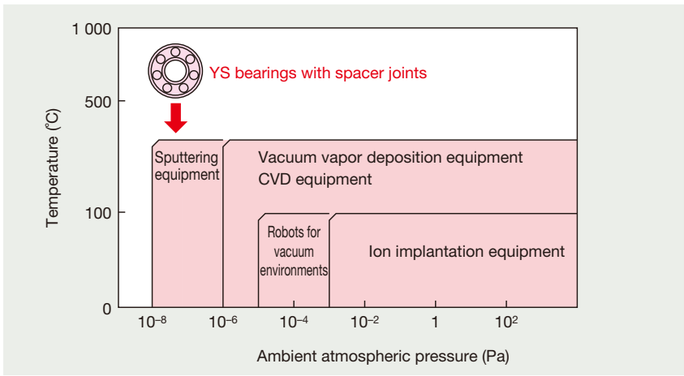
- For use in vacuum environments.
- Restrictions apply to bearings mounted to a vertical shaft due to a notch in the outer and inner rings. (Refer to the bearing manual)
- Keep bearings packed until immediately before mounting.
- Avoid storing the bearing for a long amount of time.
- Avoid exposure to 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.

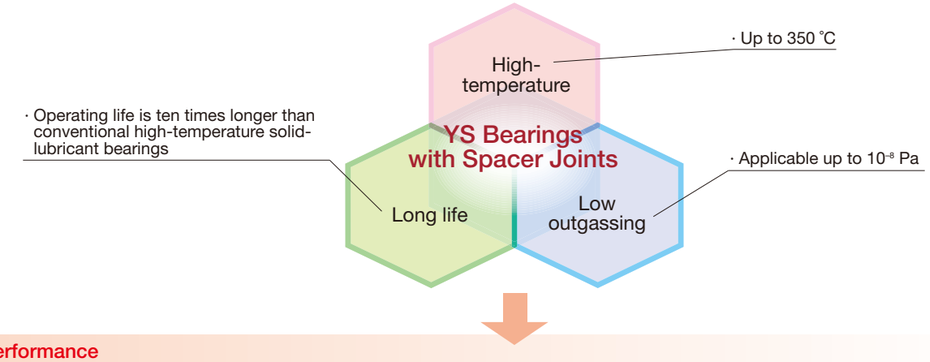



## Features

- Grease-free, $MoS_2$ 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

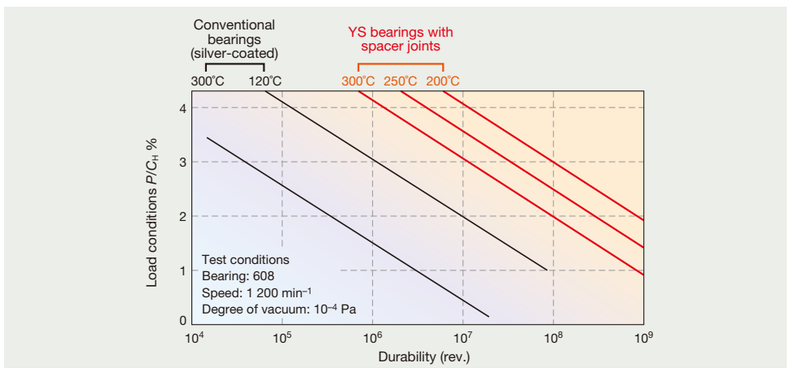



## Performance

### Durability

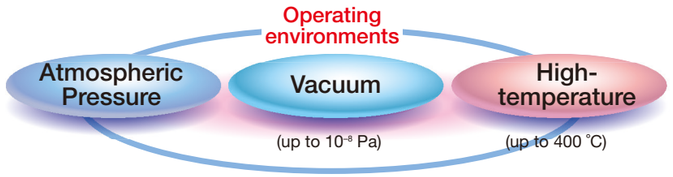
Over ten times more durable than conventional high-temperature solid-lubricant bearings.



# 15. SJ Bearings

Page A26 Dimensions, accuracy and availability of bearings.

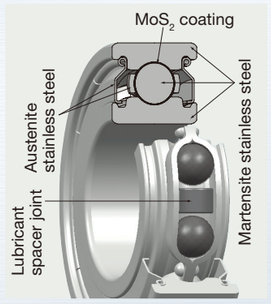
SJ bearings have a “peapod” structure, with solid lubricant spacer joints mounted between two balls in cage pockets. These bearings are suitable for high-temperature environments at atmospheric pressure up to vacuum.




## Product Specifications



## Representative Structure

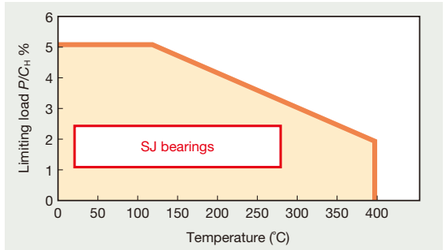



| Structure | | Shielded |
|---|---|---|
| Specifications | Outer/Inner rings | Martensite stainless steel |
| | Balls | Martensite stainless steel and $MoS_2$ coating |
| | Cage | Stainless steel and lubricating spacer joints (sintered alloy) |
| | Lubricant | $MoS_2$ solid lubricant |
| | Shields | Austenite stainless steel |

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

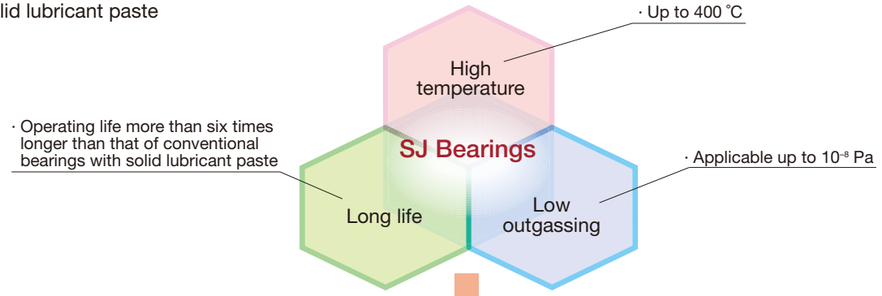
## Operating Instructions and Notes

- 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

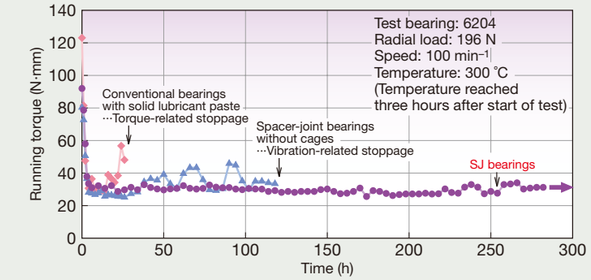
- Grease-free, $MoS_2$ solid lubricant
- Applicable from atmospheric pressure up to vacuums at $10^{-8}$ Pa and temperatures up to 400 °C
- “Peapod” structure provides excellent torque stability and long life
- Over six times more durable than conventional high-temperature bearings with solid lubricant paste




## Performance

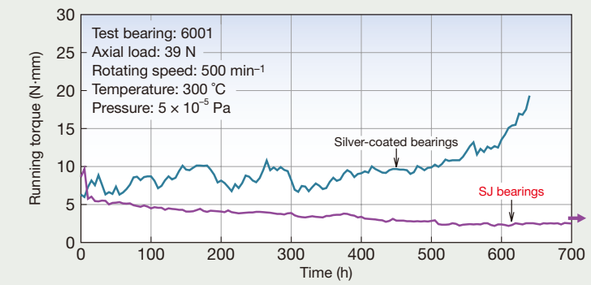
### Durability

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

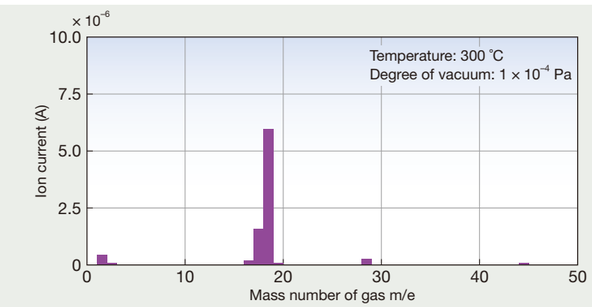
Outperforms silver-coated bearings in durability and torque stability.




### 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.

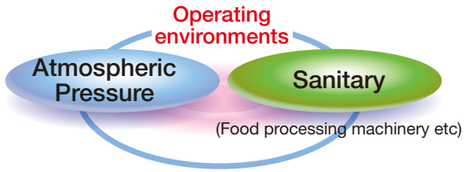


# 16. Food Grade Grease-Packed Bearings

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.

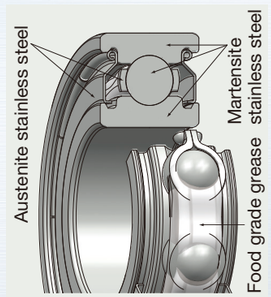
*NSF (International) : U.S. non-profit third party accreditation organization that is internationally recognized in the field of public safety and health.




**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

## 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




H1: Usable where incidental food contact is possible

H2: Usable where there is no possibility of food contact

## Performance

### Properties of grease

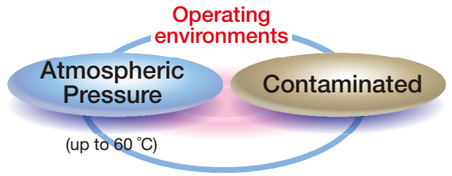
| Name | RLS | BL2 for high temperatures |
|---|---|---|
| NSF category | H1 | H1 |
| Base oil | Synthetic hydrocarbon oil | Fluorine oil |
| Thickener | Aluminum alloy soap | PTFE |
| Kinematic viscosity ($mm^2/s$, 40 °C) | 150 | 415 |
| Consistency | 280 | 280 |
| Water wash-out | 7.6% | 0.1% |
| Operating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

## Operating Instructions and Notes

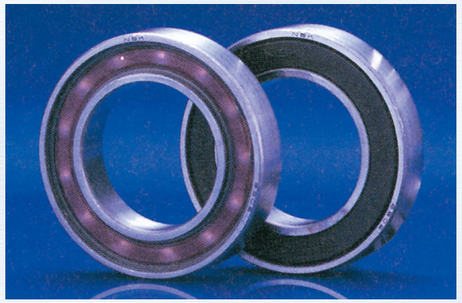
- Keep bearings packed until immediately before mounting.
- See the tables on Pages A27 and A28 for limiting loads and limiting rotational speeds.
- The grease is safe for incidental food contact only. Do not eat the grease.
- All comments referencing certain values or performance in this catalog are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

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

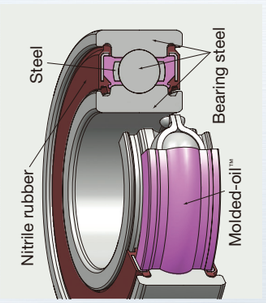
Molded-Oil™ bearings, lubricated with NSK's own oil-impregnated material, are suitable in contaminated atmospheric pressure environments.




## Product Specifications



## Representative Structure




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

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

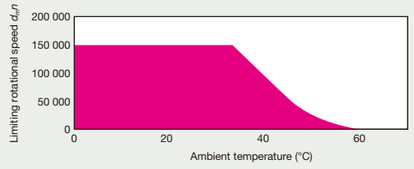
## Operating Instructions and Notes

- 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 $C_H$ <Load more than 1% is necessary.> |
| Limiting rotational speed, $d_m n$(1) | 150 000<br>Refer to the chart below for temperatures above 35 °C |

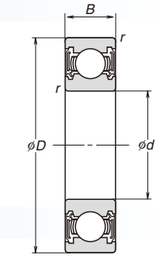
Note (1) $d_m n$ = (Bearing bore diameter + bearing outer diameter (mm)) ÷ 2 × Rotational speed ($min^{-1}$)






## 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: Bore diameter *d* (mm) | Outside diameter *D* (mm) | Width *B* (mm) | Chamfer dimension (min.) *r* (mm) | Basic designation | Availability | Limiting speed(2) (reference value) ($min^{-1}$) | Applied load(3) (reference value) (N) |
|---|---|---|---|---|---|---|---|
| 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)

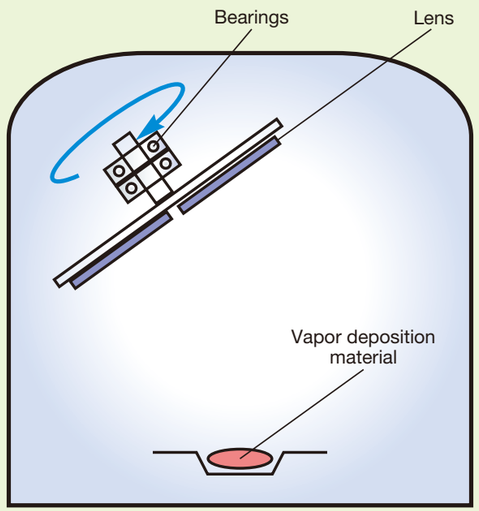
Notes (1) The actual designation may differ from the inquiry designation. ▯▯▯▯ indicates the basic designation.
(2) The limiting speed of these bearings has been calculated for 25 °C operating conditions. Limiting speeds will be slower for operating conditions of 35 °C or higher. (Refer to the previous page for further details.)
(3) The applied load is a pure radial load that has been calculated based on a bearing life of $10^7$ rotations.
(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.

# Applications of SPACEA™ Series Bearings

SPACEA™

## Vacuum Vapor Deposition Equipment




**Operating Conditions**

**Vacuum/Clean 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**

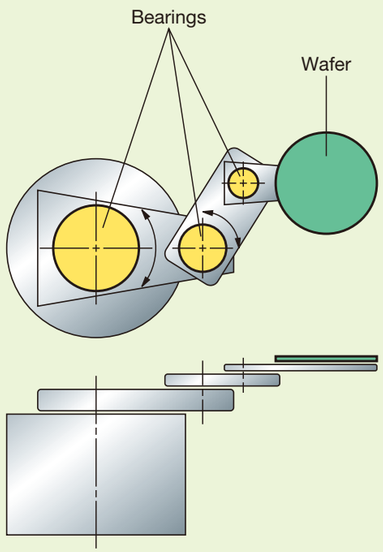
- Silver-coated bearing (6002, 6004, etc.)
- Operating life: 2 to 3 months

**NSK SPACEA™ Series**

**YS Bearings with Spacer Joints**

- Operating life: More than 1 year

## Robots for Vacuum Environments




**Operating Conditions**

**Vacuum/Clean 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

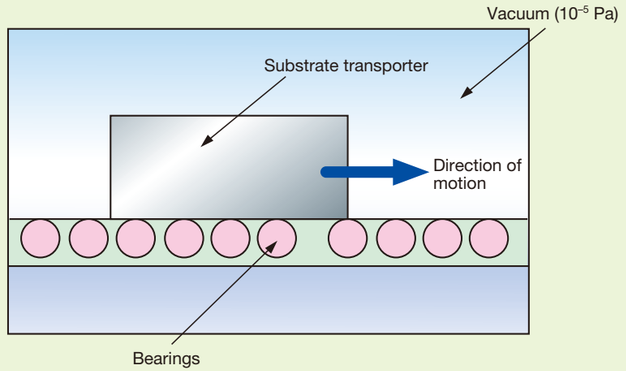
**NSK SPACEA™ Series**

**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/Clean 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**

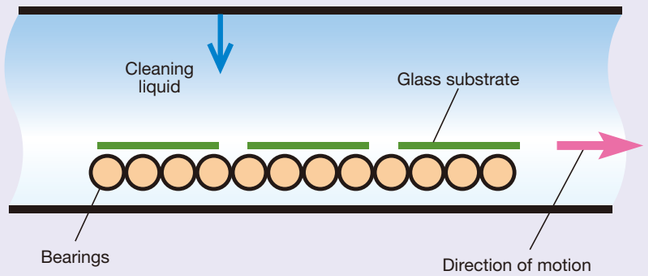
- Fluororesin coated bearing
  (bore diameter: 3/8")
- Operating life: 3 months

**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**

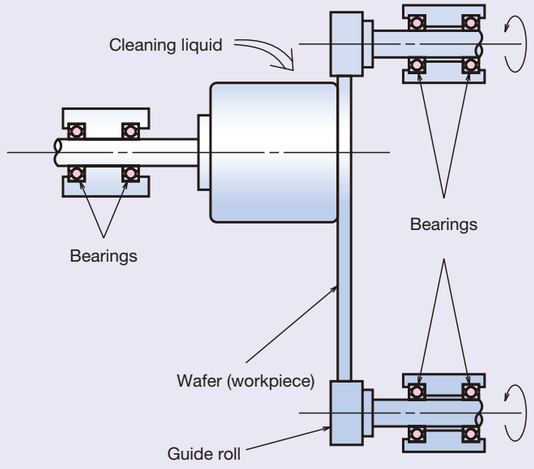
**Aqua-Bearing™**

- Operating life: More than 1 year

# Applications of SPACEA™ Series Bearings

SPACEA™

## 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**

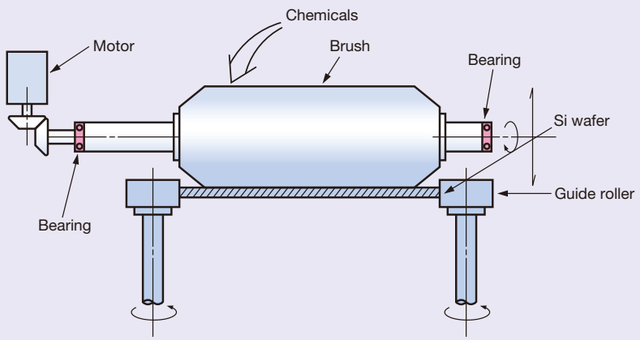
- Stainless steel bearing (degreased products 6000, 6001, 6901, etc.)
- Operating life: 2 weeks to 1 month

**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**

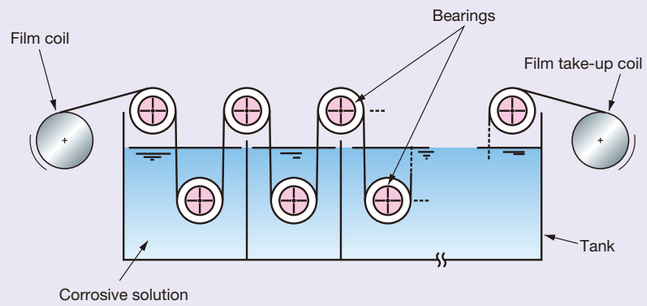
- Stainless steel bearing (6001, 6800, etc.)
- Operating life: 2 weeks to 1 month

**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**

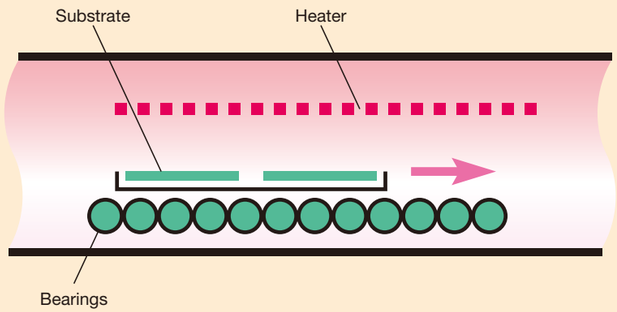
- All-ceramic bearing (silicon nitride 6204, 6206, etc.)
- Operating life: More than 1 year

**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**

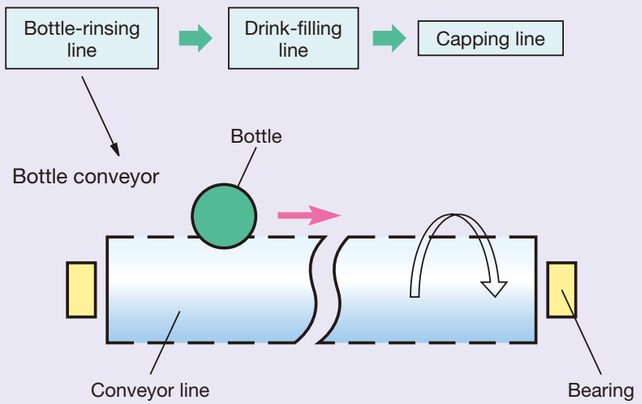
**SJ Bearings**

- Operating life: More than 1 year

# Applications of SPACEA™ Series Bearings

SPACEA™

## 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**

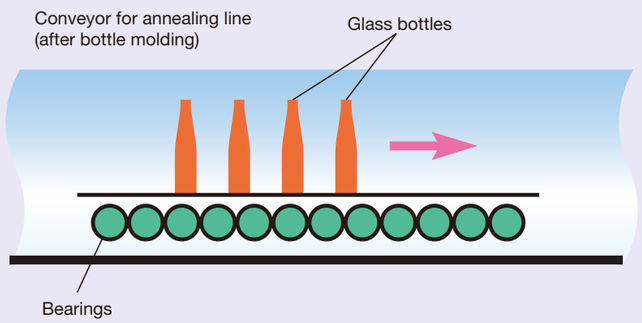
- Stainless steel bearing (6205, 6212, 6306, etc.)
- Operating life: Several months

**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**

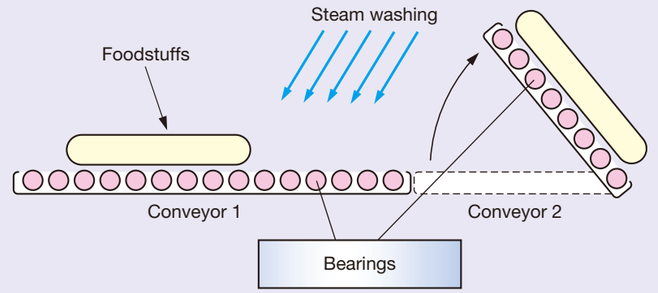
- High-temperature grease-packed stainless steel bearing (6005, 6306, etc.)
- Operating life: Several months

**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**

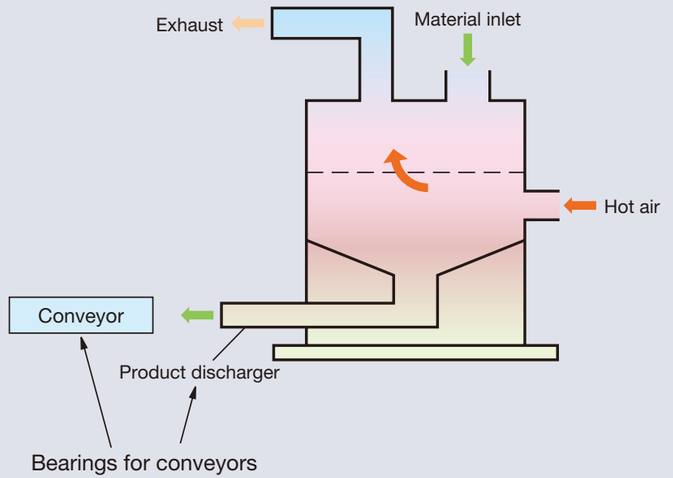
- Grease-packed stainless steel bearing

**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 Series: High-Accuracy USS Type for Cleanrooms ····· B19–B20

5. Support Units for Cleanroom Environments ····· B21–B22

6. “NSK K1™” Lubrication Unit ····· B23–B26

7. NSK High Performance Seals ····· B27–B30

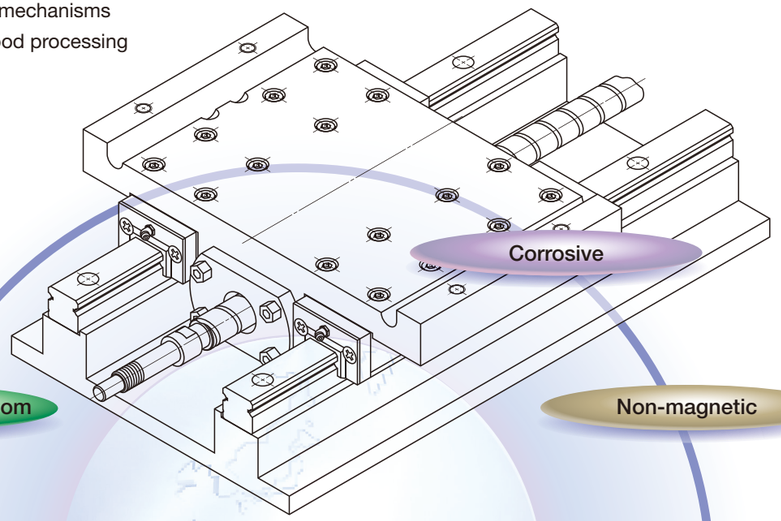
8. Ball Screws and NSK Linear Guides for High-Temperature Environments ····· B31–B32

F Applications for SPACEA™ Series Ball Screws and NSK Linear Guides ····· B33–B34

1. Semiconductor Manufacturing Equipment/Flat Panel Display Manufacturing Equipment

## 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.




### Ball Screws and Support Units for Cleanroom Environments



USS-type for High Accuracy and Cleanroom Applications

Support units for cleanrooms

### Ball screws and linear guides for special environments



### Maintenance-Free Ball Screws and NSK Linear Guides

### SPACEA™ Series Ball Screws

#### Ball screws for special environments



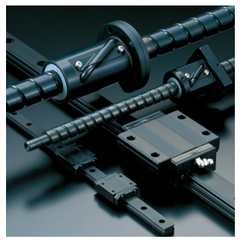
Ball screws equipped with high-performance X1 seals



Ball screws with NSK Lubricant E-DFO



Stainless steel ball screws



Ball screws for corrosive environments



Non-magnetic ball screws




NSK "Clean" Grease

### SPACEA™ Series NSK Linear Guides

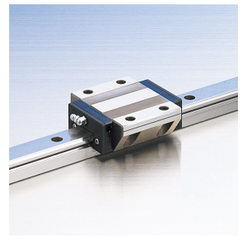
#### Linear guides for special environments



Linear guides equipped with high performance seals



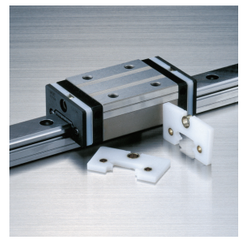
Linear guides with NSK Lubricant E-DFO



Stainless steel linear guides



Linear guides for corrosive environments



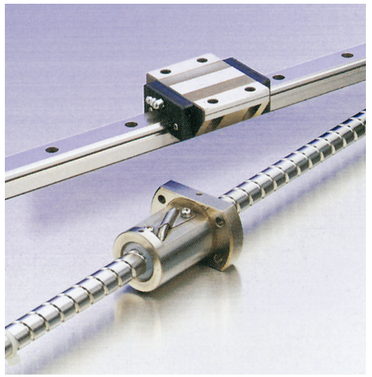
Linear guides for food processing



Linear guides for high temperatures

# B SPACEA™ Series Ball Screws and NSK Linear Guides Selection Guide

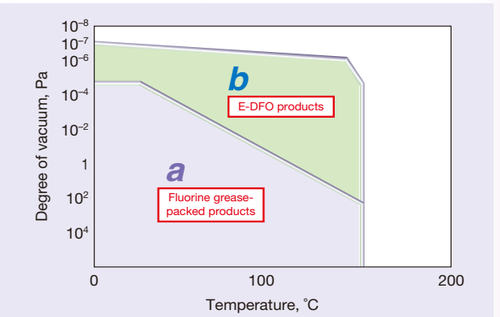
SPACEA™



**Select the most appropriate product with the following flow chart.**

① Select the group of products appropriate for your operating environment and application. → ② Find the series that meets your operating conditions. → 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



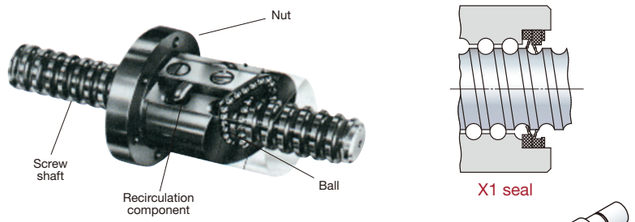

| ① Operating environment | | | Product name | | ② Operating conditions: Degree of vacuum Pa | | | | Temperature ˚C | | | Cleanliness (1) | | | Limiting rotational speed $d \cdot n$ value (2) | | | Limiting speed of linear guide m/min | | | ③ Price comparison | ③ Dimensions (availability) | ④ · Specifications · Operating instructions · Technical data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Atmospheric pressure | $10^{-4}$≤ | $10^{-8}$≤ | | ≤100 | ≤200 | ≤300 | 100–1 000 | ≤100 | ≤10 | ≤50 000 | ≤100 000 | ≤150 000 | ≤100 | ≤200 | ≤300 | | | |
| Vacuum and cleanroom | Cleanroom | Atmospheric pressure (room temperature) | LG2 grease-packed ball screws and linear guides | | ● | | | | ≤70 ˚C | | | ● | | | ≤70 000 | | | ≤100 | | | Low ▲ High | Ball screws (B9) Support units (B10) Linear guides (B11–B12) | B15–B16, B19–B20, B23–B25 |
| | | | LGU grease-packed ball screws and linear guides | | | | | | ≤120 ˚C | | | | | | | | | | | | | | |
| | Vacuum | From atmospheric pressure up to vacuum (room temperature) | Fluorine grease-packed ball screws and linear guides | | See the scope of applications for fluorine grease-packed products (upper right) a | | | | | | | ● | | | ≤70 000 | | | ≤100 | | | Low ▲ High | | B13–B14 |
| | | 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 for E-DFO products (upper right) b | | | | | | | | ● | | ≤70 000 | | | ≤100 | | | Low ▲ High | | B17–B18 |
| | 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 | | | | ≤150 ˚C | | | | | | ≤70 000 | | | ≤100 | | | – | | – |
| Corrosive | Water | Water vapor, high-humidity environments | Ball screws and linear guides for corrosive environments | (Standard grease) (Standard seal) | ● | | | | ≤80 ˚C | | | | | | ≤70 000 | | | ≤100 | | | Low ▲ High | | B13–B14, B23–B24 |
| | | 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) | ● | | | | ≤80 ˚C | | | | | | ≤70 000 | | | ≤100 | | | Low ▲ High | | B13–B14 |
| | | | Stainless steel ball screws and linear guides | | | | | | ≤150 ˚C | | | | | | | | | | | | | | |
| Sanitary | Food processing environments | | Ball screws and linear guides for food processing | | ● | | | | ≤80 ˚C | | | | | | ≤70 000 | | | ≤100 | | | – | | B25–B26 |
| Contaminated | Dust or wood chips | | Ball screws equipped with high-performance X1 seal Linear guides equipped with high performance seal | | ● | | | | ≤80 ˚C | | | | | | ≤70 000 | | | ≤100 | | | Low ▲ High | | B13–B14, B23–B24, B27–B30 |
| High-temperature | Atmospheric pressure (up to 150 ˚C) | | Ball screws and linear guides for high-temperature environments | | ● | | | | ≤150 ˚C | | | | | | ≤70 000 | | | ≤100 | | | – | | B31–B32 |
| Non-magnetic | From atmospheric pressure up to vacuum | | Non-magnetic stainless steel ball screws and linear guides | | $10^{-5}$Pa | | | | ≤150 ˚C | | | | | | ≤70 000 | | | ≤100 | | | – | | – |

(1) Cleanliness may vary depending on surrounding structures and other factors.
(2) $d \cdot n$ = Shaft diameter of ball screws (mm) × rotational speed ($min^{-1}$)

# Types and Specifications of SPACEA™ Ball Screws and NSK Linear Guides

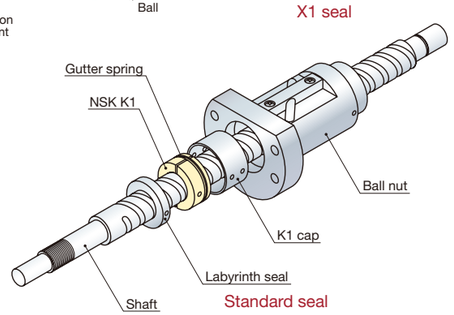
SPACEA™

## SPACEA™ Series Ball Screws

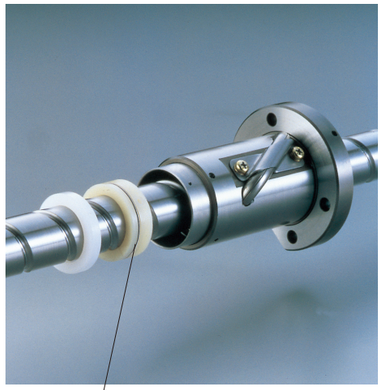




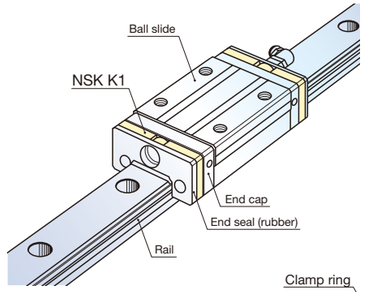
X1 seal

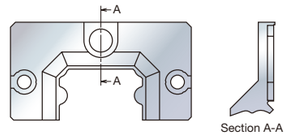


Standard seal

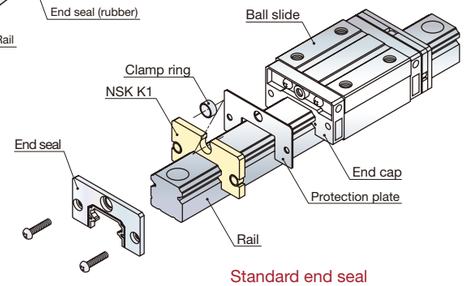

NSK K1 lubrication unit

## SPACEA™ Series NSK Linear Guides

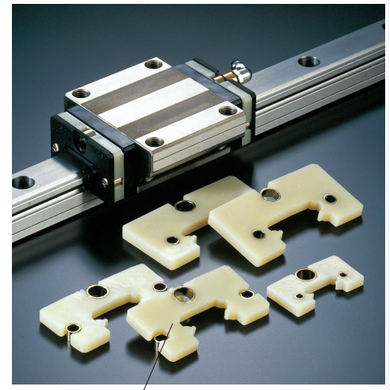


High dust-resistant end seal



Standard end seal


NSK K1 lubrication unit

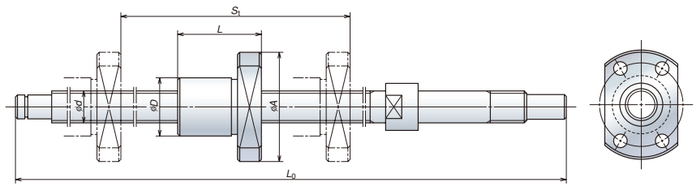
| Operating environment | | | Product name | | Component specifications | | | | | | · Specifications · Operating instructions · Technical data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ball screw specifications | Shaft, nut | Ball | Recirculation components | Seal | Corrosion-Resistant coating | Lubricant | |
| | | | | Linear guide specifications | Rail, ball slides | | End cap | | | | |
| Vacuum and cleanroom | Cleanroom | Atmospheric pressure (room temperature) | LG2/LGU grease-packed ball screws and linear guides | | Standard material | Standard material | Standard material | Standard seal | Fluoride Low-Temperature chrome plating | LG2 "Clean" grease, NSK K1 | B15–B16, B19–B20, B23–B24 |
| | | | | | Martensite stainless steel | Martensite stainless steel | Austenite stainless steel | | | LGU "Clean" grease, NSK K1 | |
| | Vacuum | From atmospheric pressure up to vacuum (room temperature) | Fluorine grease-packed ball screws and linear guides | | | | | – | | Fluorine grease | B13–B14 |
| | | From atmospheric pressure up to vacuum (up to 150 ˚C) | Ball screws and linear guides with NSK Lubricant E-DFO | | | | | | – | E-DFO (+ DLC) or Molybdenum disulfide | B17–B18 |
| | Non-magnetic | From atmospheric pressure up to vacuum | Non-magnetic stainless steel ball screws and linear guides | | Special austenite stainless steel | Ceramics | Austenite stainless steel | Standard seal | – | Standard grease, Fluorine grease | – |
| Corrosive | Water | Water vapor, high-humidity environments | Corrosion-resistant coated ball screws and linear guides | | Standard material | Standard material | Standard material | Standard seal | Fluoride Low-Temperature chrome plating | Standard grease + NSK K1 | B13–B14, B23–B24 |
| | | Water-immersed, water-spray | Stainless steel ball screws and linear guides | | Martensite stainless steel | Martensite stainless steel | Austenite stainless steel | | | | |
| | Weak acid, weak alkali Strong acid, strong alkali | | Corrosion-resistant coated ball screws and linear guides | | Standard material | Standard material | | Corrosion-resistant seal | Fluoride Low-Temperature chrome plating | Fluorine grease | B13–B14 |
| | | | Stainless steel ball screws and linear guides | | Martensite stainless steel | Martensite stainless steel | | | | | |
| Sanitary | Food processing environments | | Ball screws and linear guides for food processing | | Martensite stainless steel | Martensite stainless steel | Austenite stainless steel | Standard seal | – | Grease for food processing applications, NSK K1 for food processing applications and medical devices | B25–B26 |
| Contaminated | Dust or wood chips | | Ball screws equipped with high-performance X1 seal | | Standard material | Standard material | Standard material | X1 seal | Fluoride Low-Temperature chrome plating | Standard grease | B13–B14, B27 |
| | | | Linear guides equipped with high performance seal | | | | | High dust-resistant seal | | Standard grease + NSK K1 | B13–B14, B23–B24, B28-B30 |
| High-temperature | Atmospheric pressure (up to 150 ˚C) | | Ball screws and linear guides for high-temperature environments | | Martensite stainless steel | Martensite stainless steel | Austenite stainless steel | (High dust-resistant seal) | – | Heat-resistant grease, Fluorine grease | B31–B32 |
| Non-magnetic | From atmospheric pressure up to vacuum | | Non-magnetic stainless steel ball screws and linear guides | | Special austenite stainless steel | Ceramics | Austenite stainless steel | Standard seal | – | Standard grease, Fluorine grease | – |

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.

# Dimensions and Availability of SPACEA™ Series Ball Screws

SPACEA™

## 1. Ball Screw Dimensions




| Series | Shaft diameter d | Lead | Effective turns of balls | Number of starts | Nut outer diameter D | Flange outer diameter A | Nut length L | Maximum shaft length $L_0$max | Stroke $S_t$ | Dynamic load rating (N) | Cleanroom | Vacuum | Corrosive | High-temperature | Contaminated | Sanitary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 6 | 1 | 1×3 | 1 | 12 | 24 | 21 | 174 | 100 | 555 | ○ | | ○ | | | |
| | 8 | 1 | 1×3 | 1 | 14 | 27 | 21 | 248 | 150 | 645 | ○ | | ○ | | | |
| | | 2 | 1×3 | 1 | 16 | 29 | 28 | 248 | 150 | 1 270 | ○ | | ○ | | | |
| | 10 | 2 | 1×3 | 1 | 18 | 35 | 29 | 308 | 200 | 1 470 | ○ | | ○ | | | |
| | | 4 | 2.5×1 | 1 | 26 | 46 | 34 | 430 | 300 | 2 630 | ○ | | ○ | | | ○ |
| | 12 | 2 | 1×3 | 1 | 20 | 37 | 29 | 380 | 250 | 1 600 | ○ | | ○ | | | ○ |
| | | 5 | 2.5×1 | 1 | 30 | 50 | 40 | 580 | 450 | 3 590 | ○ | | ○ | | | ○ |
| | | 10 | 2.5×1 | 1 | 30 | 50 | 50 | 580 | 450 | 3 620 | ○ | | ○ | | | ○ |
| | 15 | 10 | 2.5×1 | 1 | 34 | 57 | 51 | 1 161 | 1 000 | 6 660 | ○ | | ○ | | | ○ |
| | | 20 | 1.7×1 | 1 | 34 | 55 | 45 | 1 161 | 1 000 | 4 630 | ○ | | ○ | | | ○ |
| | 16 | 2 | 1×4 | 1 | 25 | 44 | 40 | 461 | 300 | 3 400 | ○ | | ○ | | | ○ |
| | 20 | 20 | 1.5×1 | 1 | 46 | 74 | 63 | 1 208 | 1 000 | 6 700 | ○ | | ○ | | | ○ |
| USS | 10 | 5 | 2.7×1 | 1 | 23 | 43 | 29 | 521 | 433 | 3 420 | ○ | | | | | |
| | 12 | | | | 24 | 44 | 30 | 621 | 530 | 3 750 | ○ | | | | | |
| | 15 | | | | 28 | 51 | 30 | 761 | 653 | 6 410 | ○ | | | | | |
| Production on demand | 10 | 2 | 1×3 | 1 | 22 | 39 | 29 | 308 | | 1 470 | ○ | ○ | ○ | ○ | | ○ |
| | | 4 | 2.5×1 | 1 | 26 | 46 | 34 | 430 | | 2 630 | ○ | ○ | ○ | ○ | | ○ |
| | 12 | 2 | 1×3 | 1 | 24 | 41 | 29 | 380 | | 1 600 | ○ | ○ | ○ | ○ | | ○ |
| | | 5 | 2.5×1 | 1 | 30 | 50 | 40 | 580 | | 3 590 | ○ | ○ | ○ | ○ | | ○ |
| | | 10 | 2.5×1 | 1 | 30 | 50 | 50 | 580 | | 3 620 | ○ | ○ | ○ | ○ | | ○ |
| | 15 | 10 | 2.5×1 | 1 | 34 | 57 | 51 | 1 161 | | 6 660 | ○ | ○ | ○ | ○ | | ○ |
| | | 20 | 1.7×1 | 1 | 34 | 55 | 45 | 1 161 | | 4 630 | ○ | ○ | ○ | ○ | | ○ |
| | 16 | 2 | 1×4 | 1 | 30 | 49 | 40 | 461 | | 3 400 | ○ | ○ | ○ | ○ | | ○ |
| | 20 | 20 | 1.5×1 | 1 | 46 | 74 | 63 | 1 208 | | 6 700 | ○ | ○ | ○ | ○ | | ○ |
| | 25 | 5 | 2.5×2 | 1 | 50 | 73 | 55 | 1 800 | | 16 000 | ○ | ○ | ○ | ○ | | ○ |
| | | 25 | 1.5×1 | 1 | 44 | 71 | 90 | 1 800 | | 9 610 | ○ | ○ | ○ | ○ | | ○ |
| | 32 | 5 | 2.5×2 | 1 | 58 | 85 | 106 | 2 400 | | 17 800 | ○ | ○ | ○ | ○ | | ○ |
| | | 10 | 2.5×2 | 1 | 74 | 108 | 125 | 2 400 | | 44 500 | ○ | ○ | ○ | ○ | | ○ |
| | | 20 | 2.5×1 | 1 | 78 | 105 | 107 | 2 400 | | 16 900 | ○ | ○ | ○ | ○ | | |
| | | 25 | 2.5×1 | 1 | 78 | 105 | 120 | 2 400 | | 16 700 | ○ | ○ | ○ | ○ | | |
| | | 32 | 1.5×1 | 1 | 51 | 85 | 109 | 2 400 | | 10 900 | ○ | ○ | ○ | ○ | | ○ |
| | | 32 | 1.7×2 | 2 | 56 | 86 | 109 | 2 800 | | 32 100 | ○ | | | | ○ | ○ |
| | 40 | 25 | 2.5×1 | 1 | 100 | 133 | 136 | 3 000 | | 27 900 | ○ | ○ | ○ | ○ | | |
| | | 32 | 1.5×2 | 2 | 100 | 133 | 122 | 3 000 | | 32 100 | ○ | ○ | ○ | ○ | | |
| | | 40 | 1.5×1 | 1 | 64 | 106 | 133 | 3 000 | | 17 400 | ○ | ○ | ○ | ○ | | ○ |
| | | 10 | 2.5×2 | 1 | 82 | 124 | 173 | 2 900 | | 61 200 | ○ | | | | ○ | ○ |
| | | 12 | 2.5×2 | 1 | 86 | 128 | 197 | 2 900 | | 71 700 | ○ | | | | ○ | ○ |
| | | 16 | 3.7×1 | 1 | 86 | 128 | 172 | 2 900 | | 66 900 | ○ | | | | ○ | ○ |
| | | 20 | 2.7×2 | 2 | 86 | 128 | 164 | 2 900 | | 77 900 | ○ | | | | ○ | ○ |
| | 45 | 8 | 2.5×4 | 1 | 82 | 120 | 162 | 3 300 | | 65 300 | ○ | ○ | ○ | ○ | | ○ |
| | | 10 | 2.5×2 | 1 | 88 | 132 | 117 | 3 300 | | 53 800 | ○ | ○ | ○ | ○ | | ○ |
| | | 8 | 2.5×2 | 1 | 82 | 124 | 146 | 2 900 | | 44 000 | ○ | | | | ○ | ○ |
| | | 16 | 3.7×1 | 1 | 92 | 134 | 173 | 2 900 | | 69 900 | ○ | | | | ○ | ○ |
| | | 20 | 2.7×2 | 2 | 92 | 134 | 164 | 2 900 | | 83 200 | ○ | | | | ○ | ○ |
| | 50 | 8 | 2.5×4 | 1 | 90 | 129 | 149 | 3 500 | | 67 900 | ○ | ○ | ○ | ○ | | ○ |
| | | 10 | 2.5×4 | 1 | 93 | 135 | 163 | 3 500 | | 101 000 | ○ | ○ | ○ | ○ | | ○ |
| | | 25 | 2.5×1 | 1 | 120 | 156 | 140 | 3 300 | | 42 000 | ○ | ○ | ○ | ○ | | |
| | | 32 | 2.5×1 | 1 | 120 | 156 | 158 | 3 300 | | 41 600 | ○ | ○ | ○ | ○ | | |
| | | 40 | 1.5×2 | 2 | 120 | 156 | 140 | 3 300 | | 48 000 | ○ | ○ | ○ | ○ | | |
| | | 50 | 1.5×1 | 1 | 80 | 126 | 161 | 3 500 | | 25 900 | ○ | ○ | ○ | ○ | | ○ |
| | | 50 | 1.5×2 | 2 | 120 | 156 | 158 | 3 500 | | 47 100 | ○ | ○ | ○ | ○ | | |
| | | 10 | 2.5×2 | 1 | 93 | 135 | 174 | 2 900 | | 68 100 | ○ | | | | ○ | ○ |
| | | 12 | 2.5×2 | 1 | 100 | 146 | 200 | 2 900 | | 91 500 | ○ | | | | ○ | ○ |
| | | 16 | 3.7×1 | 1 | 98 | 140 | 173 | 2 900 | | 72 700 | ○ | | | | ○ | ○ |
| | | 20 | 2.7×2 | 2 | 98 | 140 | 164 | 2 900 | | 85 700 | ○ | | | | ○ | ○ |

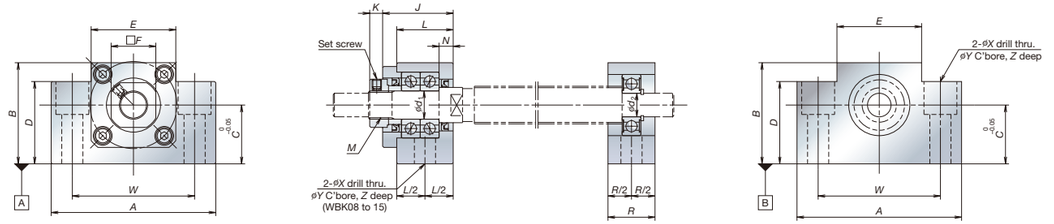
Dimensions (mm) | Suitability for special environments (availability)

○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

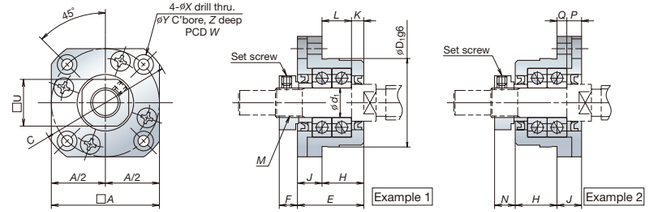
| Fixed support side unit (square type) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Reference No. (for use in clean environments) | Locknut tightening torque (reference) [N·cm] | Set screw tightening torque (reference) [N·cm] | $d_1$ | F | J | K | L | N | M |
| WBK08-01C | 230 | 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<br>9 | 17<br>14 | 15<br>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



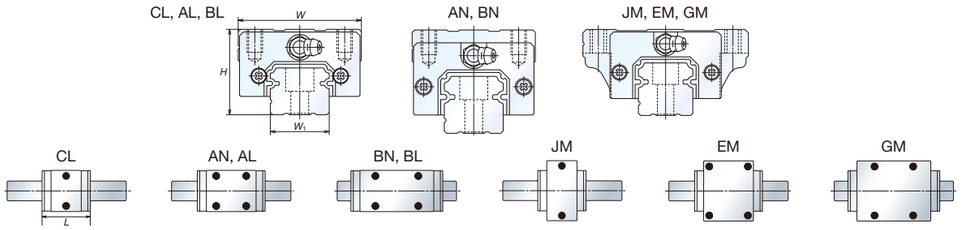

Unit: mm

| 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.

## 3. NSK Linear Guide Dimensions

NH, VH, NS, LH Series

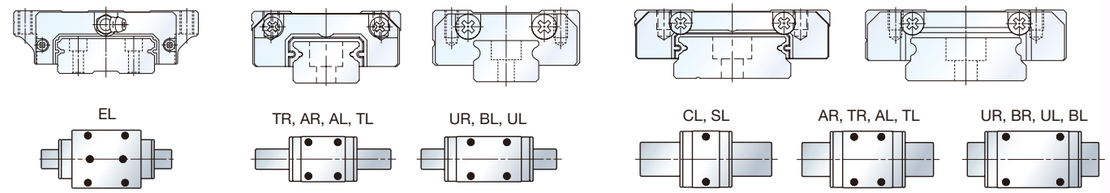



| Series | Model No. | Dimensions (mm) Height H | Overall width W | Ball slide length (L) Standard | Ball slide length (L) With NSK K1 | Rail width $W_1$ | Dynamic load rating (N) | Suitability for special environments (availability) Cleanroom | Vacuum | Corrosive | High-temperature | Sanitary | Contaminated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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)



LW Series PU Series LU Series PE Series LE Series

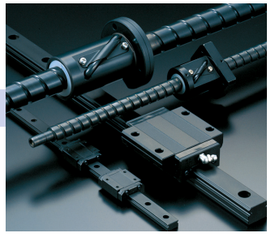



| Series | Model No. | Dimensions (mm) Height H | Overall width W | Ball slide length (L) Standard | Ball slide length (L) With NSK K1 | Rail width $W_1$ | Dynamic load rating (N) | Suitability for special environments (availability) Cleanroom | Vacuum | Corrosive | High-temperature | Sanitary | Contaminated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | **PU05TR** | 6 | 12 | 19.4 | 24.4 | 5 | 520 | ○ | | ○ | | | |
| | **PU07AR** | 8 | 17 | 23.4 | 29.4 | 7 | 1 090 | ○ | | ○ | | | |
| | **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 | **PE05AR** | 6.5 | 17 | 24.1 | 28.9 | 10 | 690 | ○ | | ○ | | | |
| | **PE07TR** | 9 | 25 | 31.1 | 37.1 | 14 | 1 580 | ○ | | ○ | | | |
| | **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)

# 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 (flouride low-temperature chrome plating) on these linear guides and ball screws for optimal rust resistance.



## Fluoride Low-Temperature Chrome Plating

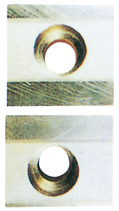
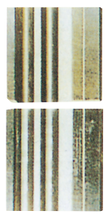
**Electrolytic rust-resistant black plating + fluororesin coating**

- 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
- Thin-film and high corrosion-resistance properties reduce factors that might adversely affect the accuracy of parts
- Outstanding durability on rolling surfaces, compared with other surface treatments
- More economical than other surface-treated or stainless steel products

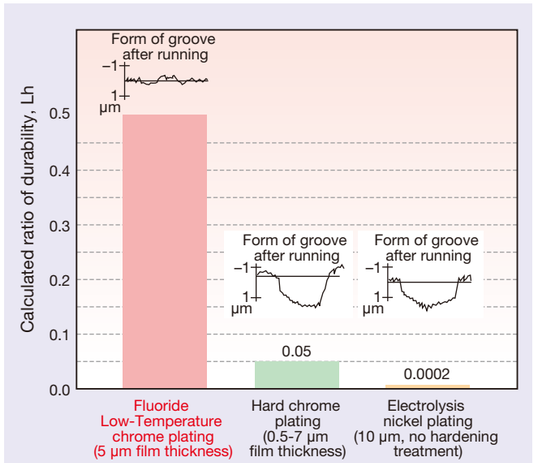
Note: Avoid using organic solvents, which may degrade the treatment's rust prevention properties.

### Test results for corrosion resistance to humidity

| Characteristics \ Type | | | Fluoride Low-Temperature chrome plating | Hard chrome plating | Electrolysis nickel plating | SUS440C | Standard product |
|---|---|---|---|---|---|---|---|
| Rust prevention | 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 |
| | Test conditions<br>● Testing machine: Dabaiespeck high-temperature and high-humidity vessel<br>● Temperature: 70 ˚C<br>● Relative humidity: 95%<br>● Time: 96 hours<br><br>Time to/from target temperature and humidity conditions.<br>To target: 5 hours<br>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



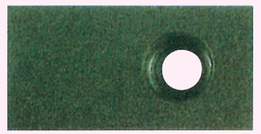
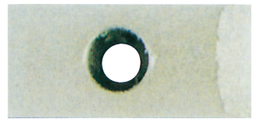
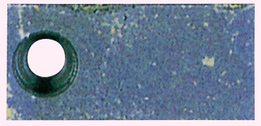
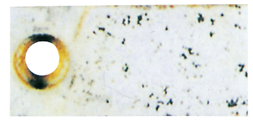
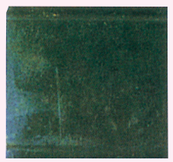

### Comprehensive evaluation

| | 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<br>Nitric acid |  |  |
|  | 24-hour soaking<br>Hydrofluoric acid |  |  |
|  | 72-hour vapor<br>Hydrochloric cleansing liquid<br>$HCl : H_2O_2 : H_2O = 1 : 1 : 8$ |  | |
| ○ | 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 |
|---|---|---|---|
| Product | LG2 | LGU | Commercially available fluorine grease K |
| Base oil | Mineral oil and synthetic hydrocarbon oil | Synthetic hydrocarbon oil | Fluorine oil |
| Thickener | Lithium soap | Diurea | PTFE |
| Kinematic viscosity ($mm^2/s$, 40 ˚C) | 32 | 95.8 | 270 |
| Consistency | 199 | 201 | 280 ± 15 |
| Maximum operating temperature, ˚C | up to 70 | up to 120 | up to 200 |

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

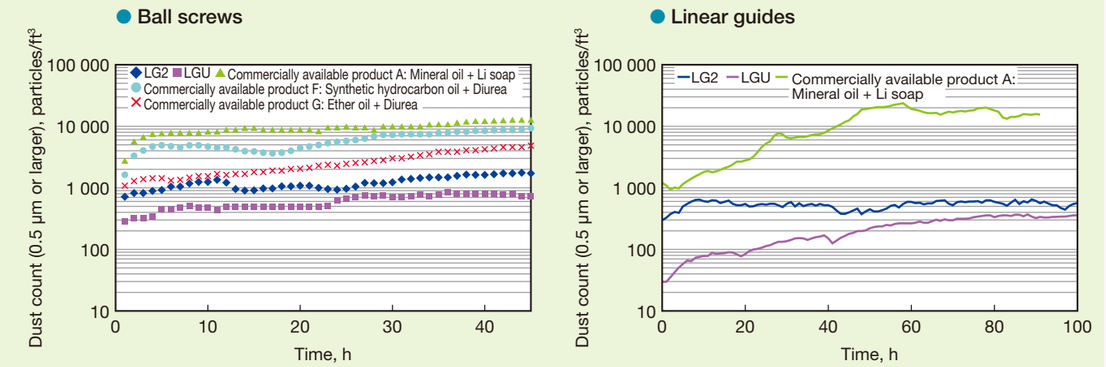
### Comprehensive evaluation

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

○: Excellent △: Poor ×: Not recommended

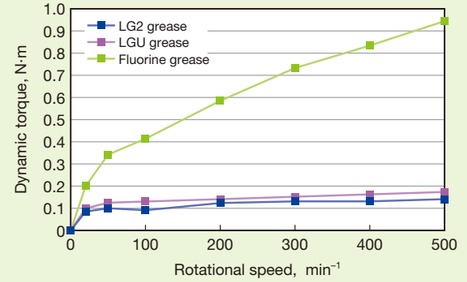
### Extremely low particle emissions

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



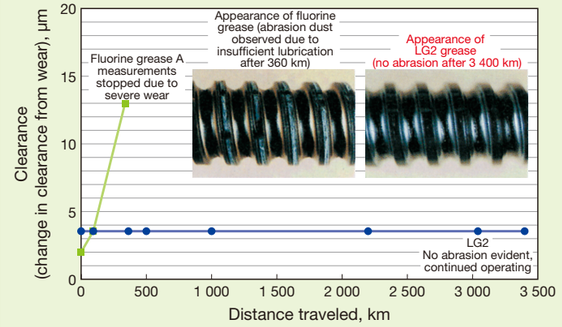

### Stable low-torque characteristics

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 $min^{-1}$).



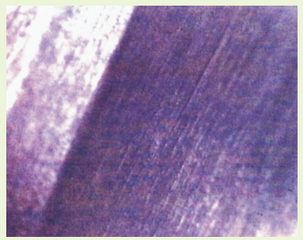

### Long life

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



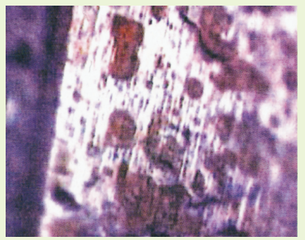

### Superior rust prevention

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 fluororesin coatings or solid lubricants.



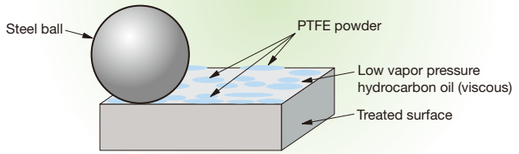

## Features

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

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

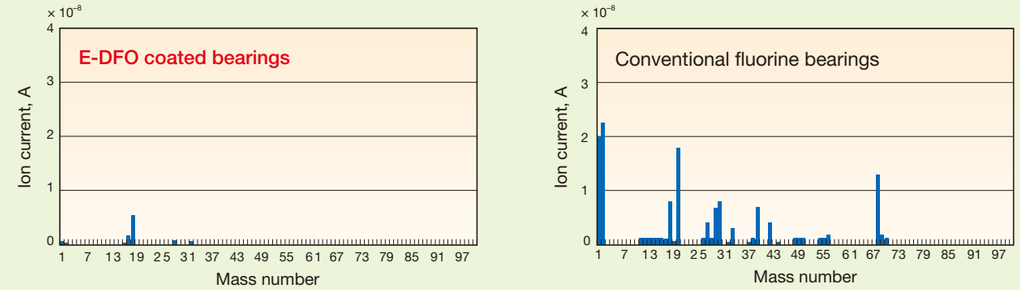
| | Performance | | | Compatible operating environment | | |
|---|---|---|---|---|---|---|
| Lubricant | Durability | Particle emissions | Outgassing | Operating environment | Ball screws | Linear guides |
| E-DFO | ○ | ○ | ◎ | Atmospheric pressure, vacuum | ● | ● |
| Fluororesin | △ | △ | ○ | Atmospheric 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)

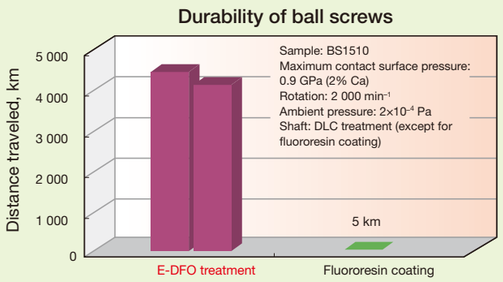
Outperforms conventional fluorine-coated bearings.




### Long life

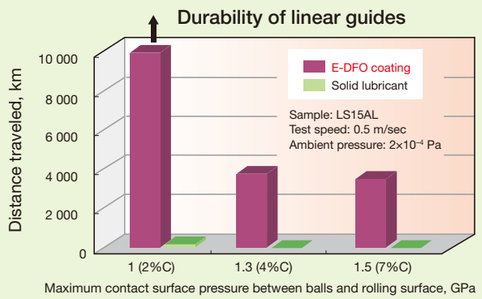
- Durability of ball screws

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 Series: High-Accuracy USS Type for Cleanrooms

A precision Series 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)

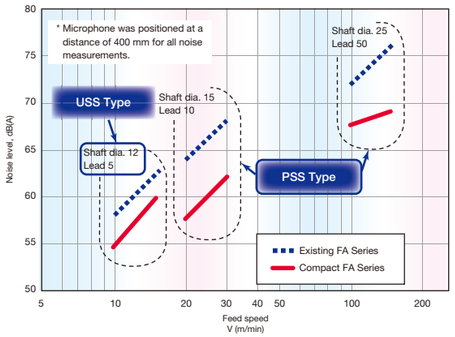
## Features of the USS Type

· **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.

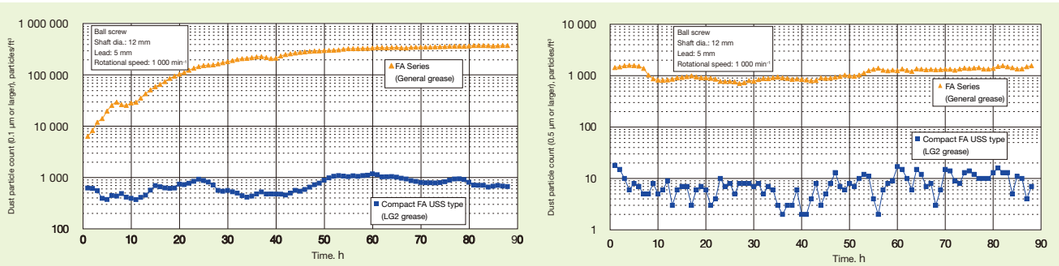
### ● Low-noise

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

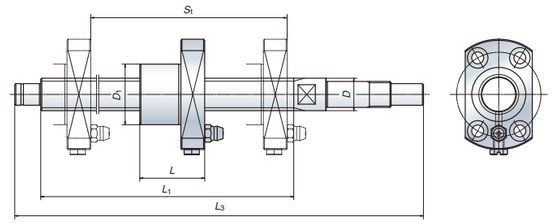



*Dust emissions will increase if ball screw revolutions increase.

### ● Compact FA Series USS type reference number

Example : **USS** **15** **05** **N1D** **0361**

- USS — Compact FA Series USS type
- 15 — Screw shaft diameter (mm)
- 05 — Lead (mm)
- N1D — NSK control code
- 0361 — Screw shaft length (mm)




### ● Specifications/Performance

Unit: mm

| Reference no. | Screw shaft dia. $d$ | Lead $l$ | Basic load ratings (N) Dynamic $C_a$ | Basic load ratings (N) Static $C_{0a}$ | Stroke St Nominal | Stroke St Max. | Nut dimensions Diameter $D1$ | Nut dimensions Overall length $L$ | Screw shaft dimensions Threaded length $L_1$ | Screw shaft dimensions Shaft length $L_3$ | Lead accuracy Travel compensation $T$ | Lead accuracy Deviation $e_p$ | Lead accuracy Variation $V_u$ | Dynamic preload torque *1 (N·cm) | Permissible rotational speed (min⁻¹) *2 Fixed-Simple |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 | | 3 750 | 5 810 | 100 | 130 | 24 | 30 | 160 | 221 | | 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 | | 6 410 | 10 100 | 100 | 159 | 28 | 30 | 189 | 261 | | 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 ℃

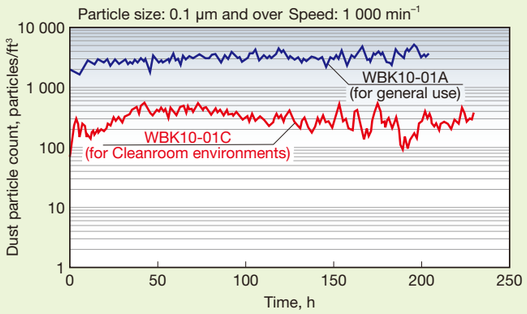
# 5. Support Units for Cleanroom Environments

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.)

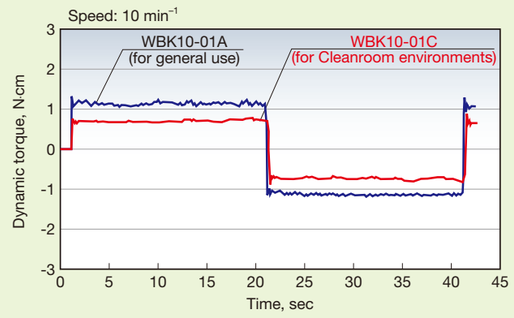
## Features of Support Units for Cleanroom Environments

- **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

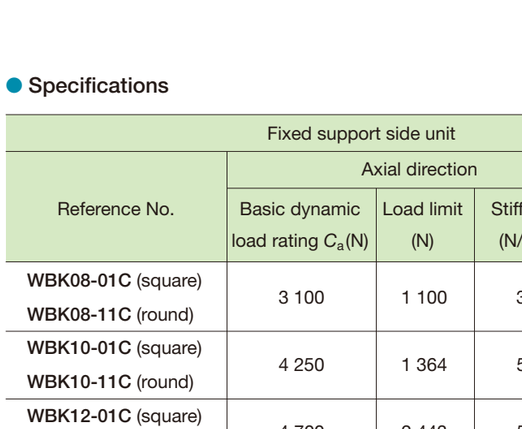
Example: **WBK 08 S - 01 C**

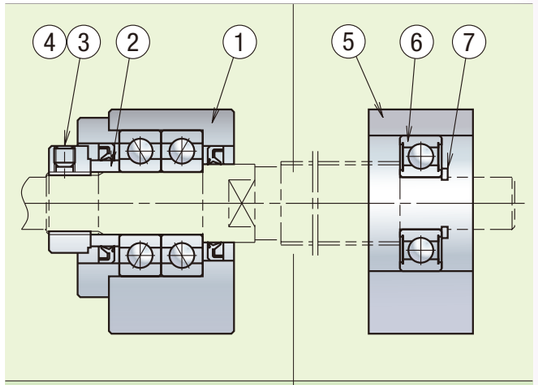
- WBK: Product code for support unit
- 08: Nominal size code (bearing bore diameter)*
- S: Mounting code — No code: Fixed support unit; S: Simple support unit
- 01: Square type; 11: Round type
- C: For cleanroom environments

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

### Structure

Support units




| Fixed support side | | Simple support side | |
|---|---|---|---|
| Part No. | Name of part | Part No. | Name of part |
| ① | Bearing housing | ⑤ | Bearing housing |
| ② | Spacer | ⑥ | Bearing |
| ③ | Locknut | ⑦ | Snap ring |
| ④ | Set screw with set piece | | |

- 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

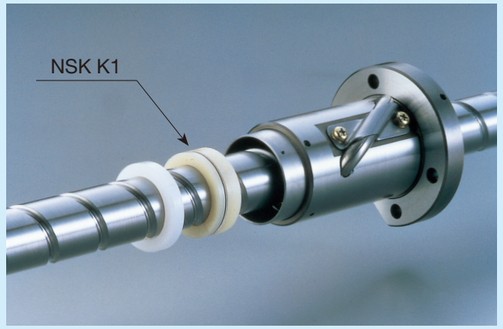
| Reference No. | Fixed support side unit: Axial direction: Basic dynamic load rating $C_a$(N) | Fixed support side unit: Axial direction: Load limit (N) | Fixed support side unit: Axial direction: Stiffness (N/μm) | Fixed support side unit: Maximum starting torque (N·cm) | Simple support side support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

# 6. "NSK K1™" Lubrication Unit

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

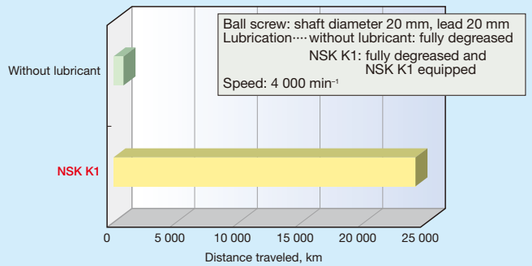
NSK has developed maintenance-free ball screws and linear guides featuring the newly-developed NSK K1 lubrication unit. (A version for food processing equipment and medical devices is also available. See pages B25–B26.)

### 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.

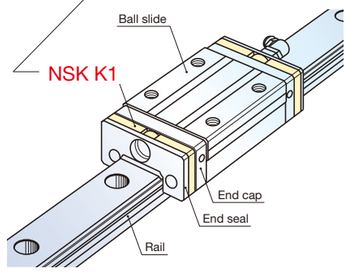



Notes at bottom page also apply to ball screws with NSK K1.

### 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**






Notes:
To maintain optimal performance of NSK K1 note the following:

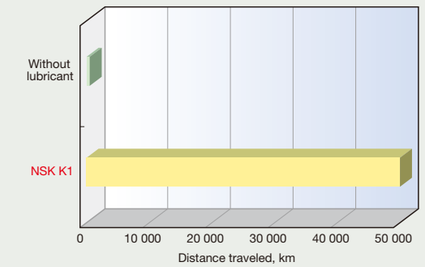
1. Operating temperatures: Maximum operating temperature: 50°C
   Maximum momentary operating temperature: 80°C
2. Avoid contact with: Organic solvents with degreasing properties, such as hexane and immersion in white kerosene thinner or anti-corrosive oil (containing white kerosene)

## 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 the seal's 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

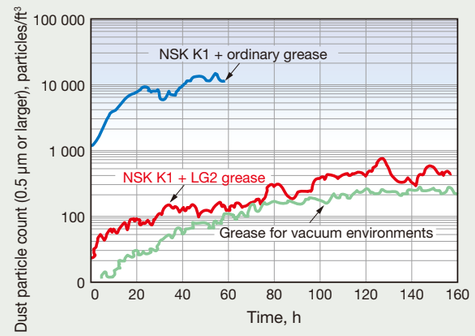





**Dust characteristics**

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 at right shows test results for 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

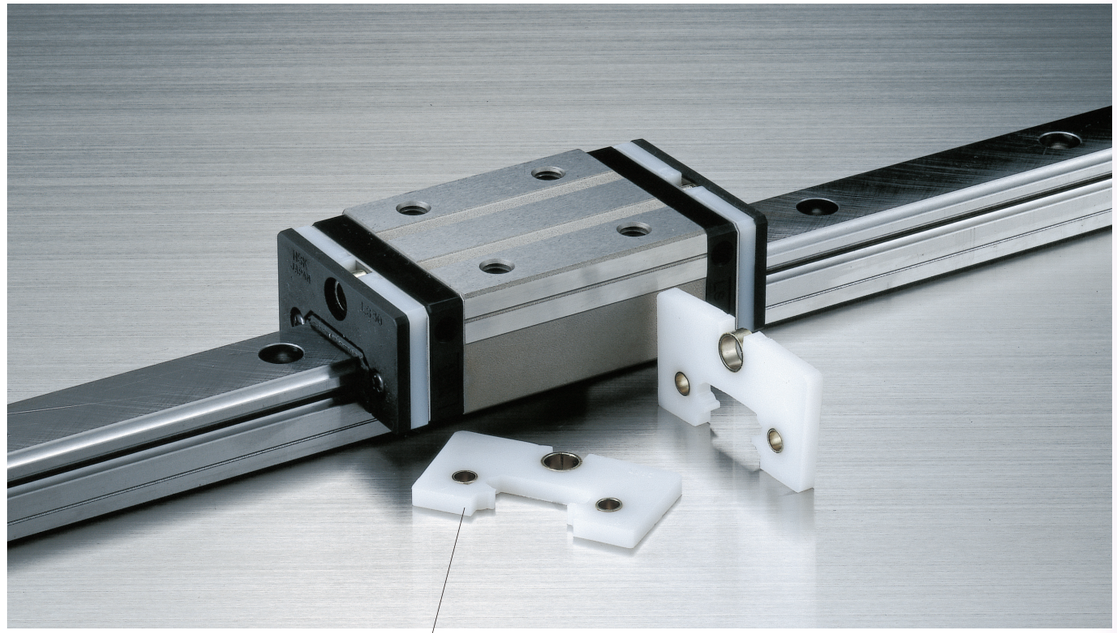
# 6. “NSK K1™” Lubrication Unit

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

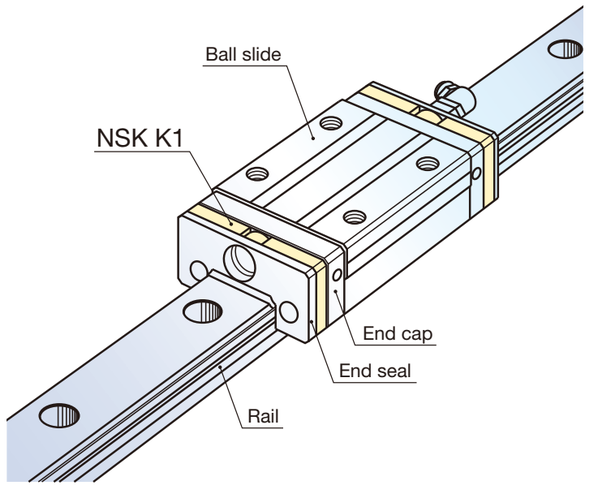
Thanks to a new material seal, NSK K1 for food processing and medical equipment is safe and FDA-compliant.
In NSK K1, a newly developed, porous synthetic resin provides continuous and abundant lubricant. The unit is also easy to install inside standard end seals made of rubber. After success in general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

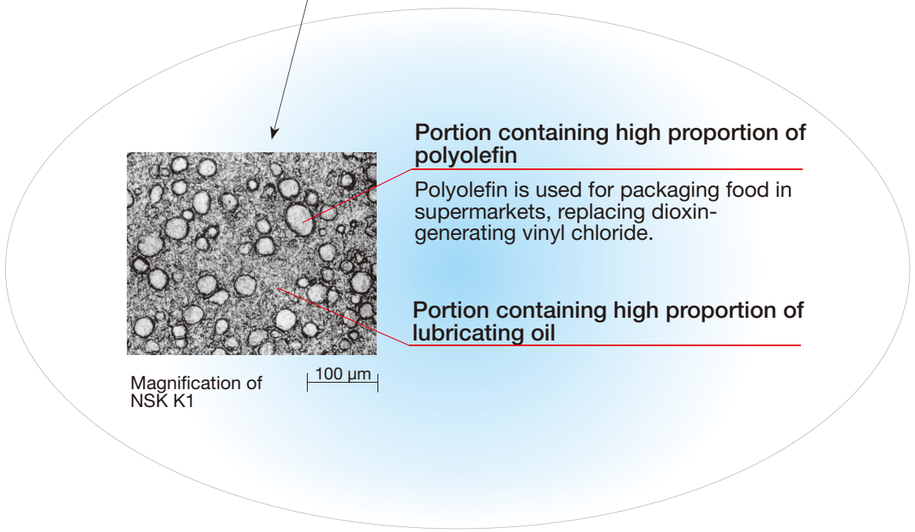
### Features

- **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



### Featuring reliable FDA-compliant material



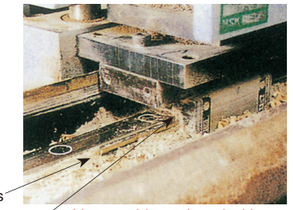




**Notes:**
To maintain optimal performance of NSK K1 in linear guides, note the following:

1. Operating temperatures: Maximum operating temperature: 50 °C
   Maximum momentary operating temperature: 80 ℃
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)

# 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.

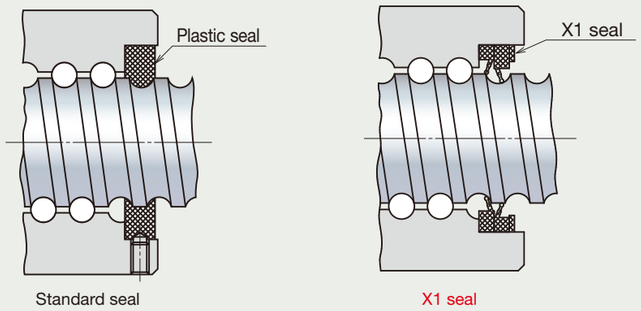



- **Applications:** Woodworking machinery (photo at right), tire buffing machinery, welding lines, graphite processing machinery, laser machinery

## 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.



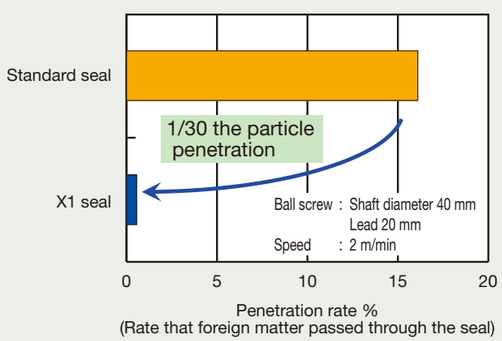




**Note:** The nut with an X1 seal is slightly longer than the standard.

### Performance

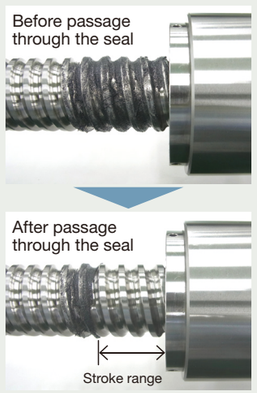
#### Particle penetration rate test

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.

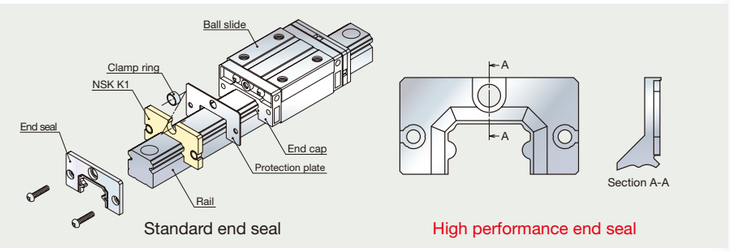





## Features High Performance Seals for Linear Guides

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



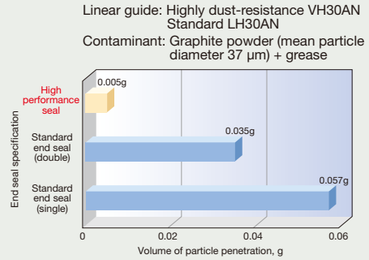




**Note:** Linear guides with high performance seals come standard with the NSK K1 lubrication unit. The seals will jut out slightly, making slide length slightly longer than with standard seals. See the table below for details.

### Performance

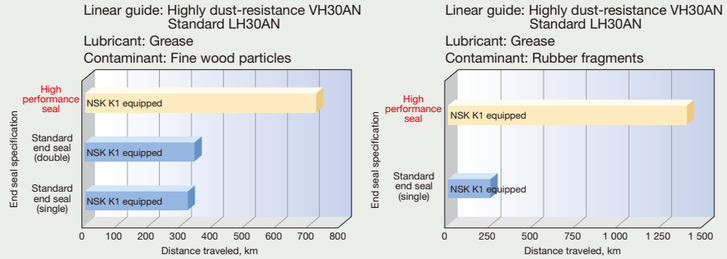
#### High dust-resistance

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.



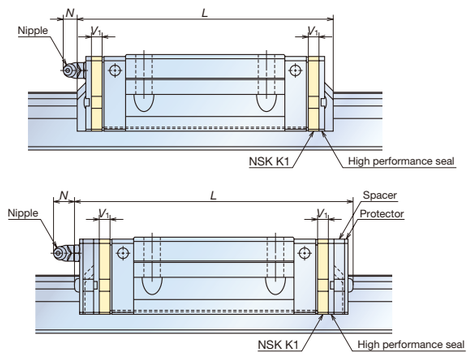

### Specifications

Unit: mm

| Model No. | | Ball slide length *L* | Nipple extrusion *N* |
|---|---|---|---|
| VH15 | AN/EM<br>BN/GM | 70.6 ( 77 )<br>89.6 ( 96 ) | 1 ( 8.2) |
| VH20 | AN/EM<br>BN/GM | 87.4 ( 94.2)<br>109.4 (116.2) | 11.1 (12.3) |
| VH25 | AL/AN/EM<br>BL/BN/GM | 97 (104.4)<br>125 (132.4) | 9.6 (12.9) |
| VH30 | AL/AN<br>EM<br>BL/BN/GM | 104.4 (114.8)<br>117.4 (127.8)<br>143.4 (153.8) | 11.4 (14.2) |
| VH35 | AL/AN/EM<br>BL/BN/GM | 128.8 (139.2)<br>162.8 (173.2) | 10.9 (13.7) |
| VH45 | AL/AN/EM<br>BL/BN/GM | 161.4 (174.2)<br>193.4 (206.2) | 12.5 (14.1) |
| VH55 | AL/AN/EM<br>BL/BN/GM | 185.4 (198.2)<br>223.4 (236.2) | 12.5 (14.1) |

Dimensions in parentheses apply when equipped with a protector.

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

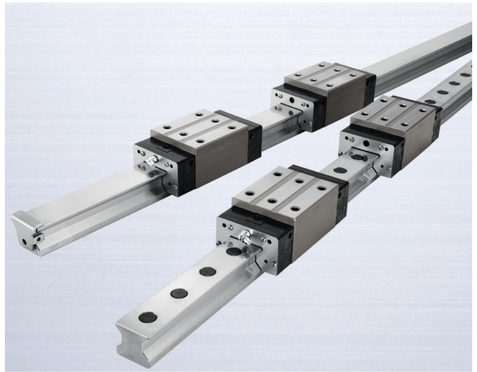


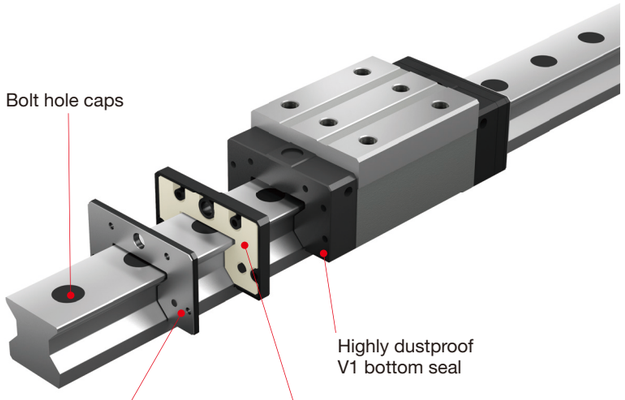

Data shown reflect test results. NSK offers no warranty for seal performance in actual machinery. Since performance is affected by the usage environment and lubrication conditions, we highly recommend using covers or other measures to protect machinery from contaminants.

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

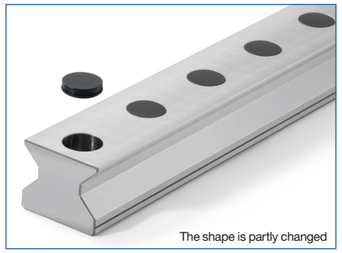
- **Excellent for machine tools** ····· Built on the RA Series, with a proven track record in the industry.
- **Abrasion resistance** ····· Uses the V1 highly dustproof seal made of new materials and a shape optimized to resist dust. A bottom V1 seal is also available for some models (RA35, RA45, RA55,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

Roller guides equipped with highly dustproof V1 Seal



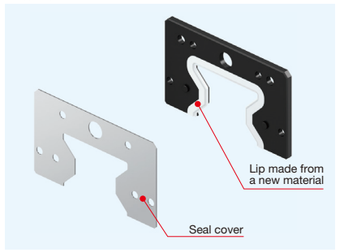



### Bolt hole caps



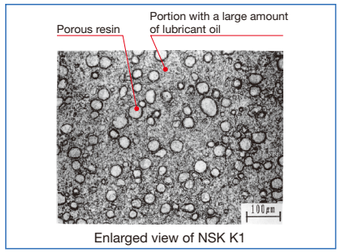

These caps prevent foreign matter from building up inside the rail mounting holes. These are standard parts.

### 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.

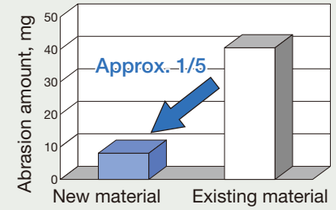
**Note:** Linear guides with V1 seals come standard with the NSK K1 lubrication unit. This makes the slide length slightly longer with standard seals. See the table on Page B30 for details.

## Performance

### Abrasion resistance

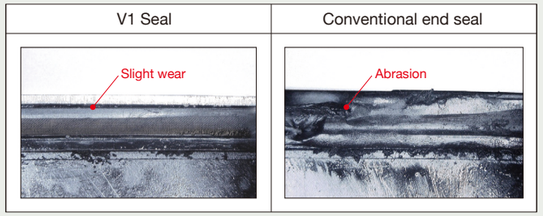
Highly abrasion-resistant material is used for the seal lip.

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

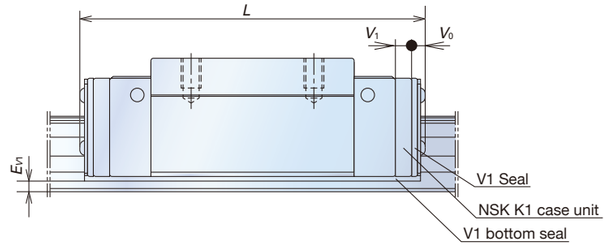



The durability of the seal lip has been greatly improved by adopting new materials and optimizing the seal lip shape.

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-temperate 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 series: 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 series and sizes

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

| Applicable Series | 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 |

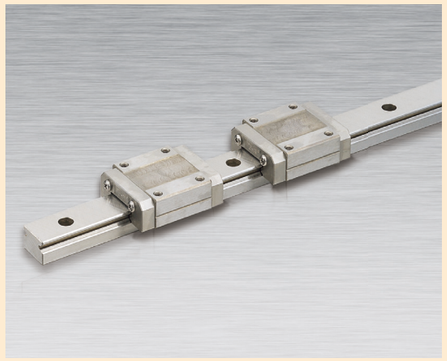
Note: *Example of a basic code NH 20

Series Size code·····Indicates the rail width or assembly height.

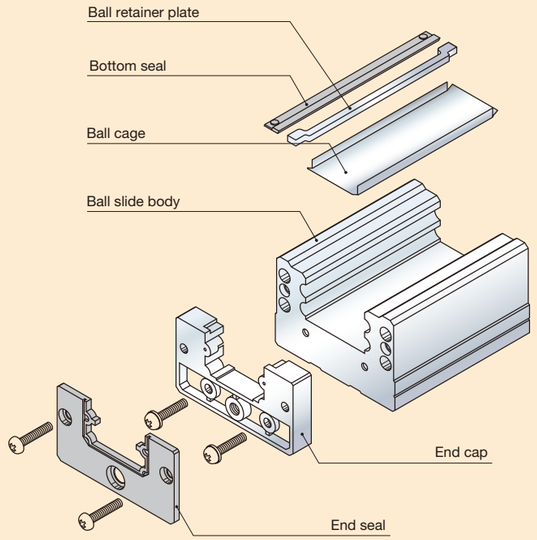
For details, see our "Precision Machine Components" catalog (No. E3162)

### 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

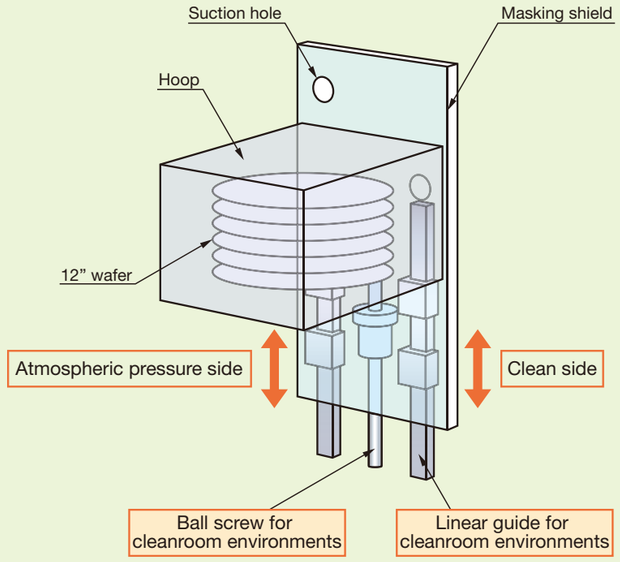
| Ball screw component | Material specification |
|---|---|
| Shaft, nut | Martensite stainless steel |
| Ball | SUS440C |
| Recirculation components | Austenite stainless steel |

# F Applications for SPACEA™ Series Ball Screws and NSK Linear Guides

SPACEA™

## 1. Semiconductor Manufacturing Equipment/Flat Panel Display Manufacturing Equipment

### Wafer Conveyor




**Operating Conditions**

**Cleanroom environments**

- Cleanliness: Class 100
- Temperature: Room temperature
- Speed: 5 m/min
- Load: Pitching moment included

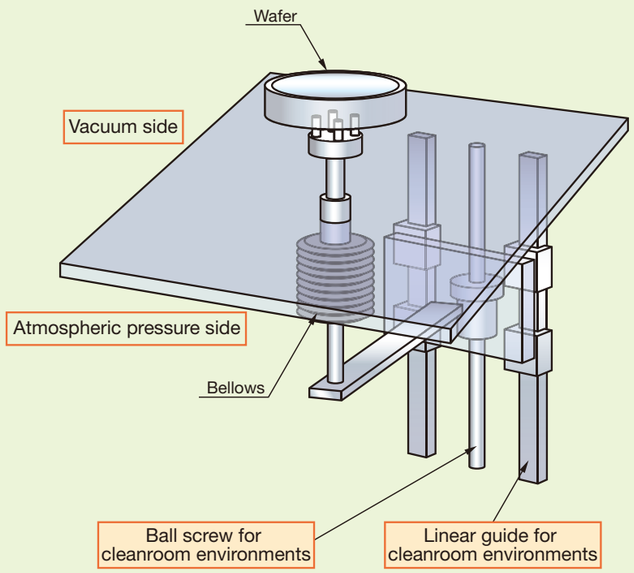
**Feature**

- 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 100
- Temperature: Room temperature
- Speed: 20 m/min
- Load: Pitching moment included

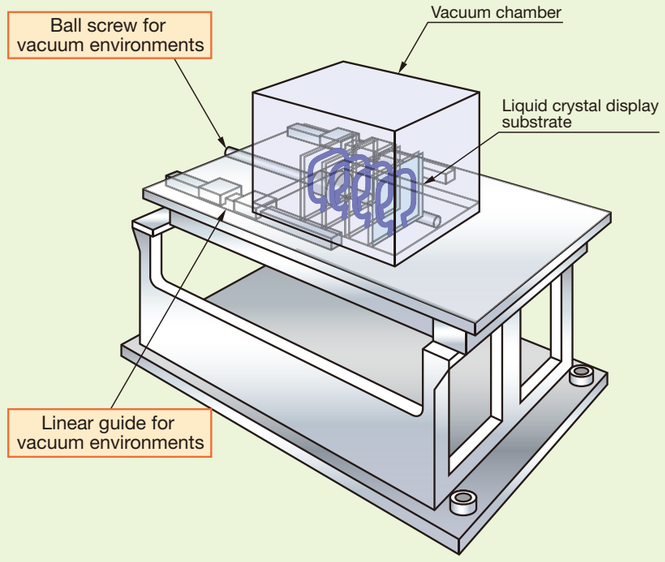
**Feature**

- 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**

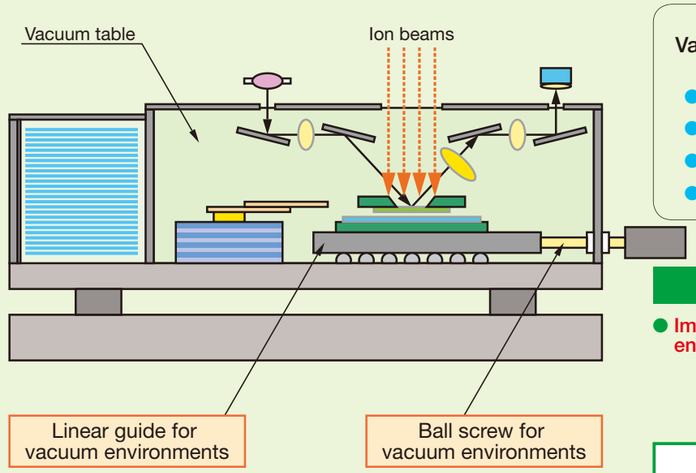
- Degree of vacuum: $10^{-1}$ Pa
- Temperature: 100–150 ˚C
- Speed: 10 m/min
- Load: Minimal

**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. Unit conversion tables listing general weight, length, and hardness are also included for your reference.
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

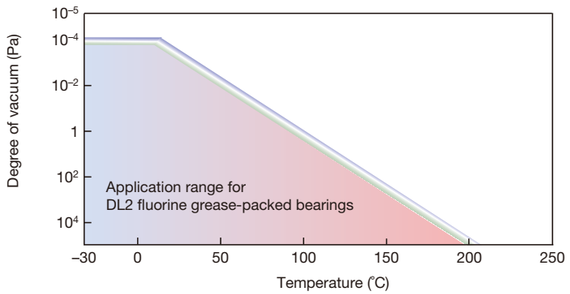

**Physical Properties of Materials, Unit Conversion Tables** ····· C3–C24

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)

## 1. Properties of SPACEA™ Series Greases

| Operating environment | Grease | Atmospheric pressure, vacuum | Maximum operating temperature ˚C | Cleanliness[1] | Base oil | Thickener | Kinematic viscosity mm²/s, 40 ˚C | Consistency |
|---|---|---|---|---|---|---|---|---|
| Atmospheric pressure | NS7 | Atmospheric pressure | 100 | — | Polyol ester oil + Diester oil | Lithium soap | 26 | 250 |
| Atmospheric pressure, clean | LG2 | Atmospheric pressure | 70 | Class 100–1 000 | Mineral oil and synthetic hydrocarbon oil | Lithium soap | 32 | 199 |
| | LGU | | 120 | | Synthetic hydrocarbon oil | Diurea | 96 | 201 |
| From atmospheric pressure up to vacuum, clean | DL2 | See the application range for DL2 Grease-Packed Bearings below. | | | Fluorine oil | PTFE | 200 | 280 |
| Atmospheric pressure, high-temperature | KPM | Atmospheric pressure | 230 | — | Fluorine oil | PTFE | 420 | 290 |
| | RLS | Atmospheric pressure | 120 | — | Synthetic hydrocarbon oil | Aluminum alloy soap | 150 | 280 |
| | BLS | | 200 | — | Fluorine oil | PTFE | 415 | 280 |

Note (1) 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/cm³ | 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 | $2.6 \times 10^{-3}$ | 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 | $2.2 \times 10^{-6}$ | 200 | 200 | 0.2–0.5 | — | △ | ◎ |
| Silver Ag | 10.5 | 107.87 | Face-centered cubic | $1.6 \times 10^{-6}$ | — | 600 | — | 0.2–0.3 | △ | ◎ |
| Lead Pb | 11.3 | 207.2 | Face-centered cubic | $2.08 \times 10^{-6}$ | 100 | 350 | 0.05–0.5 | 0.05–0.5 | △ | ◎ |

## 3. Characteristics of Metallic Materials

| Metallic material | Thermal expansion coefficient $\times 10^{-6}$ / ˚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/cm³ | 3.23 | 5.9 | 7.8 |
| Young's modulus | GPa | 330 | 210 | 208 |
| Fracture toughness | MPa · m$^{1/2}$ | 6 | 7.5 | 18 |
| Hardness (HV) | — | 1 500 | 1 300 | 700 |
| Thermal expansion coefficient | $\times 10^{-6}$ / ˚C | 2.8 | 10.5 | 12.5 |
| Thermal conductivity | W / m · k | 31 | 3 | 50 |
| Bending strength | MPa | 900 | 1 100 | ≥2 500 |
| Rotating capability in water | — | ◎ | ○ | × |
| Rotating capability in acid solvents | — | △ | ○ | × |
| Cost | — | High | Standard | Low |

## 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 abrasion-resistant additives.

| Plastic | Classification[1] | Elasticity coefficient GPa | Strength GPa | Density g/cm³ | Tm[2] ˚C | Heat distortion temperature[3] ˚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) Tm: Melting point
(3) Heat distortion temperature values in parentheses are at 454 kPa, all other values are at 181 MPa.

## 6. Properties of Commercially Available Fluorine Lubricants (Krytox)

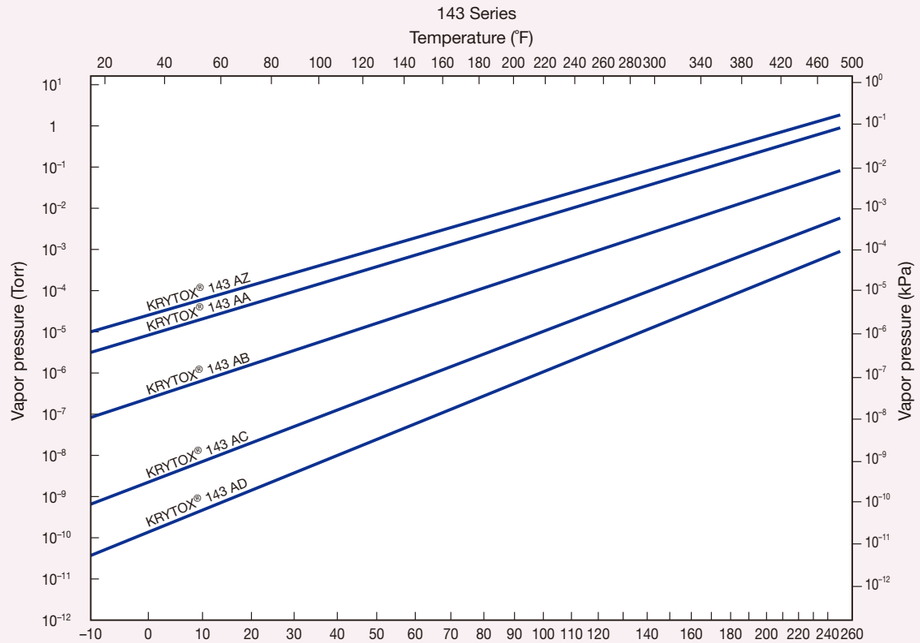
● Krytox oil (Chemours)

| Product | | Average molecular weight | Kinematic viscosity mm²/s 20 °C | 38 °C | 50 °C | 100 °C | Viscosity index | Pour point °C | Vapor pressure (Knudsen number) Pa 20 °C | 38 °C | 50 °C | 260 °C | Amount of evaporation, wt % (Temperature, 22 hours) | Density g/cm³ (0 °C) | Range of operating temperatures (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 143 Series | AZ | 2 060 | 60 | 24.7 | — | 4.1 | 60 | –55 | — | $5\times10^{-5}$ | — | 0.2 | 18 (149 °C) | — | — |
| | AA | 2 210 | 88 | 35 | — | 5.3 | 96 | –50 | — | $1\times10^{-5}$ | — | 0.1 | 15 (↑) | — | — |
| | AB | 3 800 | 240 | 86 | — | 10.2 | 113 | –40 | — | $7\times10^{-7}$ | — | $4\times10^{-3}$ | 1.9 (↑) | — | — |
| | AC | 5 940 | 800 | 270 | — | 25.4 | 134 | –35 | — | $1\times10^{-8}$ | — | $3\times10^{-4}$ | 4 (260 °C) | — | — |
| | AD | 7 480 | 1 540 | 502 | — | 42.4 | 146 | –30 | — | $8\times10^{-10}$ | — | $4\times10^{-5}$ | 2 (260 °C) | — | — |
| 1500 Series | 1506 | 2 160 | 60 | — | 15.5 | 4.1 | — | –60 | $4\times10^{-7}$ | — | $1\times10^{-5}$ | — | 6.5 (121 °C) | 1.88 | — |
| | 1514 | 2 840 | 140 | — | 32 | 7.2 | — | –54 | $2\times10^{-7}$ | — | $3\times10^{-6}$ | — | 1.3 (↑) | 1.89 | — |
| | 1525 | 3 470 | 250 | — | 52 | 10.6 | — | –48 | $1\times10^{-7}$ | — | $1\times10^{-6}$ | — | 0.6 (↑) | 1.9 | — |
| 1600 Series | 16256 | 9 400 | 2 560 | — | 437 | 64.6 | — | –15 | $3\times10^{-14}$ | — | $2\times10^{-12}$ | — | 0.2 (↑) | 1.92 | — |
| GPL Series | 100 | — | 12.4 | — | — | — | — | <–70 | — | — | — | — | 90 (121 °C) | — | –70/66 |
| | 101 | — | 17.4 | — | — | 2 | — | <–70 | — | — | — | — | 75 (↑) | — | –70/104 |
| | 102 | — | 38 | — | — | 3 | 29 | <–63 | — | — | — | — | 35 (↑) | — | –63/132 |
| | 103 | — | 82 | — | — | 5 | 92 | –60 | — | — | — | — | 7 (↑) | — | –60/154 |
| | 104 | — | 177 | — | — | 8.4 | 111 | –51 | — | — | — | — | 3 (↑) | — | –51/179 |
| | 105 | — | 522 | — | — | 18 | 124 | –36 | — | — | — | — | 7 (204 °C) | — | –36/204 |
| | 106 | — | 822 | — | — | 25 | 134 | –36 | — | — | — | — | <3 (↑) | — | –36/260 |
| | 107 | — | 1 535 | — | — | 42 | 145 | –30 | — | — | — | — | <1 (↑) | — | –30/288 |

● Krytox grease

| Product | Base oil | Kinematic viscosity mm²/s (38 °C) | Thickener | Consistency NLGI No. | Vapor pressure (Knudsen number) Pa 38 °C | 260 °C | Oil separation rate wt % (204 °C, 30h) | Amount of evaporation wt % (204 °C, 6.5h) | Density g/cm³ (25 °C) | Additive |
|---|---|---|---|---|---|---|---|---|---|---|
| 240AZ | 143AZ | 24.7 | PTFE | 2 | $4\times10^{-4}$ | 1.5 | 6 | 18 (149 °C) | — | None |
| 240AA | 143AA | 35 | | | $1\times10^{-4}$ | 0.8 | 5 | 15 (149 °C) | — | ↑ |
| 240AB | 143AB | 86 | | | $5\times10^{-6}$ | $3\times10^{-2}$ | 4 | 1.9 (149 °C) | — | ↑ |
| 240AC | 143AC | 270 | | | $8\times10^{-8}$ | $2\times10^{-3}$ | 3 | 4 (260 °C) | — | ↑ |
| 240AD | 143AD | 502 | | | $6\times10^{-9}$ | $3\times10^{-4}$ | 3 | 2 (260 °C) | — | ↑ |
| 250AC | 143AC | 270 | PTFE | 2 | $8\times10^{-8}$ | $2\times10^{-3}$ | 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 | | | $6\times10^{-9}$ | $3\times10^{-4}$ | 3 | 2 (260 °C) | — | Anti-rust agent |
| LVP | 16256 | 740 (40 °C) | PTFE | 2 | $1\times10^{-13}$ (20 °C) | $1\times10^{-5}$ (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



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

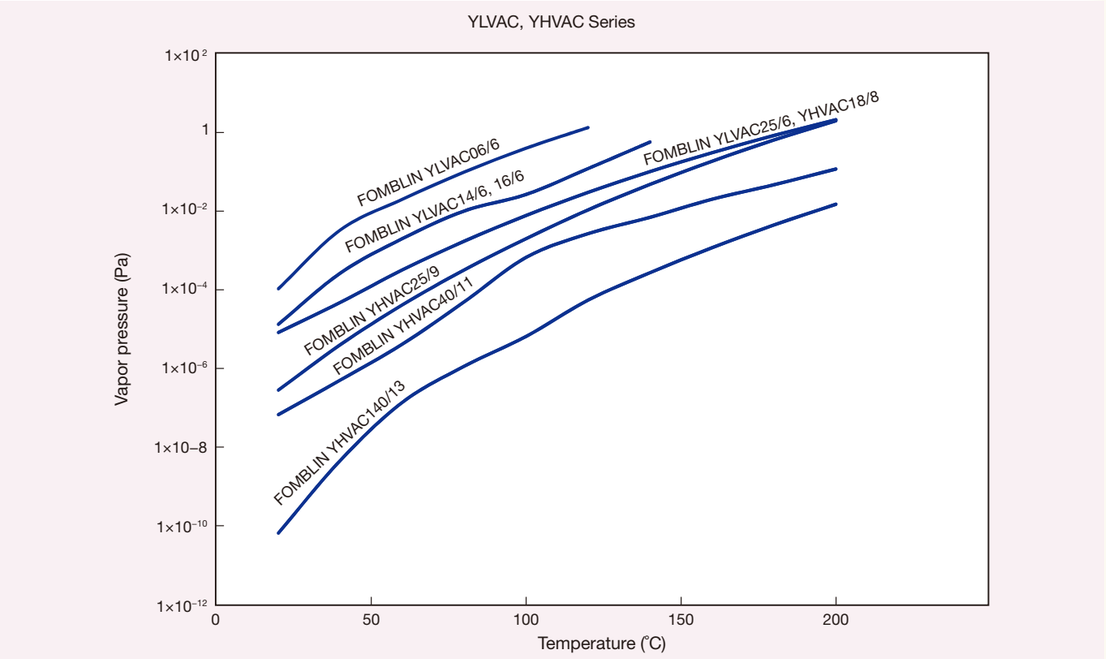
● Fomblin oil (Solvay Specialty Polymers)

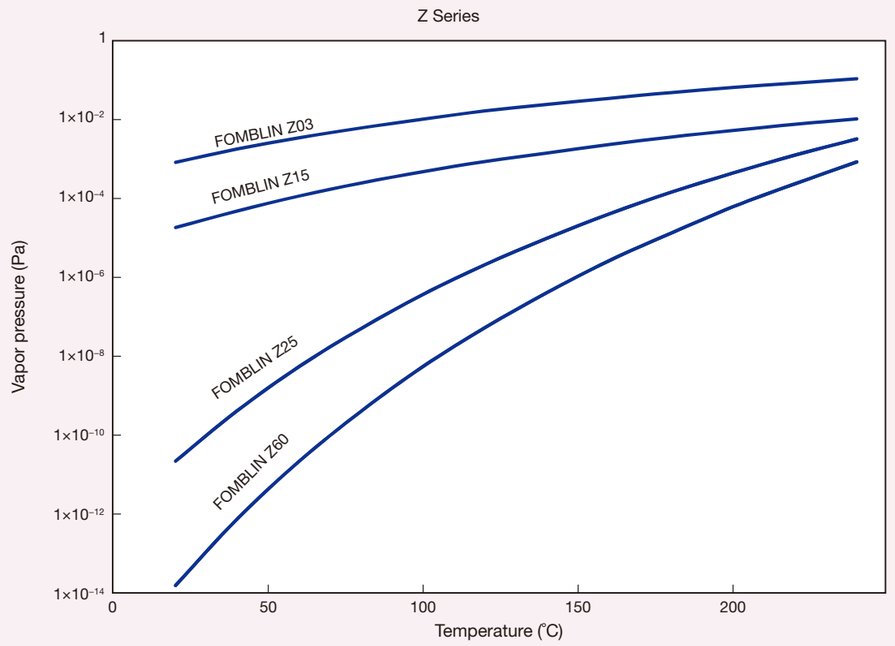
| Product | | Average molecular weight | Kinematic viscosity mm²/s | | | Viscosity index | Pour point ℃ | Vapor pressure (Knudsen number) Pa | | Amount of evaporation, wt % (Temperature, 22 hours) | Density g/cm³ (20 ℃) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 20 ℃ | 40 ℃ | 100 ℃ | | | 20 ℃ | 100 ℃ | | |
| Y Series | Y04 | 1 500 | 38 | 15 | 3.2 | 60 | –58 | — | — | 9 (120 ℃) | 1.87 |
| | Y06 | 1 800 | 60 | 22 | 3.9 | 70 | –50 | — | — | 6 (120 ℃) | 1.88 |
| | Y25 | 3 200 | 250 | 80 | 10 | 108 | –35 | — | — | 15 (204 ℃) | 1.90 |
| | Y45 | 4 100 | 470 | 147 | 16 | 117 | –30 | — | — | 1.7 (204 ℃) | 1.91 |
| | YR | 6 250 | 1 200 | 345 | 33 | 135 | –25 | — | — | 1.2 (204 ℃) | 1.91 |
| YLVAC Series | 06/6 | — | 64 | — | — | — | –50 | $\leq 1.1 \times 10^{-4}$ | $\leq 4.0 \times 10^{-1}$ | — | 1.88 |
| | 14/6 | — | 148 | — | — | — | –45 | $\leq 1.3 \times 10^{-5}$ | $\leq 2.7 \times 10^{-2}$ | — | 1.89 |
| | 16/6 | — | 168 | — | — | — | –45 | $\leq 2.7 \times 10^{-6}$ | $\leq 2.7 \times 10^{-2}$ | — | 1.90 |
| | 25/6 | — | 276 | — | — | — | –35 | $\leq 8.0 \times 10^{-6}$ | $\leq 8.0 \times 10^{-3}$ | — | 1.90 |
| YHVAC Series | 18/8 | — | 190 | — | 9 | — | –42 | $\leq 2.6 \times 10^{-6}$ | $\leq 2.6 \times 10^{-2}$ | — | 1.89 |
| | 25/9 | — | 285 | — | 12 | — | –35 | $\leq 2.6 \times 10^{-7}$ | $\leq 2.6 \times 10^{-3}$ | — | 1.90 |
| | 40/11 | — | 474 | — | — | — | –32 | $\leq 6.6 \times 10^{-8}$ | $\leq 6.6 \times 10^{-4}$ | — | 1.91 |
| | 140/13 | — | 1 508 | — | — | — | –23 | $\leq 6.5 \times 10^{-11}$ | $\leq 6.5 \times 10^{-6}$ | — | 1.92 |
| Z Series | Z03 | 4 000 | 30 | 18 | 5.6 | 317 | –90 | — | — | 6.0 (149 ℃) | 1.82 |
| | Z15 | 8 000 | 160 | 92 | 28 | 334 | –80 | — | — | 1.2 (204 ℃) | 1.84 |
| | Z25 | 9 500 | 263 | 157 | 49 | 358 | –75 | — | — | 0.4 (204 ℃) | 1.85 |
| | Z60 | 13 000 | 600 | 355 | 98 | 360 | –63 | — | — | 0.2 (204 ℃) | 1.85 |

● Klübertemp / Klüberalfa grease (NOK Klüber)

| Product | | Base oil | Thickener | Consistency NLGI No. | Oil separation Rate wt % (204 ℃, 30h) | Amount of evaporation wt % (204 ℃, 22h) | Density g/cm³ (20 ℃) | Additive | Working Temperature Range ℃ |
|---|---|---|---|---|---|---|---|---|---|
| Klübertemp | GR OT20N | Fomblin oil Y series | PTFE | 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 | GR YVAC1 | Fomblin oil YHVAC140/13 | PTFE | 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



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

### ● Barrierta oil (NOK Klüber)

| I Series | Average molecular weight | Kinematics viscosity mm²/s | | Viscosity index | Pour point ℃ | Vapor pressure (Knudsen number) Pa (20 ℃) | Density g/cm³ (20 ℃) |
|---|---|---|---|---|---|---|---|
| | | 20 ℃ | 40 ℃ | | | | |
| IEL FLUID | 3 500 | 280 | 95 | 130 | –45 | — | 1.90 |
| IMI FLUID | 4 500 | 550 | 180 | 138 | –40 | — | 1.90 |
| IS FLUID | 7 500 | 1 400 | 390 | 140 | –30 | — | 1.90 |

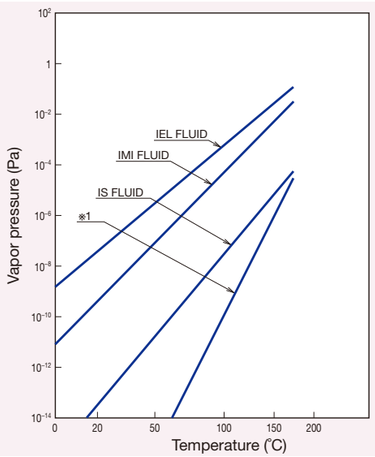
### ● Barrierta grease

| Product | Base oil | Kinematic viscosity mm²/s (40 ℃) | Thickener | Consistency NLGI No. | Vapor pressure (Knudsen number) (20 ℃) | Oil separation rate wt % (204 ℃, 24h) | Amount of evaporation wt % (204 ℃, 22h) | Density g/cm³ (25 ℃) | Additive |
|---|---|---|---|---|---|---|---|---|---|
| IEL | IEL FLUID | 95 | PTFE | 2 | $6\times10^{-6}$ | – | – | 1.90 | Anti-rust agent |
| IMI | IMI FLUID | 180 | | 2 | $7\times10^{-7}$ | – | – | 1.90 | Anti-rust agent |
| IS | IS FLUID | 390 | | 2 | $2\times10^{-8}$ | – | – | 1.90 | Anti-rust agent |
| L55/2 J | IS FLUID | 390 | PTFE | 2 | $2\times10^{-8}$ | – | – | 1.95 | Anti-rust agent |
| IEL/V | – | 65 | PTFE | 2 | $5\times10^{-6}$ | 7.0 | 0.2 | 1.95 | Anti-rust agent |
| IMI/V | – | 180 | | 2 | $9\times10^{-10}$ | 7.0 | 0.2 | 1.95 | Anti-rust agent |
| IS/V | – | 415 | | 2 | $5\times10^{-14}$ | 7.0 | 0.1 | 1.95 | None |
| SUPER IS/V | – | 415 | | 2 | $5\times10^{-14}$ | 7.0 | 0.1 | 1.95 | None |

### ● NOXLUB grease (NOK Klüber)

| Product | | Base oil | Thickener | Consistency NLGI No. | Oil separation rate wt % (204 ℃, 24h) | Amount of evaporation wt % (204 ℃, 22h) | Density g/cm³ (20 ℃) | Additive | Working Temperature Range ℃ |
|---|---|---|---|---|---|---|---|---|---|
| KF 0622 | – | 65 | PTFE | 2 | $3\times10^{-5}$ | – | – | 1.96 | None |
| KF 2024 | – | 200 | | 2 | $3\times10^{-9}$ | – | – | 1.95 | None |
| BF 9922 | ※1 | 1 200 | | 2 | $1\times10^{-15}$ | – | – | 2 | None |

### ● Vapor pressure of Barrierta oil



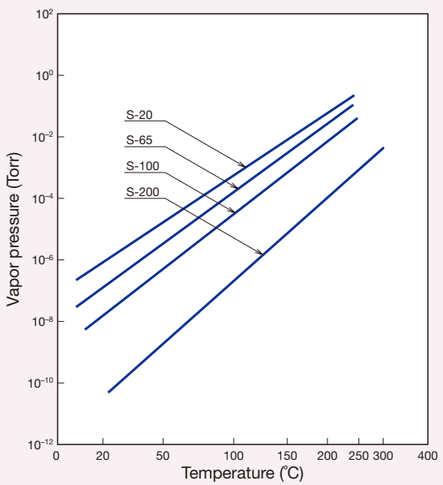

### ● Demnum oil (Daikin)

| Product | Average molecular weight | Kinematic viscosity mm²/s | | | Viscosity index | Pour point ℃ | Density g/cm³ (20 ℃) |
|---|---|---|---|---|---|---|---|
| | | 20 ℃ | 40 ℃ | 60 ℃ | | | |
| S-20 | 2 700 | 53 | 25 | 14 | 150 | –75 | 1.86 |
| S-65 | 4 500 | 150 | 65 | 33 | 180 | –65 | 1.86 |
| S-100 | 5 600 | 250 | 100 | 50 | 200 | –60 | 1.88 |
| S-200 | 8 400 | 500 | 200 | 95 | 210 | –53 | 1.89 |

### ● Demnum grease

| Product | Base oil | Kinematic viscosity mm²/s (40 ℃) | Thickener | Consistency NLGI No. | Oil separation rate wt % (200 ℃, 30h) | Amount of evaporation wt % (200 ℃, 22h) | Additive |
|---|---|---|---|---|---|---|---|
| L65 | S-65 | 65 | PTFE | 2 | <12 | <1 | None |
| L100 | S-100 | 100 | PTFE | 2 | <11 | <1 | None |
| L200 | S-200 | 200 | PTFE | 2 | <10 | <0.1 | None |

### ● Vapor pressure of Demnum oil



# Specification Inquiry for SPACEA™ Series Bearings

SPACEA™

To request a specification inquiry, please fill out the following form and contact your nearest NSK office.

| | | | |
|---|---|---|---|
| Company name | | Name | |
| Department | | Phone | |

| | | | |
|---|---|---|---|
| Bearing designation, dimensions | From NSK | | |
| | From other company | | |
| | Dimensions | Bore diameter × Outside diameter × Width (ϕ ×ϕ × mm) | |
| Application | Type of machine (example: liquid crystal cleaning equipment, coating equipment for semiconductor, etc.)<br>1. New design 2. Experience with similar equipment 3. Maintenance | | |
| Problems/ Issues | Current bearing | 1. Name of manufacturer: ( ), Model: ( )<br>2. Unknown | |
| | Specifications | 1. Material | |
| | | 2. Lubricant | |
| | Bearing life | ( hours or months ) | 1. Poor lubrication 2. Particle emissions/outgassing 3. Rusting<br>4. Contamination with foreign particles 5. Lubricant leakage<br>6. Fracture 7. Abnormal noise 9. Poor rotation |
| | Required operating life | ( ) hours or months | |
| | Details on problems/ issues | | |
| Operating environment needs | Degree of vacuum | 1. Atmospheric pressure<br>2. Atmospheric pressure up to vacuum (degree of vacuum = Pa)<br>3. Vacuum (degree of vacuum = Pa) | |
| | Corrosion resistance | 1. Water environment | 1. High-humidity 2. Water-spray 3. Water-immersed<br>4. De-ionized water 5. Other ( ) |
| | | 2. Corrosive liquids | Acid ( ) Alkali ( ) Other ( ) |
| | | 3. Corrosive gases | F-based ( ) Cl-based ( )<br>Br-based ( ) Other ( ) |
| | Cleanliness | 1. Particle emissions (Class: ) 2. Outgassing ( )<br>3. Grease-free 4. No grease leakage 5. Other ( ) | |
| | Temperature | Bearing temperature ( ℃) Ambient temperature ( ℃) | |
| Operating conditions | Speed | Normal ( ) $min^{-1}$ Max ( ) $min^{-1}$ | |
| | Bearing load | Radial ( N) Axial ( N)<br>Other load information ( ) | |
| Comments | | | |

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