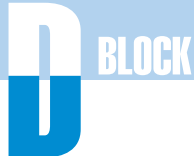


Other



Other

- 1. Special Environments D1
 - 1.1 Specifications for Special Environments D1
 - 1.2 Lubrication and Materials D3
 - 1.3 Rust Prevention and Surface Treatment D5
 - 1.4 Measures Against Special Environments D7
 - 1.5 Table to Cope with Special Environments D11
 - 1.6 Precautions for Handling..... D12
- 2. Lubrication D13
 - 2.1 Grease Lubrication D13
 - 2.2 Oil Lubrication D24
- 3. RoHS Compliant D24

1 Special Environments

1.1 Specifications for Special Environments

1. Linear guide

Table 1.1 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.		
		Rail, slide	Steel balls/rollers	Ball recirculation component	Lubrication/surface treatment			
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	D10		
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	D10		
Atmosphere-Vacuum, normal temperature				Fluoride low temperature chrome plating	D5			
Atmosphere-Vacuum up to 200°C				Fluoride grease				
Vacuum	Atmosphere-Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease			
	Atmosphere-Vacuum up to 200°C							
	Atmosphere-Vacuum up to 300°C						Molybdenum disulfide	
	High vacuum up to 500°C						Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D5		
	Acid, alkali	Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5		
						D5		
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5		
					LG2, LGU Grease	D8		
					Fluoride low temperature chrome plating	D5		
					Fluoride grease			
	Organic solvent				Fluoride grease			
High temperature	Atmosphere up to 150°C	Standard material	Standard material	Austenitic stainless steel	ET-100K Grease			
	Atmosphere up to 200°C				Fluoride grease			
	Atmosphere up to 200°C, Corrosion resistant	Martensitic stainless steel	Martensitic stainless steel		Fluoride grease			
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant			
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease			
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel				
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material		D10		
			Martensitic stainless steel	Austenitic stainless steel	NSK K1 lubrication unit	D10		
	Water, under water	Martensitic stainless steel	Standard material	Standard material		D10		
			Martensitic stainless steel	Austenitic stainless steel		D10		

2. Ball screw

Table 1.2 Ball screw specifications

Environment	Condition	NSK Ball screw specification				Technical Explanation Page No.		
		Screw shaft, ball nut	Steel balls	Ball Recirculation component	Lubrication/surface treatment			
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	D10		
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	D10		
Atmosphere-Vacuum, normal temperature				Fluoride low temperature chrome plating	D5			
Atmosphere-Vacuum up to 200°C				Fluoride grease				
Vacuum	Atmosphere-Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Ceramic	Ceramic		
	Atmosphere-Vacuum up to 200°C							
	Atmosphere-Vacuum up to 300°C						Fluoride grease	
	High vacuum up to 500°C						Molybdenum disulfide	D7
Corrosion resistance	Acid, alkali, clean	Standard material	Standard material	Austenitic stainless steel	Fluoride low temperature chrome plating	D5		
		Martensitic stainless steel	Martensitic stainless steel		Fluoride grease	D5		
Nonmagnetic	Strong acid, strong alkali, clean, nonmagnetic	Precipitation hardening stainless steel	Precipitation hardening stainless steel	Austenitic stainless steel	Fluoride grease			
		Ceramic	Ceramic		Fluoride grease			
High temperature	Atmosphere-Vacuum, clean	Special austenitic stainless steel	Ceramic	Austenitic stainless steel	Fluoride grease			
	Atmosphere-Vacuum, up to 200°C, clean	Ceramic			Fluoroplastic			
	Atmosphere up to 200°C	Standard material	Standard material	Austenitic stainless steel	Fluoride grease			
Atmosphere up to 200°C	Martensitic stainless steel	Martensitic stainless steel	Fluoride low temperature chrome plating		D5			
Low temperature	Atmosphere up to 500°C, corrosion resistance	Ceramic	Ceramic		Fluoride grease			
	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant			
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease			
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel				
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material		D10		
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	NSK K1 lubrication unit	D10		
	Water, under water					D10		

1.2 Lubrication and Materials

1. Lubrication

Grease can be used for high rotation and magnetic field. However, grease evaporates or solidifies in special environment such as vacuum, high temperature, and low temperature. Solid lubricant is

used when it is difficult to use grease. Functions of solid lubricant differ greatly by condition where it is used. It is important to select the most suitable solid lubrication for the environment.

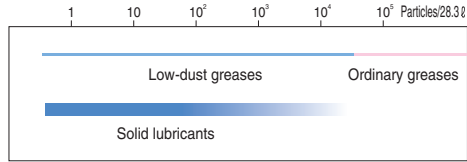


Fig. 2.1 Lubrication in clean environment

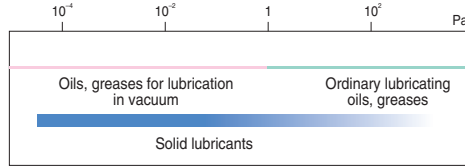


Fig. 2.2 Lubrication in vacuum

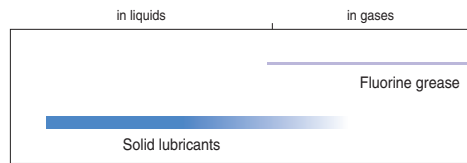


Fig. 2.3 Lubrication in corrosive environment

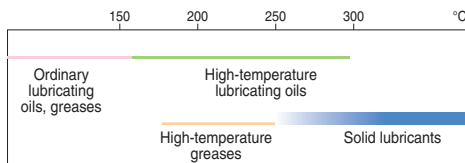


Fig. 2.4 Lubrication in high temperature

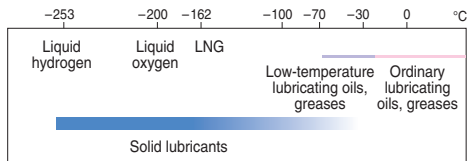


Fig. 2.5 Lubrication in low temperature

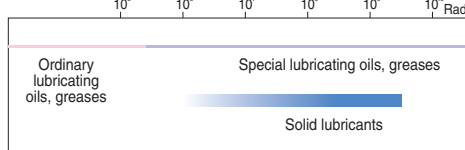


Fig. 2.6 Lubrication in radioactive environment

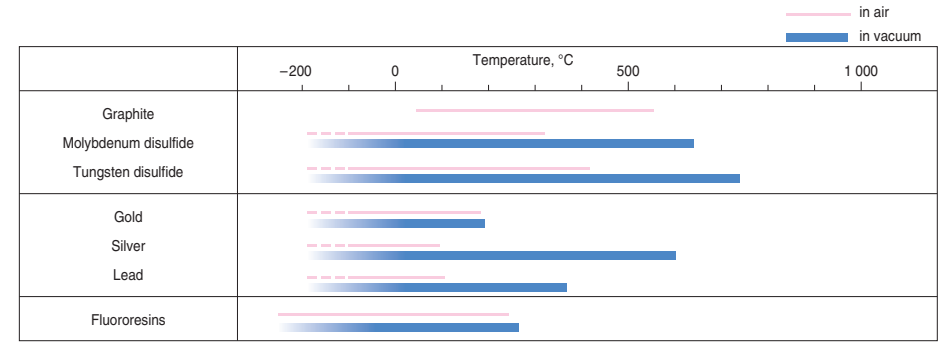


Fig. 2.7 Temperature range for using solid lubricants

2. Materials

Iron type metals are used in vacuum, high temperature, and high speed environments as the basic material. We generally use nonmagnetic stainless steel for nonmagnetic materials.

Table 2.1 Characteristics of metal materials

Application	Type of steel	Linear expansivity ×10 ⁻⁶ /°C	Young's modulus GPa	Hardness* HB
For clean environment, vacuum environment, corrosion resistance, low temperature, high temperature, radioactive resistance	Martensitic stainless steel SUS440C	10.1	200	580
	Austenitic stainless steel SUS304	16.3	193	150
	Precipitation hardening stainless steel SUS630	10.8	200	277 – 363
Nonmagnetic	Nonmagnetic stainless steel	17.0	195	420

*) Hardness of steel is usually indicated by Rockwell C Scale. For comparison, these figures are expressed by Brinell number.

1.3 Rust Prevention and Surface Treatment

1. Fluoride low temperature chrome plating



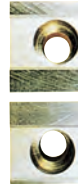







The use environment of NSK linear guides, ball screws and monocarriers is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment. Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes:

- Moisture for washing machines and other equipment
- Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.

NSK has developed electrolytic rust prevention black film treatment (black chrome plating) which is added by fluoro resin impregnating treatment. (Hereinafter referred as "Fluoride low temperature chrome plating".) This surface treatment methods has proved its superiority as the rust prevention of linear guides and ball screws which are used in the above equipment.

● Humidity chamber test

Table 3.1 Results of the humidity test

Test sample		Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel
Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
	Side	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
	Bottom	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
	End	(Machined) A	(Machined) C	(Machined) A	(Machined) C	(Machined) E
	Chamfer/grinding recess	(Drawn) A	(Drawn) D	(Drawn) A	(Drawn) C	(Drawn) E
Corrosion-resistant property	<Test conditions> ● Testing chamber: High temperature, highly moist chamber (made by DABAI ESPEC) ● Temperature: 70°C ● Relative humidity: 95% ● Testing time: 96 h Time to "ramp-up" and "ramp-down" condition of the temperature and the humidity conditions Ramp-up: 5 h Ramp-down: 2 h					
						
Film thickness		5 μm	0.5 - 7 μm	10 μm	—	—

Rusting A: No rust B: Not rusted, but slightly discolored
C: Spotty rust D: slightly rusted E: Completely rusted

● What is "Fluoride low temperature chrome plating?"









This is a type of black chrome plating which forms a black film (1 to 2 μm in thickness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

- Accuracy control is easily manageable due to low temperature treatment and to the absence of hydrogen embrittlement.
- Product accuracy is less affected due to the thin film which has high corrosion resistance.
- This method is superior to other surface treatments in durability on the rolling surface.
- Inexpensive compared with products with other surface treatment and stainless steel products.

Do not use organic solvent because it adversely affects antirust property of the plating.

● Chemical corrosion resistance test

Table 3.2 Results of the corrosion resistance test

Test conditions	Rail base material: Equivalent to SUS440C Chemical density: 1 mol/l		
Fluoride low temperature chrome plating	Immersed in solution for 24 hrs	Hard chrome plating	None surface treatment
	Nitric acid		
	Immersed in solution for 24 hrs		
	Fluoride		
	Exposed to vapor for 72 hrs		
	Hydrochloric acid type washing solution		
	HCℓ : H ₂ O ₂ : H ₂ O = 1 : 1 : 8		
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	X
○	Ammonia or sodium hydroxide	○	△

○: Normal △: Partial surface damage ▲: Overall surface damage X: Corroded

● Surface treatment durability test

Peeling resistance of surface treatment

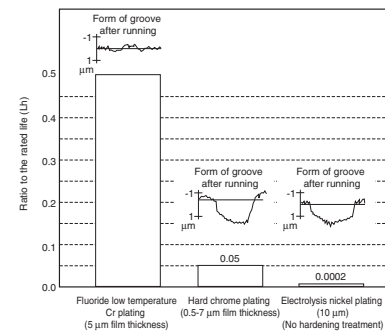


Fig. 3.1 Results of durability test

● Total evaluation

Table 3.3 Evaluation

	Available length	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating	◎ (4 m)	◎	○	◎	◎
Hard chrome plating	△ (2 m)	○	X	△	△
Electroless nickel plating	◎ (4 m)	◎	△	X	△
Material equivalent to SUS440C	○ (3.5 m)	○	◎	◎	△

◎: Excellent ○: Suitable in use
△: Not so good for use X: Problem in use

1.4 Measures Against Special Environments

1. In vacuum

● Silver-film plated ball screw

Ball screws that are plated by soft metal (special silver film) as a solid lubricant are developed the application for vacuum environment such as semiconductor manufacturing equipment and surface modification systems.

● Durability test in high vacuum

Test equipment and conditions

Table 4.1 shows ball screw specifications. Fig. 4.1 is a schematic of the testing system in vacuum chamber.

Table 4.2 shows testing conditions.



Photo 4.1 Vacuum testing system

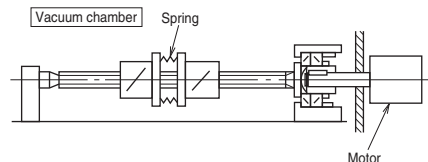


Fig. 4.1 Schematic of the testing system

Table 4.1 Ball screw specifications		
Shaft diameter	12 mm	
Lead	4 mm	
Steel ball diameter	2.381 mm	
Numbers of circuit of balls	2.5 turns, 1 circuit	
Axis load (preload)	29.4 N	
Maximum surface pressure (preload volume)	about 690 MPa	
Material	Shaft	SUS630
	Nut	SUS440C
	Ball return tube	SUS304
	Steel balls	SUS440C
Solid lubricant	Special silver film	

Table 4.2 Testing conditions	
Rotational speed	300 min ⁻¹
Vacuum chamber pressure	1.3×10 ⁻⁵ – 1.3×10 ⁻⁶ Pa
Stroke	160 mm

Evaluation method

It is understood that the rolling bearing with solid lubrication reaches end of life when the lubrication film deteriorates, resulting in sudden rise of friction torque. In this test, ball screw rotation torque was constantly measured to study durability and operation. Results were then evaluated.

Test results

Fig. 4.2 shows two distinctive examples obtained in the torque characteristic test.

Test results of the ball screw (a)

The torque tendency was stable until about 1 × 10⁷ rev. Then the torque characteristics slightly deteriorated. At about 1.35 × 10⁷ rev, the torque suddenly rose. At this point, it was determined that the ball screw reached the end of its life.

Test results of the ball screw (b)

Torque value is a little higher in the test (a). The value is also little unstable. The torque momentarily soared several times during the test (some 10 N·cm). It is thought this is attributable to the repeated peeling/sticking of the surface film made of soft metal (silver, etc.).

When the torque finally soared at 1.13 × 10⁷ rev., it was determined that the ball screw reached the end of its life.

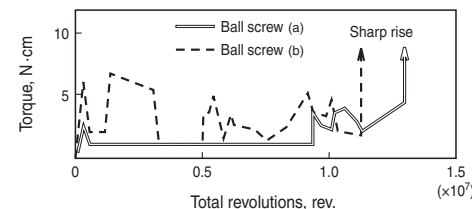


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability			
Classification	Ball screw (a)	Ball screw (b)	
Life	Total revolutions (rev.)	1.35×10 ⁷	1.13×10 ⁷
	Total traveling distance (km)	54.0	45.2
	Total traveling hours*(h)	750	628

* Total traveling hours when operated constantly at 300 min⁻¹

Conclusion

Table 4.3 explains results of the two ball screw durability tests.

From these results and other findings, it is estimated that a life of more than 1 × 10⁷ rev. is possible with a load of about 29.4 N.

Torque may soar momentarily before the ball screw reaches its final life due to peeling/sticking of the surface film made of soft metal like silver. For this reason, it is recommendable to select a drive motor with extra torque capacity.

2. Clean environment

● NSK Clean Grease LG2 and LGU

NSK Clean Grease LG2 is used in clean room for NSK linear guides, ball screws, Monocarriers, XY Modules, Megatorque motors, XY tables, etc. with low-dust emitting specifications. For its low dust emission and high durability, LG2 earns trust and high reputation of semiconductor equipment manufacturers. LG2 is superior in many areas to fluorine greases which are commonly used in clean room.

Features

- Remarkably low dust emission
- Long life -- More than ten times longer than fluoride greases, and equivalent to ordinary greases.
- Excellent rust prevention -- Significantly higher capacity than fluorine greases.
- Low and stable torque -- 20% or less than that of fluorine greases

Table 4.4 Nature of Clean Grease LG2 and LGU

Name	Thickener	Base oil	Base oil kinematic viscosity mm ² /s (40°C)	Consistency	Dropping point °C
Clean Grease LG2	Lithium soap	Synthetic hydrocarbon oil + mineral oil	32	199	201
Clean Grease LGU	Diurea	Synthetic hydrocarbon oil	95.8	201	260

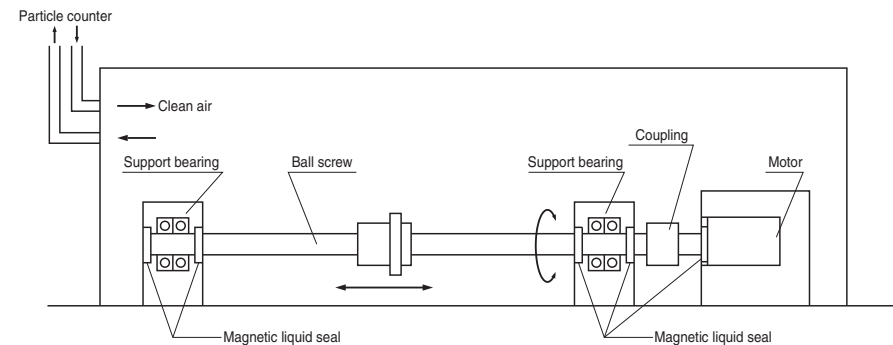


Fig. 4.3 Setting to measure dust generated by ball screw

● **Feature 1: Remarkably low dust emission**

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

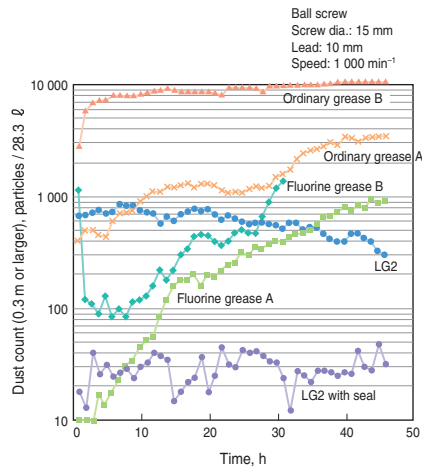


Fig. 4.4 Comparison in dust emission characteristics

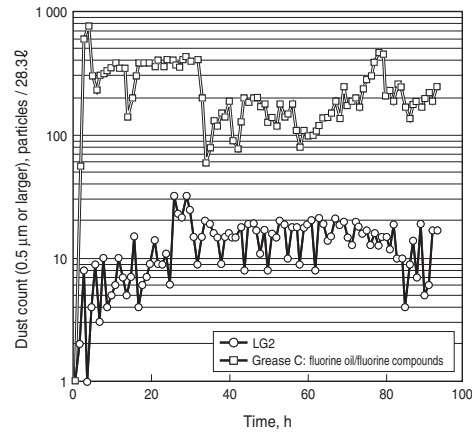


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● **Feature 2: Long life**

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

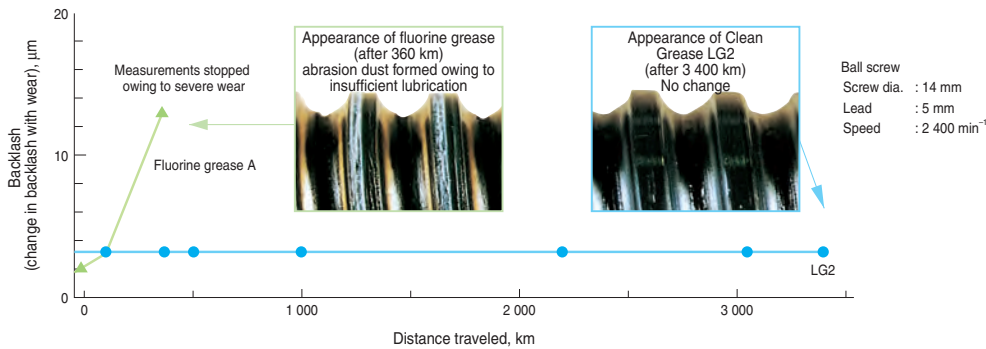


Fig. 4.6 Results of ball screw durability test

● **Feature 3: Excellent rust prevention capacity**

The rust prevention capacity is significantly higher than fluoride type greases. Handling and preparation for operation are easy.

Ball screw rust prevention test (test conditions: 96 hr at humidity 95%, temperature 70°C)

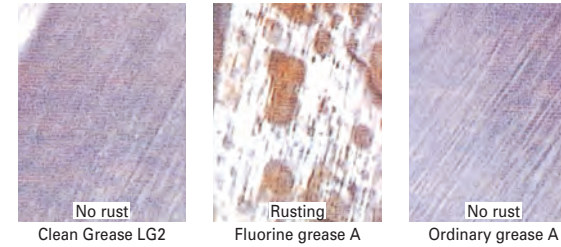


Photo 4.2

Table 4.5 Rust prevention test on bearing

Type	Rusting after 7 days
NSK Clean Grease LG2	No rust
Fluorine grease B	Rusted

Test conditions : 19 mg is sealed in ball bearing 695
: Temp. 90°C, Humidity 60%
Evaluation : Studied by microscope

● **Feature 4: Stable torque**

Torque is 20% or lower than fluorine greases.

● **Total evaluation**

Table 4.6 Evaluation

Characteristic	LG2	Fluorine grease	General grease
Dust generation	○	○ - △	△ - X
Torque	○	X	○ - △
Durability	○	△ - X	○
Rust prevention ability	○	△ - X	○

○: Suitable △: Not very suitable X: Problem in use

Ball screw
Screw dia.: 25 mm
Lead: 5 mm
Preload: 294 N

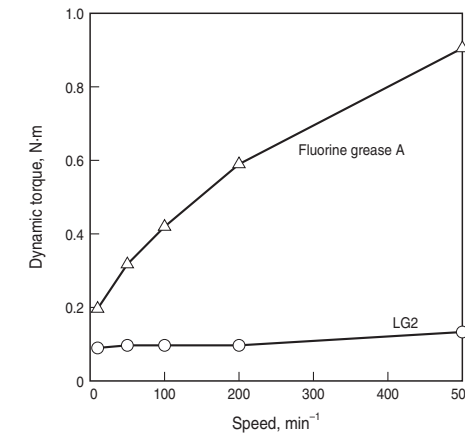


Fig. 4.7 Comparison of torque characteristics

3. Environment with foreign matters

● **NSK K1 lubrication unit (linear guide and ball screw)**

Molded oil is made of a lubrication oil and polyolefin which has affinity with the lubrication oil. More than 70% of the mass is lubrication oil.

Molded oil which is formed into NSK K1 lubrication unit effectively seals linear guides, continually supplying lubrication oil. NSK K1 lubrication unit has made it possible to use linear guides in water or powder dust.

NSK K1 lubrication unit for ball screws is also available.

For monocarriers, NSK K1 is equipped as a standard feature.

Features

- **Extend maintenance-free intervals**
- **No contamination of surrounding environment**
- **Prolong life of the products exposed to water**

Refer to pages A38, B579 and C141 for details of NSK K1 lubrication unit.

1.5 Table to Cope With Special Environments

1. Linear guides

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
NH	NH15	○		○		○	
	NH20	○		○		○	
	NH25	○	○	○		○	
	NH30	○	○	○		○	
	NH35	○		○		○	
	NH45	○		○		○	
VH	NH55	○		○			
	NH65	○		○			
	VH15	○		○			○
VH	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
NS	NS15	○	○	○		○	
	NS20	○	○	○		○	
	NS25	○	○	○		○	
	NS30	○	○	○	○*	○	
	NS35	○		○		○	
	LW	LW17	○		○	○*	○
LW21		○		○	○*	○	
LW27		○		○	○	○	
LW35		○		○		○	
LW50		○		○			
PU		PU05	○		○		
	PU07	○		○			
	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
	LU	LU05	○		○		
LU07		○		○			
LU09_L		○	○	○	○	○	
LU09_R		○		○		○	
LU12_L		○	○	○	○	○	
LU12_R		○		○		○	
LU15	○	○	○	○*	○		

*) Dust-proof parts are not applicable to high-temperature environmental use.

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
	LE	LE05	○		○		
LE07		○		○	○*		
LE09_L		○	○	○	○*	○	
LE09_R		○		○		○	
LE12_L		○	○	○	○	○	
LE12_R		○		○		○	
LH	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
	LH08	○		○			
	LH10	○		○			
	LH12	○	○	○	○*	○	
	RA	RA15	○		○		
RA20		○		○			
RA25		○		○			
RA30		○		○			
RA35		○		○			
RA45		○		○			
RB	RA55	○		○			
	RA65	○		○			
	RB30	○		○			
	RB35	○		○			
	RB45	○		○			
	RB55	○		○			
LA	RB65	○		○			
	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
HA	LA65	○		○			
	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

2. Ball screws

Series	Special environment				
	Clean	Vacuum	Rust prevention	High temp.	Foreign matters
KA Series	○	○	○		
For Contaminated environments VSS Type					○
Made-to-order ball screw	○*	○*	○*	○*	○*

*Available in the made-to-order ball screw.

Please consult NSK.

3. Monocarriers

Please consult with NSK for special environmental use.

1.6 Precautions for Handling

Please observe the following precautions to maintain high functions of ball screws and linear motion guide bearings in special environment over a long period.

- Products are washed to remove oil, and wrapped in a way to protect them from moisture. Use the product as soon as possible after opening the package.
- After opening, store the ball slide (random-matching type linear guide) and ball nut (R series ball screw) in a clean, air-tight container such as desiccator with desiccating agent (e.g. silica gel). Do not apply rust preventive oil or paper or product that vaporizes rust preventive agent.
- Wear plastic gloves and handle product in clean place.

2. Lubrication

There are two types of lubricating method -- grease and oil -- for ball screws, linear guides and monocarriers. Use a lubricant agent and method most suitable to condition requirements and purpose to optimize functions of ball screws, linear guides and monocarriers.

In general, lubricants with low base oil kinematic viscosity are used for high-speed operation, in which thermal expansion has a large impact, and in low temperatures.

Lubrication with high base oil kinematic viscosity is used for oscillating operations, low speeds and high temperatures.

The following are lubrication methods using grease and oil.

2.1 Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping. Grease lubricants made by NSK are:

- Various types of grease in bellows tubes that can be instantly attached to a grease pump;
- NSK Grease Unit that consists of a hand grease pump and various nozzles. They are compact and easy to use.

1. NSK grease lubricants

Table 1.1 shows the marketed general grease widely used for linear guides, ball screws and monocarrier for specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides, ball screws and monocarriers

Type	Thickener	Base oil	Base oil kinematic viscosity mm ² /s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium type	Mineral oil	130	-10 – 110	For general use at high load
PS2	Lithium type	Synthetic oil + synthetic hydrocarbon oil	15.9	-50 – 110	For low temperature and high frequency operation
LR3	Lithium type	Synthetic oil	30	-30 – 130	For high speed, medium load
LG2	Lithium type	Mineral oil + synthetic hydrocarbon oil	32	-20 – 70	For clean environment
LGU	Diurea	Synthetic hydrocarbon oil	95.8	-30 – 120	For clean environment
NF2	Urea composite type	Synthetic hydrocarbon oil	26	-40 – 100	For fretting resistance

(1) NSK Grease AS2

• Features

It is an environmentally friendly and widely used grease for high load application. It is mineral oil based grease containing lithium thickener and several additives. It is superb in load resistance as well as stability in oxidation. It not only maintains good lubrication over a long period of time, but also demonstrates superb capability in retaining water. Even containing a large amount of water, it does not lose grease when it is softened.

• Application

It is a standard grease for general NSK linear guides, ball screws and monocarriers. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability in oxidation.

(2) NSK Grease LR3

• Features

It contains a special synthetic oil for high temperature and stability, and a carefully selected anti-oxidation agent. This grease dramatically increases lubrication life under high temperature conditions. It is used for high speed, medium load. Lubrication life exceeded 2 000 hours in the endurance test at 150°C. Its rust prevention capacity in severe conditions such as water and moist environments is further strengthened.

• Application

It is a standard grease for ball screws PSS type (shaft dia. 15 mm or over), FSS type, FA type (except shaft dia. 10 mm with lead of 4mm and shaft dia. 12 mm with lead of 5 mm) and VFA type. It is ideal for operation with medium load, at high speed such as positioning in high tact material handling equipment.

(3) NSK Grease PS2

• Features

The major base oil component is synthetic oil with mineral oil. It is an excellent lubrication especially for low temperature operation. It is for high speed and light load.

• Application

It is a standard grease for NSK miniature linear guides and ball screws. It is especially superb for low temperature operation, but also functions well in normal temperatures, making it ideal for small equipment with light load.

• Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	181°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm ² /s (40°C)

• Nature

Thickener	Lithium soap base
Base oil	Synthetic oil
Consistency	228
Dropping point	208°C
Volume of evaporation	0.58% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	1.9% (100°C, 24 hr)
Base oil kinematic viscosity	30 mm ² /s (40°C)

• Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + Synthetic hydrocarbon oil
Consistency	275
Dropping point	190°C
Volume of evaporation	0.60% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	3.6% (100°C, 24 hr)
Base oil kinematic viscosity	15.9 mm ² /s (40°C)

(4) NSK Grease LG2

• Features

This grease was developed by NSK to be exclusively used for linear guides and ball screws in clean room. Compared to the fluorine grease which are commonly used in clean room, LG2 has several advantages such as:

- Higher in lubrication function
- Longer lubrication life
- More stable torque (resistant to wear)
- Higher rust prevention.

In dust generation, LG2 is more than equal to fluorine grease in keeping dust volume low. Since the base oil is not a special oil but a mineral oil, LG2 can be handled in the same manner as general greases.

• Application

LG2 is a lubrication grease for rolling element products such as linear guides and ball screws for semiconductor and liquid crystal display (LCD) processing equipment which require a highly clean environment. Because LG2 is exclusively for a clean environment at normal temperatures, however, it cannot be used in a vacuum environment. Refer to "Special environment" in page D8 for detailed data on superb characteristics of NSK Grease LG2.

• Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	199
Dropping point	201°C
Volume of evaporation	1.40% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic viscosity	32 mm ² /s (40°C)

(5) NSK Grease LGU

• Features

This is a proprietary urea base grease of NSK featuring low dust emission exclusively for ball screws and linear guides which are used in clean rooms.

In comparison with fluorine base grease, which has been used commonly in clean rooms, LGU has better

lubricating property, longer duration of lubricant, better torque variation, much better anti-rust property, and equivalent or better dust emission. In addition, this grease can be handled in the same way as the other common grease because high-grade synthetic oil is used as the base oil.

LGU grease contains much less metallic elements compared to LG2 grease. It can be used in high temperature environment.

• Application

This is exclusive lubrication grease for ball screws and linear guides that are installed in equipment that requires cleanliness, as same as LG2 grease, and it can be used in high temperature range of -30 to 120°C.

This cannot be used in vacuum.

• Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	201
Dropping point	260°C
Volume of evaporation	0.09% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	95.8 mm ² /s (40°C)

(6) NSK Grease NF2

• Features

It uses high-grade synthetic oil as the base oil and urea base organic compound as the thickener. It has remarkable anti-fretting corrosion property. It can be used in wide temperature range, from low to high, and has superior lubrication life.

• Application

This grease is suitable for ball screws and linear guides of which application include oscillating operations. Allowable temperature range is -40 to 100°C.

• Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	260°C
Volume of evaporation	0.22% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.5% (100°C, 24 hr)
Base oil kinematic viscosity	26 mm ² /s (40°C)

• Precautions for handling

- Wash the linear guides and ball screws to remove oil prior to applying Clean Grease LG2 or LGU, so the grease functions are fully utilized.
- Clean grease is exclusively used for clean environments at normal temperatures.

Note) Refer to NSK Grease Unit Catalog (CAT. No.3317) for details of NSK Grease.

2. Before use of NSK Precision Products

Wipe off the rust preventive oil before use for the products that the oil is applied.

If grease is not applied, apply grease, and move a ball slide or ball nut a few strokes so the grease permeates into the ball slide and inside the nut. (Move the ball slide or the ball nut 5 to 10 times with full stroke.)

Then wipe off the excess grease.

3. How to replenish grease and volume of grease to be replenished

Use grease fitting if exclusive grease supply component is not used. Supply required amount through grease fitting by a grease pump.

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used or there is no oil filler due to the size limitation, apply grease directly to the rail or to the ball groove of the screw shaft. Remove the seal if possible, move a ball slide or ball nut a few strokes so that the grease permeates into the ball slide, nut and inside the slider.

Once grease is replenished, another supply is not required for a long time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.

* When replenishing using a grease pump:

Use a grease pump and fill the inside of ball slide, ball nut and monocarrier slider with grease. Supply grease until it comes out from the ball slide, ball nut or monocarrier slider area. Move ball slide, ball nut or monocarrier slider by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease. Trial operations are necessary because the resistance to sliding force and screw torque greatly increases immediately after replenishment (full-pack state) and may cause problems. The agitating resistance of grease is accountable for this phenomenon. Wipe off excess grease that accumulates at end of rail and screw shaft after trial runs so the grease does not move to other areas.

* When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:

- All at once, replenish the amount that fills about 50% of the internal space of the ball slide or the internal space of the ball nut. This method eliminates waste of grease and is efficient.

Tables 1.2, 1.3 and 1.4 show internal spaces of ball slide, ball nut and monocarrier slider for reference.

Table 1.2 Inside space of the slide of linear guide

NH Series Unit: cm³

Model No.	Series NH	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100
65	139	186

PU, LU Series Unit: cm³

Model No.	Series PU		Series LU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	-	0.1	-
07	0.1	-	0.1	-
09	0.2	0.3	0.2	0.3
12	0.3	0.4	0.3	0.4
15	0.8	1.1	0.8	1.1

VH Series Unit: cm³

Model No.	Series VH	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

PE, LE Series Unit: cm³

Model No.	Series PE		Series LE		
	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	0.1	-	0.1	0.1	-
07	0.2	-	0.1	0.2	0.3
09	0.4	0.5	0.2	0.4	0.5
12	0.5	0.7	0.3	0.5	0.7
15	1.2	1.6	0.8	1.2	1.6

NS Series Unit: cm³

Model No.	Series NS	
	Medium-load type	High-load type
15	2	3
20	3	4
25	5	8
30	8	12
35	12	19

Miniature LH Series Unit: cm³

Model No.	Series LH
08	0.2
10	0.4
12	1.2

LW Series Unit: cm³

Model No.	Series LW
17	3
21	3
27	7
35	24
50	52

RA Series Unit: cm³

Model No.	Series RA	
	High-load type	Super-high-load type
15	1	1.5
20	2	2.5
25	3	3.5
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

RB Series Unit: cm³

Model No.	Series RB	
	High-load type	Super-high-load type
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

LA Series Unit: cm³

Model No.	Series LA	
	High-load type	Super-high-load type
25	8	12
30	14	18
35	21	29
45	38	48
55	68	86
65	130	177

HA, HS Series Unit: cm³

Model No.	Series HA	Series HS
	15	-
20	-	9
25	16	16
30	27	25
35	42	40
45	67	-
55	122	-

Table 1.3 Inside space of ball nut
Return tube type (single nut)

Unit: cm ³		Unit: cm ³		Unit: cm ³		Unit: cm ³	
Nut model	Inside space	Nut model	Inside space	Nut model	Inside space	Nut model	Inside space
1004 - 2.5	0.8	2004 - 5	2.7	2520 - 2.5	12	3225 - 2.5	17
1205 - 2.5	1.2	2005 - 5	4.3	2525 - 1.5	7.5	3232 - 1.5	15
1210 - 2.5	1.4	2010 - 2.5	4.7	2805 - 5	6	3610 - 5	32
1405 - 2.5	2.2	2020 - 1.5	4.2	2805 - 10	9	4005 - 10	14
1408 - 2.5	2.1	2504 - 5	3.2	2806 - 5	6	4010 - 5	30
1510 - 2.5	2.3	2505 - 5	5	2806 - 10	9.5	4012 - 5	34
1605 - 2.5	2.6	2506 - 5	7	3205 - 5	7	4510 - 5	34
1616 - 1.5	2.1	2510 - 3	9.5	3206 - 5	9.5	5010 - 5	37
				3210 - 5	22	5010 - 10	59

Deflector (bridge) type (single nut) Unit: cm³

Nut model	Inside space
2505 - 6	6.5
2510 - 4	10
3205 - 8	9.5
3210 - 6	28
4010 - 8	42
5010 - 8	52

End cap type Unit: cm³

Nut model	Inside space
1520 - 1.5	1.9
1632 - 1	2
2040 - 1	2.8
2550 - 1	4.2

Note:
Nut model: shaft diameter, lead, total number of turns of balls
Please consult NSK for other specifications.
Refer to B110 to B146 for Compact FA Series.

Table 1.4 Inside space of the monocarrier

MCM Series			MCH Series					
Model No.	Unit: cm ³		Model No.	Unit: cm ³		Model No.	Unit: cm ³	
	Lead (mm)	Inside space		Lead (mm)	Inside space		Lead (mm)	Inside space
MCM02	1	0.3	MCM06	5	8.3	MCH06	5	2.8
	2	0.3		10	6.5		MCL06	10
MCM03	1	1		20	5.5	MCH09	20	2.7
	2	0.9	5	11.6	5		5.8	
	10	1.8	10	9.8	10	5.8		
	12	1.7	20	8.7	20	5.6		
MCM05	5	4.2	MCM08	30	4.3	MCH10	10	10.9
	10	4		10	19.4		20	10.1
	20	2.1		20	17.4			
	30	2.0	30	8.8				

4. Intervals of checks and replenishments

Although the grease is of high quality, it gradually deteriorates and its lubrication function diminishes. Also, the grease in the ball slide and ball nut is gradually removed by stroke movement. In some environments, the grease becomes dirty, and foreign

objects may enter. Grease should be replenished depending on frequency of use. The following is a guide of grease replenishment intervals for linear guides and ball screws.

Table 1.5 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chips	Usually once per year. Every 3 000 km for material handling system that travels more than 3 000 km per year. Replenish if checking results warrant it necessary.

- Notes: 1) As a general rule, do not mix greases of different brands.
2) Grease viscosity varies by temperature. Viscosity is particular high in winter due to low temperatures. Pay attention to increases in linear guide and monocarrier sliding resistance and ball screw and monocarrier torque in such conditions.
3) When the ambient temperature is low, or in Winter, if it is difficult to pump out the grease from the container, wait until the grease is softened.
4) In locations where coolant is dispersed or scattered, the emulsification of lubricants and rinsing with water may significantly deteriorate the integrity of the lubricant and efficiency of the grease. Protect the grease unit from coolant by shielding it with a cover, etc.

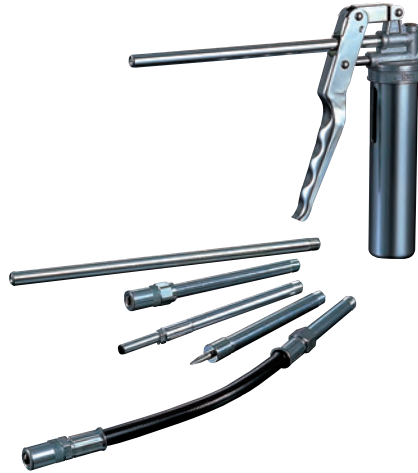
5. NSK Grease Unit

Supply grease to NSK linear guides and ball screws by manual type hand grease pump. Install grease in

bellows tube to the pump. Several types of grease (80 g) are available.



Grease in bellows tube



(1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit		Name	(Tube color)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LR3	NSK Grease LR3	(Green)	NSK GRS LR3
	NSK Grease LG2	NSK Grease LG2	(Blue)	NSK GRS LG2
	NSK Grease LGU	NSK Grease LGU	(Yellow)	NSK GRS LGU
	NSK Grease NF2	NSK Grease NF2	(Gray)	NSK GRS NF2
NSK Hand Grease Pump Unit				
NSK Hand Grease Pump (Straight nozzle NSK HGP NZ1 -- One nozzle is provided with hand pump.)				NSK HGP
Grease nozzle (used with hand grease pump)				
NSK straight nozzle				NSK HGP NZ1
NSK chuck nozzle				NSK HGP NZ2
NSK drive-in fitting nozzle				NSK HGP NZ3
NSK point nozzle				NSK HGP NZ4
NSK flexible nozzle				NSK HGP NZ5
NSK flexible extension pipe				NSK HGP NZ6
NSK straight extension pipe				NSK HGP NZ7
NSK nozzle for MCH				NSK HGP NZ8

(2) NSK Greases (80 g in bellows tube)

Refer to pages D14 and D15 for their natures and details.

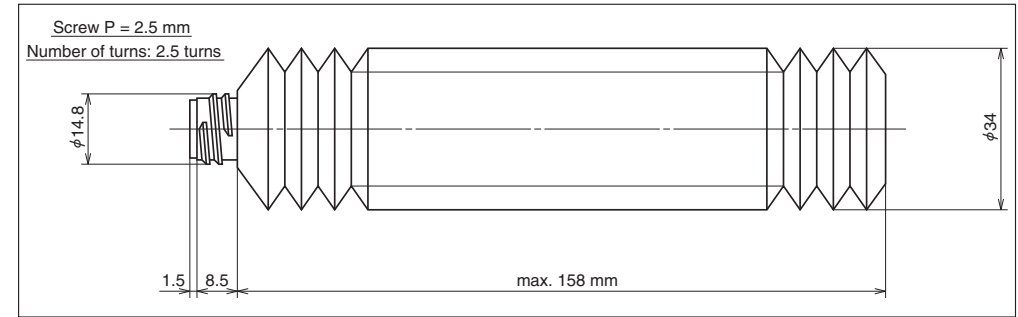


Fig. 1.1 Bellows tube

(3) NSK Manual Grease Pump Unit

a) NSK Hand Grease Pump (Reference number: NSK HGP)

● Features

- Light-weight Can be operated by one hand, yet there is no worry to make a mistake.
- Inserting by high pressure.... Insert at 15 Mpa.
- No leaking Does not leak when held upside down.
- Easy to change grease.... Simply attach grease in bellows tube.
- Remaining grease Can be confirmed through slit on tube.
- Several nozzles Six types of nozzles to choose from.

● Specifications

- Discharge pressure .. 15 Mpa
- Spout volume 0.35 cc/shot
- Mass of main body ... Without nozzle 240 g
Provided nozzle 90 g
- Grease tube outer diameter ϕ 38.1
- Accessory..... Several nozzles for a unique application can be attached

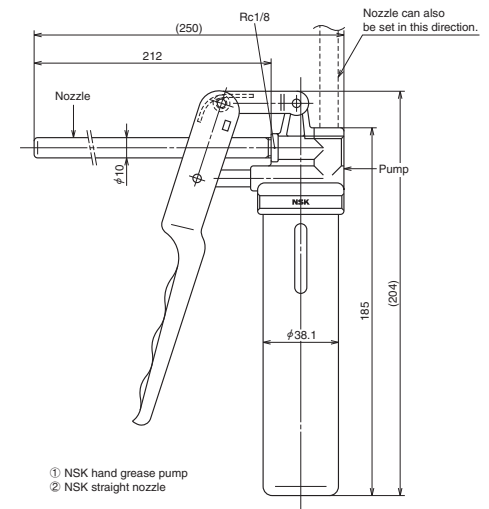


Fig. 1.2 NSK Hand Grease Pump with NSK straight nozzle

*Air is contained in the unopened bellows tube. Try the system tens of times when to use the hand grease pump. The tube will be use after deflated from the tube.

b) Nozzles

Table 1.6 Nozzles that can be attached to NSK Hand Grease Pump

Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come to contact due to the chucking mechanism at the tip.	
NSK drive-in fitting nozzle	NSK HGP NZ3	Dedicated for the - φ 3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides and ball screws which do not have grease fitting. Supplies grease directly to the ball grooves, or through the opening of ball slide or ball slide to inside.	
NSK flexible nozzle	NSK HGP NZ5	The tip of the flexible nozzle is chuck nozzle. The straight nozzle is not available for use.	
NSK flexible extension pipe	NSK HGP NZ6	Flexible extension pipe connects the grease pump and the nozzle	
NSK straight extension pipe	NSK HGP NZ7	Straight extension pipe connects the grease pump and the nozzle.	
NSK nozzle for MCH	NSK HGP NZ8	For MCH Series grease replenishment	

Table 1.7 Grease fittings used for NSK linear guide

Series	Model number	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
NH	NH15	φ 3	Drive-in type			○		
	NH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	NH45, 55, 65	Rc1/8	B type	○	○			○
VH	VH15	φ 3	Drive-in type			○		
	VH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
NS	NS15	φ 3	Drive-in type			○		
	NS20, 25, 30, 35*	M6×0.75	B type	○	○			○
	LW17	φ 3	Drive-in type			○		
LW	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
	PU	PU05, 07, 09, 12	-	-				○
PU15		φ 3	Drive-in type			○		
LU	LU05, 07, 09, 12, 15	-	-				○	
PE	PE05, 07, 09, 12	-	-				○	
PE15	PE15	φ 3	Drive-in type			○		
LE	LE05, 07, 09, 12, 15	-	-				○	
Miniature LH	LH08, 10	-	-				○	
	LH12	φ 3	Drive-in type			○		
RA	RA15, 20	φ 3	Drive-in type			○		
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
RB	RB30	φ 3	Drive-in type			○		
	RB35, 45	M6×0.75	B type	○	○			○
	RB55, 65	Rc1/8	B type	○	○			○
LA	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS	HS15	φ 3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

*1) If using a chuck nozzle, avoid interference with table and rail.

Note: 1) For PU, PE, LU, and LE Series, apply grease directly to ball groove, etc. using point nozzle.

2) A long threaded grease fitting is required for NSK linear guides because of dust-proof parts. Please refer to the sections pertaining to the lubrication and dust-proof parts of each series.

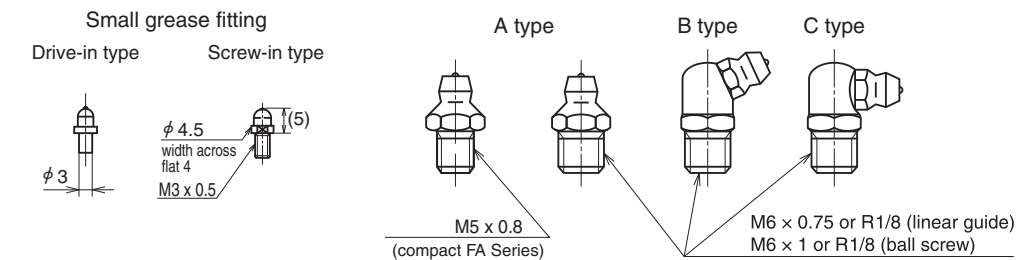


Fig. 1.3 Grease fittings

Table 1.8 Applicable grease nozzle for ball screws

Series		Tap hole for grease fitting	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5	
Finished shaft end	Compact FA	High-accuracy, clean	USS	M5x0.8	A type	○	○		○	○	
		General	PSS		A type	○*1	○*1		○	○*1	
		Transfer equipment	FSS		A type	○*1	○*1		○	○*1	
	Miniature, fine lead	MA	Shaft dia. 12 or less Shaft dia. 16 or over	—	—				○		
	Small equipment	FA		M6x1	—	○*2	○*2		○	○*2	
	Machine tools	SA	Shaft dia. 36 or less	M6x1	—	○	○		○	○	
			Shaft dia. 40 or over	Rc1/8	—	○	○		○	○	
	Stainless steel	KA	Shaft dia. 12 or less and lead 2 or less	M3x0.5	—			○	○		
			except above	M6x1	—	○*2	○*2		○	○*2	
	Transfer equipment	VFA	Shaft dia. 12 or less	φ 2.7	—				○		
Shaft dia. 15 or over			φ 3.5	—				○			
RMA			—	—				○			
Blank shaft end	Miniature, fine lead	MS	Shaft dia. 12 or less Shaft dia. 16 or over	—	—				○		
	Small equipment	FS		M6x1	—	○*2	○*2		○	○*2	
	Machine tools	SS	Shaft dia. 36 or less	M6x1	—	○	○		○	○	
			Shaft dia. 40 or over	Rc1/8	—	○	○		○	○	
		HSS		M6x1	—	○	○		○	○	
	Transfer equipment	RMS		—	—				○		
		RNFTL	Shaft dia. 12 or less	M3x0.5	—			○	○		
			Shaft dia. 14 or over	M6x1	—	○	○		○	○	
		RNFBL	Shaft dia. 12 or less	M3x0.5	—			○	○		
			Shaft dia. 14 or over	M6x1	—	○	○		○	○	
RNCT			—	—				○			
RNFCL	Shaft dia. 12 or less	M3x0.5	—				○	○			
	Shaft dia. 15 or over	M6x1	—	○	○		○	○			
RNSTL		M6x1	—	○	○		○	○			

*1 Unavailable for shaft dia. 25 mm *2 If using A type grease fitting, may not install the nozzle.

Notes: 1) Normally, grease fitting is not provided to NSK ball screw except Compact FA Series. Ball nut has a tap hole to install a grease fitting. The user should install a grease fitting if necessary.

2) For M3 x 0.5 tap hole, small fitting (screw-in type) is available. Please contact NSK.

3) VFA type cannot install grease fitting. Apply grease directly to inside the nut through oil hole using point nozzle.

4) MA, RMA, MS, RMS, and RNCT types have no tap hole, apply grease directly to the screw shaft and ball grooves using point nozzle.

Table 1.9 Applicable grease nozzles for Monocarriers

Series	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Flexible nozzle NZ5	MCH exclusive fitting nozzle NZ8
MCM	MCM02	—	—					
	MCM03,05,08,10	φ 3	Drive-in type			○		○*
	MCM06	M6x0.75	A type	○	○		○	
MCH	MCH06,09,10	φ 3	Drive-in type					○

*) Use of NZ3 is recommended.

2.2 Oil Lubrication

Required amount of new oil is regularly supplied by:
 • Manual or automatic intermittent supply system;
 • Oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than grease lubrication. However, oil mist lubricating system supplies air as well as oil, raising the inner pressure of the ball slide. This prevents foreign matters from entering, and the air cools the system. Use an oil of high atomizing rate such as ISO VG 32 to 68 for the oil mist lubrication system. ISO VG 68 to 220 are recommended for common intermittent replenishment system. Approximate volume of oil Q for a ball slide of linear guide per hour can be obtained by the following formula.

In case of ball type linear guides except the LA Series

$$Q \geq n/150 \text{ (cm}^3\text{/hr)}$$

In case of LA Series, RA Series

$$Q \geq n/100 \text{ (cm}^3\text{/hr)}$$

n: Linear guide code

e.g. When NH45 is used,

$$n = 45$$

Therefore,

$$Q = 45/150 = 0.3 \text{ cm}^3\text{/hr}$$

Similarly, approximate oil supply volume Q to ball screw can be obtained by the following formula.

$$Q = d/15 \text{ (cm}^3\text{/hr)}$$

d: Nominal shaft diameter of the ball screw

e.g. When the shaft diameter is 50,

$$d = 50$$

Therefore,

$$Q = 50/15 = 3.3 \text{ cm}^3\text{/hr}$$

For oil lubrication by gravity drip, the oil supply position and installation position of the ball slide or ball nut are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all raceway surface. This may cause insufficient lubrication. For ball screw lubrication as well, oil does not spread if the oil orifice is installed at the bottom, causing insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has internal design which allows oil lubricant to flow throughout the system. **Table 2.1** shows the criterion of intervals of oil checks and replenishments.

Table 2.1 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment or intervals of changes
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check. Suitable volume for tank capacity.
Oil bath	Daily before operation	Oil surface	Make a suitable criterion based on consumption

Notes: 1) As with grease lubrication, do not mix oil lubricant with different types.

2) Some components of the linear guide and ball screw are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating system, please confirm an oil supply amount at the each outlet part.

3. RoHS Compliant

1. Linear Guides

• Linear Guides listed in the catalog except the products for special environments, are compliant with RoHS.

• Please consult NSK for RoHS of special parts and lubricant provided by customer, and customer-supplied product.

2. Ball Screws

• Ball screws listed in the catalog except the products for special environments, are compliant with RoHS.

3. Monocarriers

• Monocarriers listed in the catalog are compliant with RoHS.

4. Ball Screw Support Bearings

• Ball screw support bearings listed in the catalog are compliant with RoHS.

*For details of country-specific RoHS, contact NSK.