



Shin-Etsu silicone

# Greases • Fluid Compounds



# Boost the reliability of your equipment with the diverse functionalities of our products.

**Shin-Etsu silicone grease** products are made by blending additives and fillers such as metal soaps into a silicone fluid base. They have superior thermo-oxidative stability and moisture resistance over a wide temperature range. These products are used mainly for lubrication of moving parts.

**Shin-Etsu silicone fluid compounds** are grease-like products made by blending silica or metal powders into a silicone fluid base. They have excellent thermo-oxidative stability, electrical properties, and water repellency over a wide temperature range. These products are used primarily for electrical insulation, sealing, water repellency, and as a thermal interface material, mainly on nonmoving parts.

Both are used extensively in transport vehicles, electronics and machinery in a range of industries to improve the durability, safety and reliability of key equipment.

## A vast array of applications.



Bearing lubrication



Filling junctions of optical equipment



Heat dissipation for power transistors



High-vacuum seals



Protecting insulators from salt-air



Lubricating the rubber cups of auto brakes

## Contents

- Features & Advantages.....3
- Types.....4
- Selection Criteria.....4
- Product Properties
  - 1. Greases.....6
  - 2. Fluid Compounds.....14
- Packaging.....20
- Safety Data.....21
- Handling Precautions.....22

# Features & Advantages

Typically, silicone greases and fluid compounds offer the following advantages.

1

## Superior resistance to heat and cold

The silicone fluid base oil is highly resistant to heat and cold, offering the following advantages:

- ◆High drop point
- ◆Low oil separation and volatility
- ◆Good thermo-oxidative stability
- ◆Little variation in consistency
- ◆Won't solidify even at  $-50^{\circ}\text{C}$

2

## Superior moisture resistance

Resistant to moisture and humidity.

When left in water for long periods, greases whiten on the surface but there is virtually no internal change.

3

## Safe

The silicone fluid base oil is physiologically inert, so these products pose almost no risk to living organisms. (see p. 21)

4

## Effective in small amounts

Silicones offer excellent performance in small amounts.

5

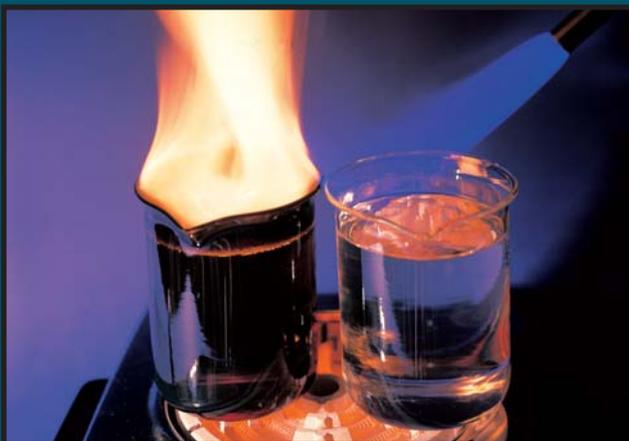
## Products available that reduce contact faults

Our lineup includes products with greatly reduced content of volatile low-molecular-weight silicone, which can be a cause of contact faults.

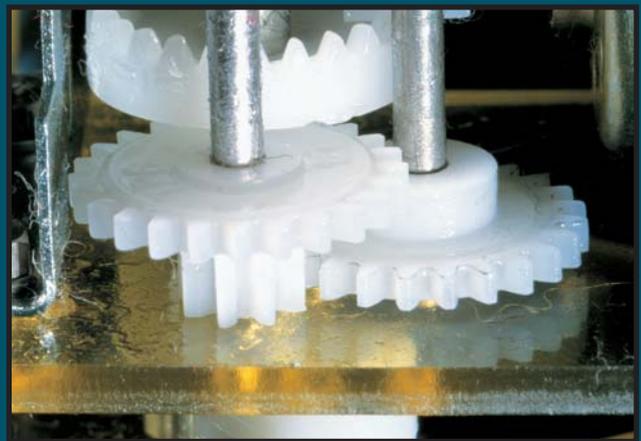
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## Other properties

Other properties include shear stability, radiation resistance, good electrical properties and water repency, and non-corrosivity.



Heat resistance comparison (Left: mineral oil. Right: silicone fluid)



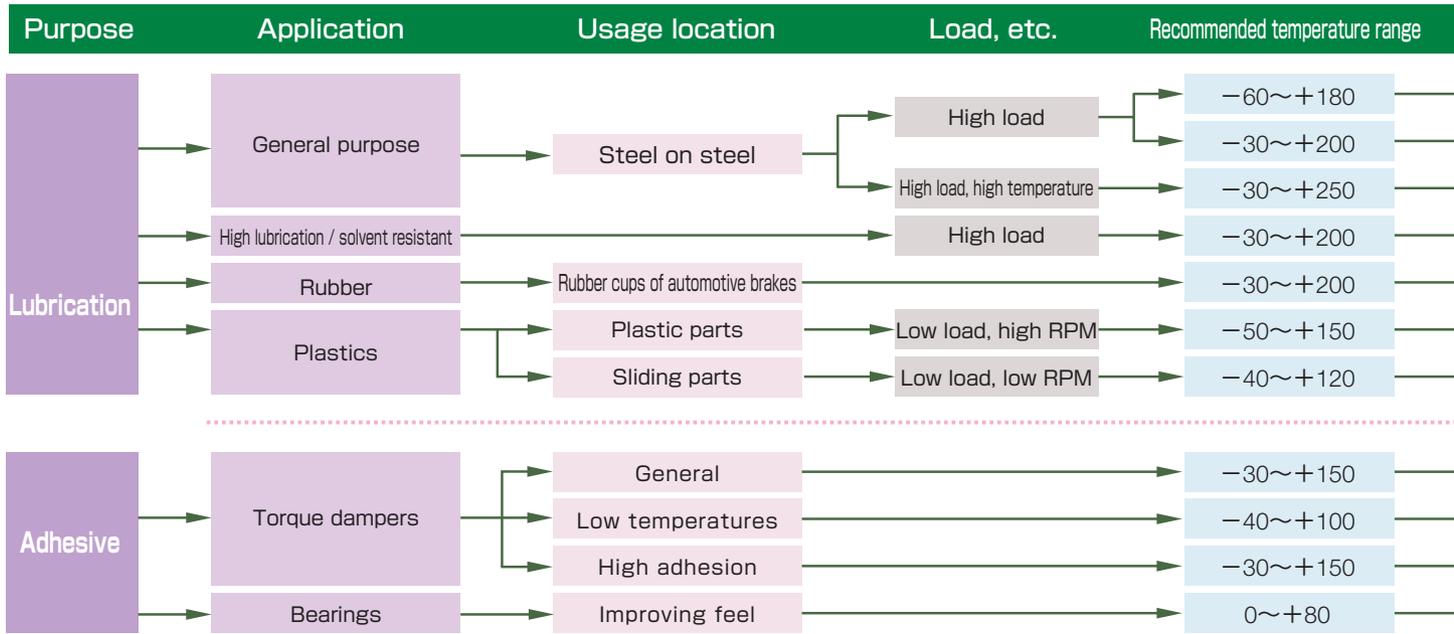
Superior lubrication even when used in small amounts

\*Before use, always test to determine whether our products are suitable for your intended application.



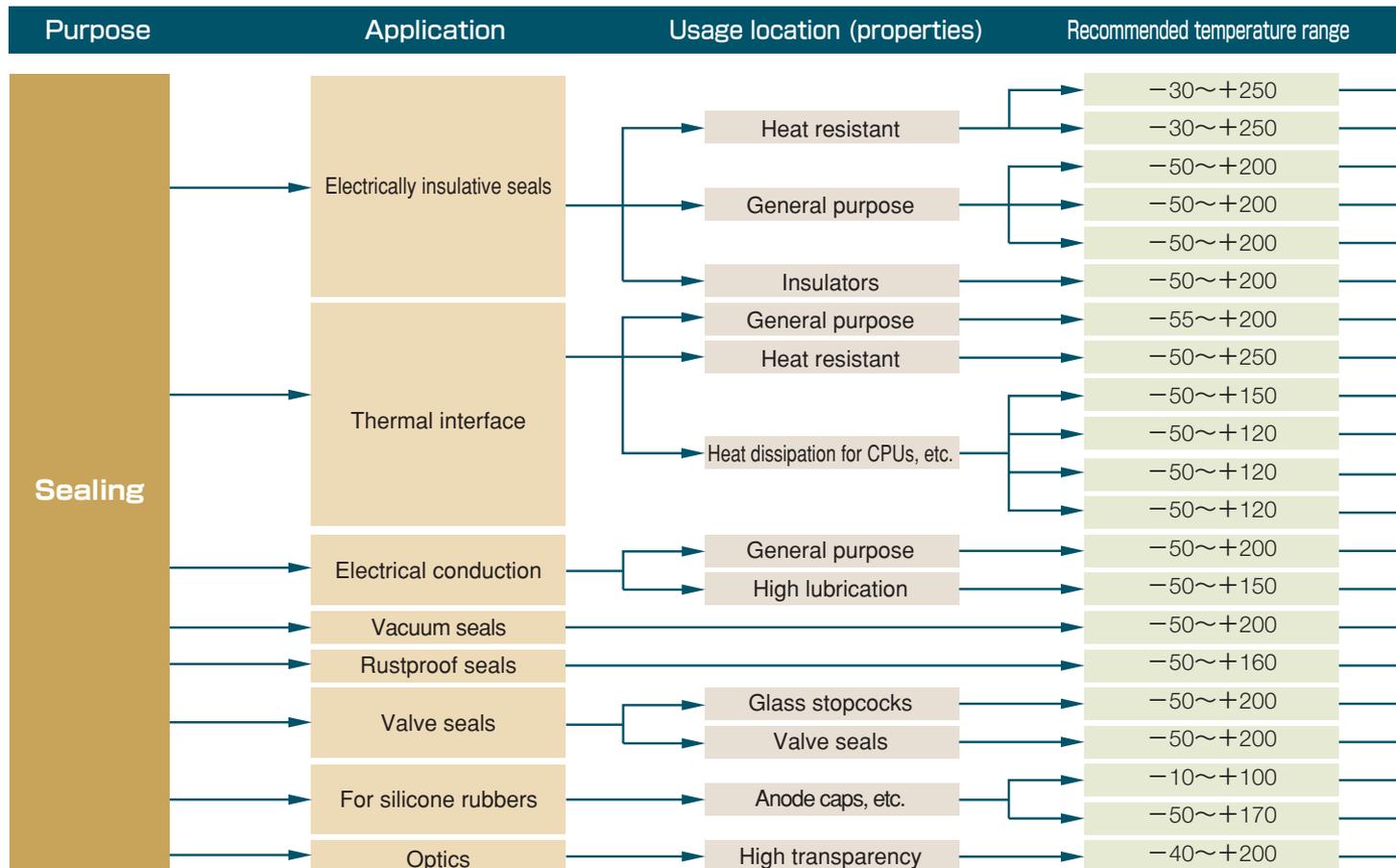
# Greases

## Selection Criteria & Product Types



# Fluid Compounds

## Selection Criteria & Product Types



Product name	Description
<b>G30 Series</b>	..... General purpose. Suitable for lubrication in extremely low temperature applications, in which petroleum greases cannot be used.
<b>G40 Series</b>	..... General purpose. Suitable for lubrication of sealed bearings. Performance complies with MIL-L-15719A.
<b>G420</b>	..... Good lubrication particularly at high temperatures.
<b>FG720 Series</b>	..... Especially good boundary lubrication and solvent resistance.
<b>G411</b>	..... For rubber cups of automotive brakes.
<b>G501</b>	..... Does not cause stress cracking in plastic. Good lubrication for steel on steel.
<b>G6500</b>	..... For low RPM applications.
<hr/>	
<b>G330 Series</b>	..... General purpose.
<b>G340 Series</b>	..... For low temperature applications. Little change in torque values in temperatures ranging from -30°C to +60°C.
<b>G350 Series</b>	..... High adhesion type.
<b>G630 Series</b>	..... For bearings. Good feel. Base oil is non-silicone.

Product name	Description
<b>KS62F</b>	..... Heat resistant. Paste consistency.
<b>KS62M</b>	..... Heat resistant.
<b>KS63W</b>	..... General purpose.
<b>KS64F</b>	..... Paste.
<b>KS64</b>	..... Performance meets MIL-S-8660B specifications.
<b>KS63G</b>	..... Complies with JRS standards.
<b>KS609</b>	..... Thermal conductivity (0.73 W/m·°C). General purpose.
<b>KS613</b>	..... Thermal conductivity (0.76 W/m·°C).
<b>G747、X-23-7795</b>	..... Thermal conductivity 1–2 W/m·°C.
<b>G765、G750</b>	..... High heat dissipation 2.9–3.5 W/m·°C.
<b>G751</b>	..... High heat dissipation 4.5 W/m·°C. Not high insulation.
<b>X-23-7762、X-23-7783D</b>	..... High heat dissipation 6.0 W/m·°C. (after evaporation of solvent). Fine filler is used in X-23-7783D. Not high insulation.
<b>KS660</b>	..... Volume resistivity. (0.49Ω·m)
<b>KS660B</b>	..... High lubricity version of KS660.
<b>HIVAC-G</b>	..... Good thermo-oxidative stability and chemical stability. Can be used for high vacuums of 10 <sup>-6</sup> Torr.
<b>KS622</b>	..... Good rustproofing effect on copper.
<b>KS65A</b>	..... Suitable for sealing and lubrication of valves, stopcocks, and packing of common chemical equipment.
<b>KS623</b>	
<b>KS650N</b>	..... Does not cause swelling of silicone rubber. Good electrical insulation.
<b>KS651</b>	..... Does not cause swelling of silicone rubber. Good electrical properties and temperature characteristics.
<b>Optseal</b>	..... Good light transmissivity. Refractive index ( $n_D^{25}$ ) 1.4690.

# Characteristics of Silicone Greases

Silicone grease products are made with a silicone fluid base oil blended with materials such as fillers, oiliness improvers and antioxidants. They have greater thermo-oxidative stability and moisture resistance than common mineral oil-based greases, and can be used in a wider range of temperatures. Furthermore, silicone greases are chemically inert, so they can be used on most any equipment.

## For lubrication in low temperature applications

### ■ G30L G30M G30H

The G30 series provide superior lubrication particularly at low temperatures.  
Consistency (grease hardness): L is softest, followed by M and H.

#### ■ General properties of the G30 Series

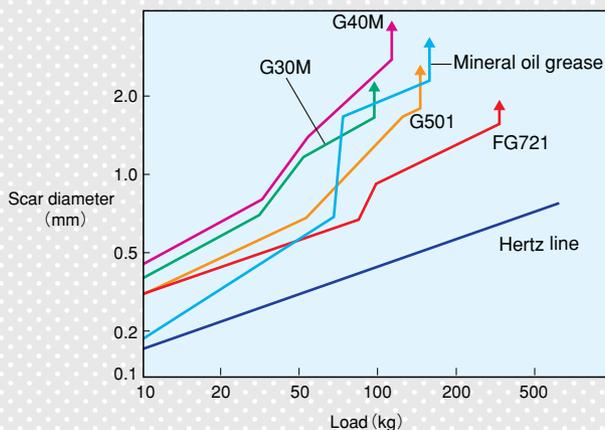
Item		G30L	G30M	G30H
Appearance		Grayish white grease		
Specific gravity 25°C		0.99	1.00	0.99
JIS K2220	Penetration 25°C/JIS worked	280–320	240–280	200–240
	Drop point (°C)	Over 200	Over 200	Over 200
	Oil separation (%) 150°C/100h	5.7	2.3	0.5
	Oxidative stability (MPa) 150°C/50h*1	0.03	0.03	0.03
	Moisture resistance (%)	1	1	1
	Work stability 100,000 times	400 (max.)	400 (max.)	400 (max.)
	Low-temperature torque value (N·m×10 <sup>4</sup> ) (starting/running) -60°C	1090/320	2710/950	3350/1240
MIL-L15719A	Low-temperature torque value 2,000 N·m×10 <sup>4</sup> /-60°C	Less than 1 sec	1 sec	1 sec
BTB	Free acid or free alkali	Neutral		
Usage temperature range (°C)		-60 to +180		
Volatile content (%) 150°C/100h		0.35	0.41	0.35
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> -D <sub>10</sub>		Less than 100		

\*1 Thermo-oxidative stability test conditions outlined in JIS K2220 are 98.9°C/100 hours, but here was measured at 150°C/50 hours. G30 can be used at speed factors (bearing diameter mm\_RPM) up to 200,000.

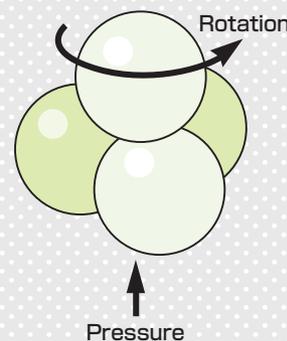
(Not specified values)

## Testing Data Boundary lubrication

### ● Correlation between scarring and overload as determined in four-ball tests



### ● Four-ball test



Test conditions  
Revolution speed : 1,500 RPM  
Test time : 1 min  
Temperature : room temp.  
Test balls : 0.5 inch diameter balls  
Bearing steel

#### \* Hertz line

The Hertz line is the diameter of the steel ball deformation under load, without applying rotation, tested in the manner shown above.

## For lubrication in high temperature applications

### ■ G40L G40M G40H G420

The G40 series are ideal for lubrication of sealed bearings particularly in high temperature applications. These greases meet US military MIL-L15719A specifications. They are available in three consistencies: L, M, H. G420 provides superior lubrication in the very high temperature range.

#### ■ General properties of G40L G40M G40H G420

Item		G40L	G40M	G40H	G420
Appearance		Beige grease		Dark brown grease	White grease
Specific gravity 25°C		1.06	1.05	1.06	1.10
JIS K2220	Penetration 25°C/JIS worked	280–320	240–280	200–240	281
	Drop point (°C)	Over 200	Over 200	Over 200	Over 250
	Oil separation (%) 150°C/100h	8.9	5.9	3.0	5.7*1
	Oxidative stability (MPa) 150°C/50h*1	0.01	0.01	0.01	—
	Moisture resistance (%)	1	1	1	1
	Work stability 100,000 times	400 (max.)	360 (max.)	320 (max.)	310 (max.)
	Low-temperature torque value (N·m×10 <sup>-4</sup> ) (starting/running) -60°C	670/300	850/470	1190/580	420/250
MIL-L15719A	Low-temperature torque value 2,000 N·m×10 <sup>-4</sup> /-60°C	Less than 5 sec	Less than 5 sec	Less than 5 sec	Less than 5 sec
BTB	Free acid or free alkali	Neutral			
Usage temperature range (°C)		-30 to +200			-30 to +250
Volatile content (%) 150°C/100h		0.4	0.3	0.3	0.3*1
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> -D <sub>10</sub>		Less than 100			

\*1 200°C/24h

(Not specified values)

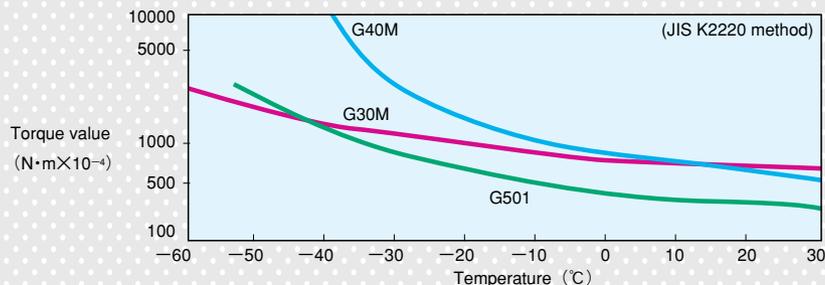
\*2 Thermo-oxidative stability test conditions outlined in JIS K2220 are 98.9°C/100 hours, but here was measured at 150°C/50 hours.  
G40 can be used at speed factors (bearing diameter mm\_RPM) up to 200,000.

### Testing Data Torque values (sliding resistance)

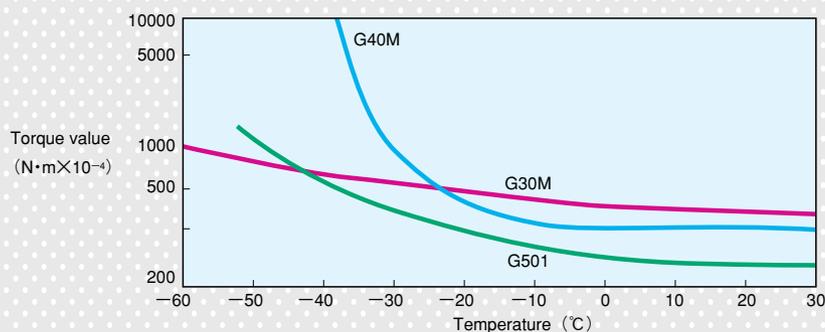
Measured according to JIS K2220. Bearing 6204, 1 RPM.

After maintaining the specified temperature for 2 hours, starting torque is measured, and the value after continuous rotation for 10 minutes is defined as running torque.

#### ● Starting torque



#### ● Running torque



# Solvent-resistant lubrication

## Fluorosilicone Grease

### ■ FG720 FG721 FG722

The FG720 series are fluorosilicone greases made by blending fluororesin powder into a base oil of fluorosilicone fluid.

These greases have the characteristics of both silicone and fluorine compounds, so they offer outstanding resistance to heat, solvents and other chemicals. They provide excellent lubrication in high speed, high load conditions.

#### ■ General properties of the FG720 Series

Item		FG720	FG721	FG722	
Appearance		White grease			
Specific gravity	25°C	1.40	1.44	1.43	
JIS K2220	Penetration	25°C/JIS worked	303	303	281
	Drop point (°C)		231	246	295
	Oil separation (%)	200°C/24h	3.9	2.6	0.2
	Oxidative stability (MPa)	150°C/100h	0.01	0.01	0.01
	Work stability	100,000 times	346	319	322
	Low-temperature torque value (N·m×10 <sup>4</sup> )	-30°C (starting/running)	640/450	2,180/1,290	2,030/1,890
	Copper plate corrosion	Room temp./24h	Passed		
Usage temperature range (°C)		-30 to +200			
Volatile content (%)	200°C/24h	0.3	0.5	0.4	
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> -D <sub>10</sub>	Less than 100			

(Not specified values)

#### ■ FG720·FG721·FG722 / Solvent resistance (normal temp.)

Solvent name	Solvent resistance
Methyl alcohol	○
Ethyl alcohol	○
Isopropyl alcohol	○
Ethylene glycol	○
Acetone	×
Methyl ethyl ketone	×
Methyl isobutyl ketone	×
Tetrahydrofran	×
Benzene	○
Toluene	○
Xylene	○
Styrene	○
n-hexane	○
Kerosene	○
Perchloroethylene	○
Dichloromethane	×
Butane	○
Ethyl ether	×
Dimethyl silicone fluid KF96 (20mm <sup>2</sup> /s)*	○
Water	○

\*Made by Shin-Etsu

○ : Insoluble    × : Soluble

## Non-mineral oil lubrication for rubbers

### ■G411

G411 is a non-mineral oil grease for rubber automotive parts. It has excellent resistance to heat and cold. G411 has no adverse effects on synthetic rubber cups. It provides consistent lubrication and meets JIS K 2228 specifications.

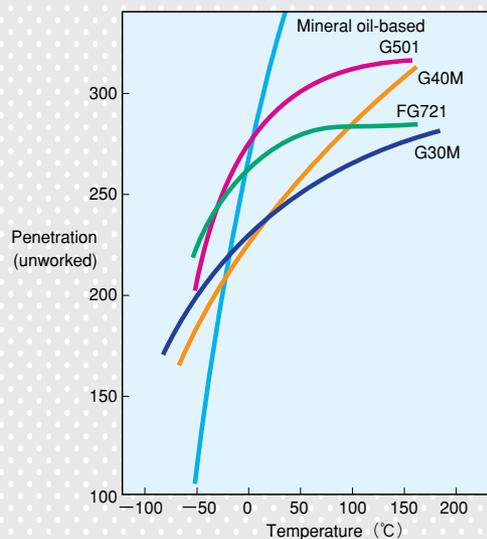
#### ■General properties of G411

Item		G411			
Appearance		Brown			
Specific gravity		25°C	1.1		
JIS K2220	Penetration	25°C/JIS worked	303		
	Drop point (°C)		229		
	Oil separation (%)	150°C/100h	5.1		
	Oxidative stability (MPa)	100°C/100h	0.007		
	Evaporation (%)	100°C/22h	0.18		
	Impurities	#/cm <sup>3</sup>	10µm and larger	2930	
25µm and larger			220		
75µm and larger			0		
125µm and larger			0		
Wet		50°C/500h	Class A		
JIS K2228	Rubber swelling 70±2°C/120±2h	Base diameter mm	SBR	+0.06	
			NR	+0.28	
		Hardness change Hs	SBR	-2	
			NR	-4	
	Appearance		No change		
	Rubber swelling 120±2°C/70±2h	Base diameter mm	SBR	+0.07	
			NR	+0.42	
		Hardness change Hs	SBR	-3	
			NR	-11	
	Appearance		No change		
	Metal corrosion 100±2°C/120±2h	Condition of metal sample	Mass change mg/cm <sup>2</sup>	Tinplate	+0.004
				Copper	+0.007
Aluminum				+0.010	
Cast iron				+0.058	
Brass				+0.008	
Steel				+0.012	
Zinc	+0.015				
Usage temperature range (°C)		-30 to +200			
Volatile content (%)		150°C/100h	1.4		
Low-molecular-weight silicone content (ppm)		ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100		

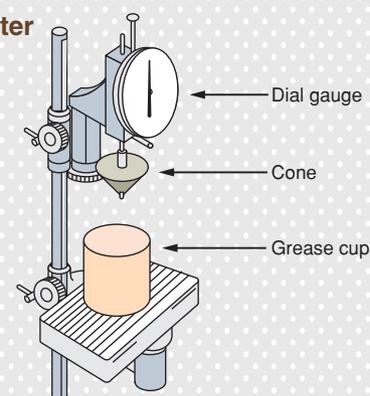
(Not specified values)

#### Testing Data Consistency (hardness)

##### ●Consistency change due to temperature change



##### ●Penetrometer



##### \* Penetration test

Using a penetrometer as outlined in JIS K 2220 (method for testing the consistency of grease), a sample was placed in the specified grease cup and the surface leveled. After maintaining a temperature of 25±0.5°C, the cone is allowed to drop vertically into the grease for 5 seconds. The consistency of the sample is expressed as the depth of penetration measured in 0.1 mm increments and multiplied by 10. Worked penetration is the consistency measured after 60 strokes over 1 minute in a regulation grease worker.

## For plastic lubrication

### ■ G501

G501 uses a special silicone fluid as the base oil. It is specially formulated for lubrication and noise reduction for blower bearings and plastic parts.

With G501, there is low incidence of stress cracks in polycarbonate (PC), polyacetal (POM), ABS and other plastics. It also provides good lubrication for steel-on-steel.

#### ■ General properties of G501

Item		G501
Appearance		White-pale yellow grease
Specific gravity 25°C		0.92
JIS K2220	Penetration 25°C/JIS worked	306
	Oil separation (%) 150°C/24h	2.5
	Low-temperature torque value (N·m×10 <sup>-4</sup> ) (starting/running) -50°C	2,150/1,050
Usage temperature range (°C)		-50 to +150
Volatile content (%) 150°C/24h		0.1
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>		Less than 100

(Not specified values)

## Lubrication for sliding parts

### ■ G6500

G6500 provides good lubricating performance and there is low incidence of stress cracks in plastic.

Applying G6500 to sliding parts such as slide volume controls improves the feel and operation life.

G6500 is recommended for use in locations with relatively low revolution speeds.

#### ■ General properties of G6500

Item		G6500
Appearance		Beige grease
Specific gravity 25°C		0.93
JIS K2220	Penetration 25°C/JIS worked	414
	Oil separation (%) 105°C/24h	5.0
Usage temperature range (°C)		-40 to +120
Volatile content (%) 105°C/24h		0.2
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>		Less than 100

(Not specified values)

## Testing Data Effect on plastics

○ : No effect    △ : Slight effect    × : Significant effect

	ABS	POM	PBT	PVC	PS	PP	PC	HIPS	PMMA	AS	ASGF	6 nylon	66 nylon	Noryl	Dura nex
G330	○	○	○	○	○	○	○	○		○	○	○	○	○	○
G332	○	○	○	○	○	○	○	○		○	○	○	○	○	○
G334	○	○	○	○	○	○	○	○		○	○	○	○	○	○
G340	○	○	○	○	○	○	○	○		○	○	○	○		○
G342	○	○	○	○	○	○	○	○		○	○	○	○		○
G631	○	○	○			○	△								
G632	×	○	○			○	×								
G30M	△~○	○	○	○		○									○
G40M	△~○	○	○	○	○	○	△	×	×	○	○	○	○	×	○
G501	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
FG720	○	○	○	○	○	○	△~○	○	○	○	○	○	○	○	○
KS63W	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
KS64	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
KS65A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
KS660	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
KS62M	×	○	○	○	○	○	△	△	×	○	○	○	○	×	○
HIVAC-G	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
KF96H-20 mm <sup>2</sup> /s	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ● Stress cracking in plastics caused by silicone greases

When plastics are under stress and in contact with certain chemicals for long periods, cracks can occur at much lower load levels than when the plastic is not exposed to the chemicals. This phenomenon is commonly called stress cracking, and it is characterized by glass-like cracking, usually with no whitening. Stress cracking of plastics is affected by factors including stress, temperature, time and chemicals; but of these, chemicals are most critical. Silicone greases have been known to cause stress cracking in plastics.

There is great variation in the occurrence of stress cracking depending on the type of silicone grease and plastic. Even with the same plastic, in injection-molded items the effects can differ according to molding strain, orientation and other conditions. Thus, before using silicone greases on plastics it is important to fully determine the extent of the greases effect on the plastic.

Shin-Etsu tests its silicone greases in the manner outlined below. Even so, you should perform your own tests to see whether there will be any adverse effects in the actual usage conditions of your intended application.

#### 【Test Method】

1. A 140 mm plastic test strip (Width: 25 mm ; Thickness : 3 mm) is clamped in a jig set to a length of 130 mm.
2. Grease is applied evenly to the convex surface.
3. The strip is processed in this position at 80°C for 16 hours.
4. After processing, the grease is wiped off and a visual inspection is made for cracking.

The Results are compared to those for a strip to which no grease has been applied.

## For adhesive applications (torque, damper applications)

### ■ G330 G331 G332 G333 G334

### ■ G340 G341 G342

### ■ G351 G352 G353

The greases in the G330, G340 and G350 series provide high adhesion and exhibit little change in torque values resulting from temperature changes. In a range of equipment, these greases are applied to sliding and rotating parts, where their high adhesive strength provides a superior damping effect.

The G330 series are low adhesion greases (torque 5–35), whereas the G350 series are high adhesion (torque 40–50). The G340 series is specially formulated for consistent torque forces in the low temperature range.

#### ■ General properties of the G330 Series

Item	G330	G331	G332	G333	G334
Appearance	White grease		Blue grease	White grease	Blue grease
Specific gravity 25°C	1.15	1.15	1.12	1.11	1.08
Penetration 25°C/JIS unworked	285	305	307	304	250
Oil separation (%) 105°C/24h	0.01	0.01	0.12	0.38	0.36
Torque value (N·m×10 <sup>-4</sup> ) after 50 revolutions	23	34	9	7	5
Usage temperature range (°C)	-30°C to +150°C				
Volatile content (%) 105°C/24h	0.05	0.05	0.06	0.06	0.06
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100				

#### ■ General properties of the G340 Series

Item	G340	G341	G342
Appearance	Pale yellow grease		
Specific gravity 25°C	1.01	1.02	1.04
Penetration 25°C/JIS unworked	158	182	168
Oil separation (%) 105°C/24h	0.03	0.06	0.02
Torque value (N·m×10 <sup>-4</sup> ) after 50 revolutions	11	9	16
Usage temperature range (°C)	-40°C to +100°C		
Volatile content (%) 105°C/24h	0.06	0.08	0.07
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100		

#### ■ General properties of the G350 Series

Item	G351	G352	G353
Appearance	White grease		
Specific gravity 25°C	1.15	1.14	1.14
Penetration 25°C/JIS unworked	264	242	254
Oil separation (%) 105°C/24h	0.01	0.01	0.01
Torque value (N·m×10 <sup>-4</sup> ) after 50 revolutions	46	42	47
Usage temperature range (°C)	-30°C to +150°C		
Volatile content (%) 105°C/24h	0.25	0.16	0.11
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100		

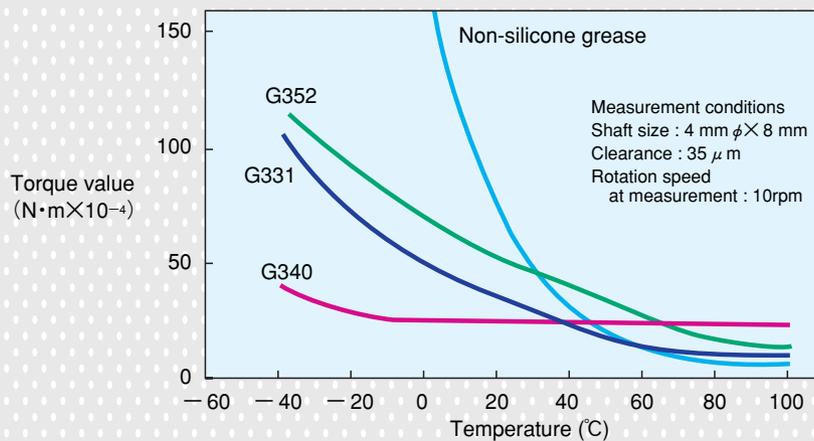
\*Torque meter: Torque Tester MDT2-AMP made by Shinmei Electric Co., Ltd.

(Not specified values)

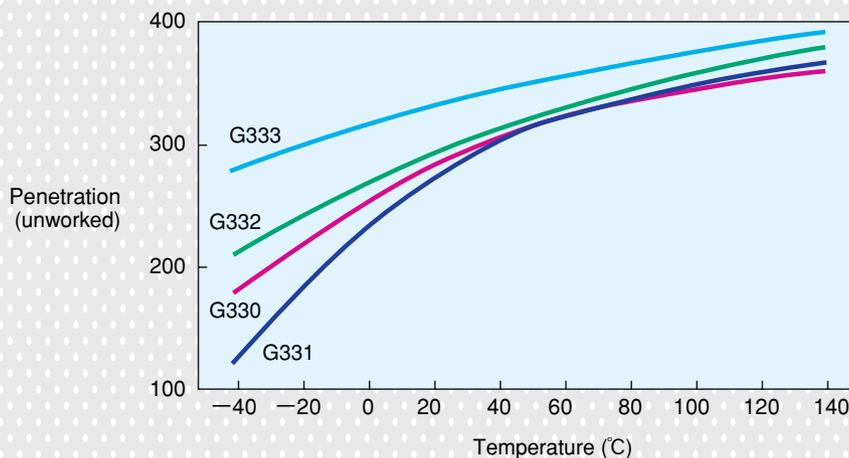
The sample is applied evenly to the shaft (4 mmφ×8 mm) and bearing clearance (35μm) section. The shaft is then manually rotated 360° one time, a process performed 50 times at a rate of 1 revolution per second. It is then set in the torque meter and the reference value is defined as the torque value after rotation at 10 RPM for 1 minute.

## Testing Data Torque value (sliding resistance)

### ● Correlation between temperature and torque value



### ● Temperature change and consistency of the G330 series



## ■ G631 G632 G633

The G630 series were developed for the bearings of variable resistors and can also be used for damping. They provide exceptional feel with consistent, high torque force.

### ■ General properties of G631 G632 G633

Item	G631	G632	G633	
Appearance	Creamy white translucent grease	Colorless-pale yellow transparent grease	Pale yellow-cream white translucent grease	
Specific gravity	25°C	0.89	0.98	0.87
Penetration	25°C/JIS unworked	213	228	235
Oil separation (%)	105°C/24h	0.78	0.02	0.04
Torque value (N·m×10 <sup>-4</sup> ) after 50 revolutions		13	30	64
Usage temperature range (°C)	0 to +80°C			
Volatile content (%)	105°C/24h	0.07	0.06	0.07
Low-molecular-weight silicone content (ppm) $\Sigma D_3 \sim D_{10}$	Less than 100			

(Not specified values)

# Characteristics of Silicone Fluid Compounds

Silicone fluid compounds are made by blending fine silica or metal powders into a base oil of silicone fluid. They have fine electrical properties and water repellency over a wide temperature range and are exceptionally stable against heat and oxidation. These products are thus used extensively for electrical insulation and sealing, and as thermal interface materials and water repellents.

## Thermal Interface Materials for Heat Dissipation

### ■KS609 KS613 G747 X-23-7795

All feature a base oil of silicone fluid blended with highly thermally-conductive fillers. These products have high thermal conductivity and fine electrical properties. They are ideal for heat dissipation and insulation of semiconductor devices including transistors and thermistors, and for various types of heatsinks.

KS609 is for general purpose use. KS613 is heat resistant, making it ideal for potting of thermistors.

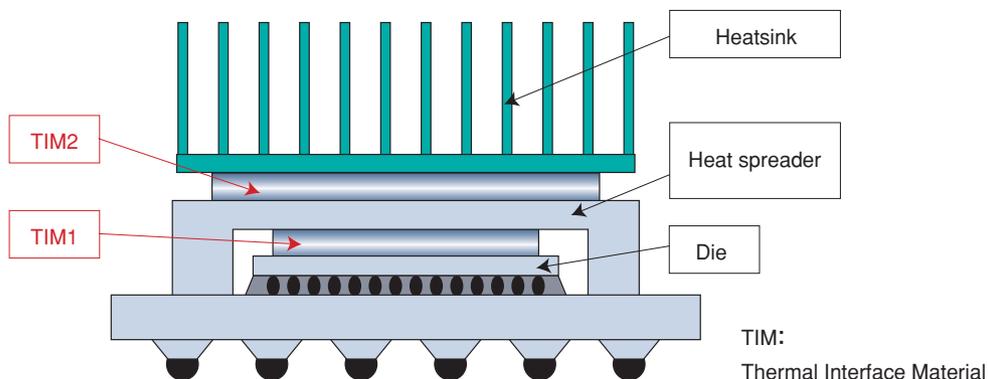
G747 is formulated for use with resin-encapsulated power transistors. X-23-7795 has a thermal conductivity of 2W/m·°C.

### ■General properties of KS609 KS612 KS613 G747 X-23-7795

Item	KS609	KS613	G747	X-23-7795
Appearance	White grease			
Specific gravity 25°C	2.50	2.36	2.65	2.88
Penetration 25°C/JIS worked	328	346	328	300* <sup>1</sup>
Oil separation (%) 200°C/24h	0.3	2.3	0.01* <sup>2</sup>	0.1* <sup>3</sup>
Thermal conductivity (W/m·°C) * <sup>4</sup>	0.73	0.76	0.90	2.2
Volume resistivity (TΩ·m)	2.3	0.5	2.5	27
Dielectric breakdown voltage (kV) 0.25mm	3.5	9.9	3.7	4.1
Usage temperature range (°C)	-55 to +200	-50 to +250	-50 to +150	-50 to +150
Volatile content (%) 200°C/24h	0.3	0.3	0.06* <sup>2</sup>	0.05* <sup>3</sup>
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100			

\*1 25°C/JIS unworked \*2 Measured after 24h @ 120°C \*3 Measured after 24h @ 150°C \*4 Measured by the hot-wire method (Not specified values)

### ●Cooling configuration of a typical CPU



## For High-heat Dissipation

### ■ G765 • G750 • G751 • X-23-7762 • X-23-7783D

These silicone fluid compounds contain highly thermally-conductive fillers. With their high thermal conductivity, these products are ideal for use as the primary thermal interface material (TIM 1) for CPUs and MPUs. G765 and G750 do have high insulation resistance, but the other compounds were formulated emphasizing thermal conductivity at the expense of their insulative properties to some extent. X-23-7762 and X-23-7783D were formulated emphasizing high thermal conductivity and workability, and contain about 2% isoparaffin solvent.

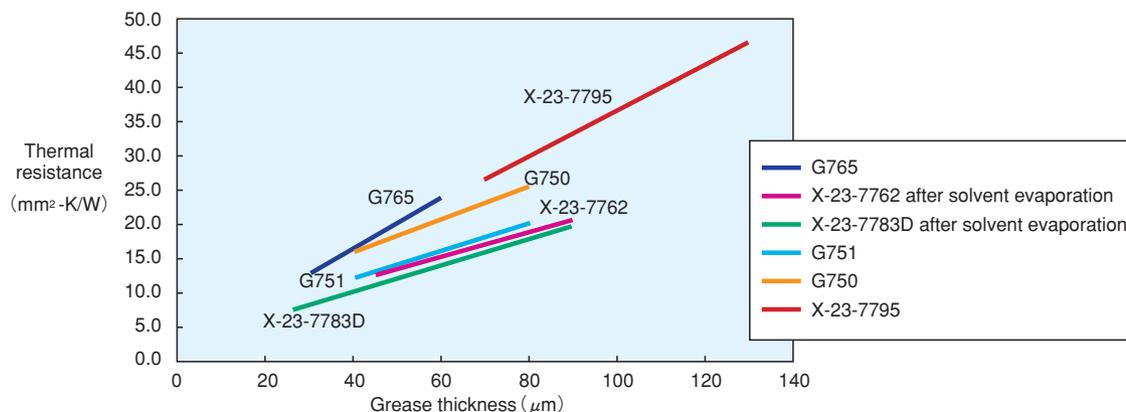
#### ■ General properties of G765 G750 G751 X-23-7762 X-23-7783D

Item		G765	G750	G751	X-23-7762	X-23-7783D
Appearance		Gray grease				
Specific gravity	25°C	2.77	2.77	2.51	2.55	2.55
Viscosity (Pa·s)	25°C	250	300	420	180	200
Oil separation (%)	150°C/24h	0.01	0.01	0.01	—	—
Thermal conductivity (W/m·°C)		2.9	3.5	4.5	4.0 (6.0*)	3.5 (5.5*)
Volume resistivity (TΩ·m)		0.1	0.1	0.008	—	
Dielectric breakdown voltage (kV)	0.25mm	4.5	4.5	Below measurable limit		
Usage temperature range (°C)		-50 to +120				
Volatile content (%)	150°C/24h	0.06	0.28	0.10	2.58	2.43
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100				

\*Value after evaporation of solvent

(Not specified values)

#### ● Correlation between grease thickness and thermal resistance



#### ● Guide to solvent evaporation conditions

<Test conditions>

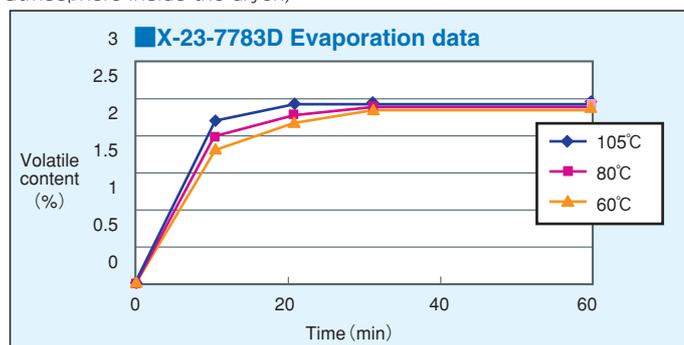
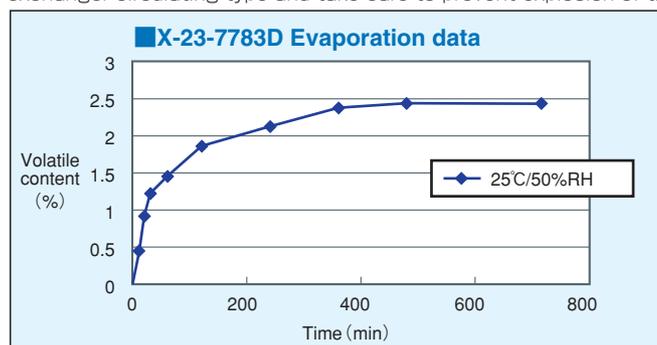
·Using a metal screen, X-23-7783D was applied in a 25 mm×25 mm square (thickness: 120μm) to an aluminum plate.

·The sample was left at various temperatures and the change in weight was measured.

<Test results>

The results below show that even at room temperature, the solvent completely evaporates after 8 hours. But if faster evaporation is desired, the drying time can be shortened with the use of drying equipment.

(Complete evaporation is possible in roughly 30 minutes at 60~80°C, or roughly 20 minutes at 105°C. For a dryer, use a warm air exchanger circulating type and take care to prevent explosion of the atmosphere inside the dryer.)



## For Electrical Insulation and Sealing

### ■KS62F KS62M KS63W KS64F KS64

These silicone fluid compounds all have fine electrical properties and water repellency, and are chemically inert. They are ideal for use as electrical insulation and sealing in electric and electronic applications and offer long-lasting protection for your valuable equipment.

KS62F and KS62M have superior heat resistance. KS63W, KS64F and KS64 are for general purpose applications. KS64 meets US military MIL-S-8660B specifications.

#### Applications

- Electrical insulation and moisture-proofing of spark plugs, cable connections, and terminal boards.
- Rustproofing and sealing of telecommunications equipment, instruments, TV tuners, etc.
- Protection against freezing for outdoor wattmeters and equipment terminals in cold climate areas.
- Improving the conformability of plastics with metals and glass, etc.
- Sealing rubber gaskets and O-rings.

#### ■General properties of KS62F KS62M KS63W KS64F KS64

Item	KS62F	KS62M	KS63W	KS64F	KS64	
Appearance	Tinted white paste	White translucent grease	White grease	White paste	White grease	
Specific gravity	25°C	1.13	1.18	1.02	1.01	1.05
Penetration	25°C/JIS worked	—	229	225	385	246
Oil separation (%)	200°C/24h	—	1.3	2.9* <sup>1</sup>	18* <sup>1</sup>	5.8
Dielectric breakdown voltage (kV)	0.1mm	3.4	3.5	3.8	3.6	4.0
Volume resistivity (TΩ·m)		0.15	56	130	230	620
Dielectric constant	60Hz	2.96	2.88	2.84	2.80	2.80
Dielectric dissipation factor	60Hz	2.5×10 <sup>-4</sup>	3.2×10 <sup>-4</sup>	2.4×10 <sup>-4</sup>	1×10 <sup>-4</sup>	2.3×10 <sup>-4</sup>
Thermal conductivity (W/m·°C) * <sup>2</sup>		0.17	0.20	0.19	0.17	0.19
Usage temperature range (°C)		-30 to +250		-50 to +200		
Volatile content (%)	200°C/24h	Less than 1.0	0.3	0.1* <sup>1</sup>	0.1* <sup>1</sup>	0.1
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100				

\*<sup>1</sup> Measured after 24h @ 150°C \*<sup>2</sup> Measured by the hot-wire method

(Not specified values)

## For Use with Silicone Rubbers

### ■KS650N KS651

Silicone fluid compounds KS650N and KS651 do not cause swelling of silicone rubbers.

They are used mainly for electrical insulation and for sealing.

#### ■General properties of KS650N KS651

Item	KS650N	KS651	
Appearance	Creamy white translucent grease	Pale yellow-yellow grease	
Specific gravity	25°C	0.98	1.02
Penetration	25°C/JIS worked	263	258
Oil separation (%)		0.7 (105°C/24h)	2.0 (150°C/24h)
Water absorption (%)	60°C/72h	Less than 1.0	Less than 1.0
Water resistance (%)	80°C	Less than 3.0	Less than 3.0
Silicone rubber swelling (%) (weight change/volume change)	105°C/500h	+0.5/+1.1	+0.6/+1.3
Volume resistivity (TΩ·m)		208	1.3
Dielectric constant	60Hz	2.48	2.6
Dielectric dissipation factor	60Hz	3.3×10 <sup>-4</sup>	4.7×10 <sup>-4</sup>
Usage temperature range (°C)		-10 to +100	-50 to +170
Volatile content (%)		0.5 (105°C/24h)	0.1 (150°C/24h)
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub>	Less than 100	

(Not specified values)

## Testing Data Swelling of synthetic rubbers in contact with various silicone fluids

### ● Testing of synthetic rubber swelling caused by various base oils

(70°C, 120°/240h)

Rubber	Item tested	KS64 (base oil)		650N (base oil)		G40 (base oil)		G30 (base oil)		FG720 (base oil)	
		70°C	120°C	70°C	120°C	70°C	120°C	70°C	120°C	70°C	120°C
IIR	Weight change (%)	-1.8	-3.7	-1.5	-2.1	-1.8	-2.8	-2.0	-3.6	-0.2	-0.9
	Volume change (%)	-3.1	-6.3	-2.4	-3.5	-3.0	-4.9	-3.3	-6.2	-0.4	-1.6
CR	Weight change (%)	-11.8	-12.1	-13.1	-14.1	-11.0	-11.6	-12.1	-12.4	-10.3	-11.1
	Volume change (%)	-18.5	-19.7	-20.1	-22.1	-17.4	-18.9	-19.0	-1.4	-16.1	-18.1
NR	Weight change (%)	-3.0	-4.2	-2.3	-5.0	-0.6	-3.0	-3.0	-4.6	-1.4	-2.0
	Volume change (%)	-5.1	-9.4	-3.5	-9.4	-1.4	-7.3	-5.1	-10.1	-2.2	-5.3
NBR	Weight change (%)	-5.4	-9.6	-6.3	-10.8	-6.1	-10.0	-5.8	-9.8	-4.9	-8.6
	Volume change (%)	-6.5	-12.9	-7.7	-13.9	-7.3	-13.0	-7.1	-13.2	-6.1	-11.6
EPDM	Weight change (%)	-17.6	-17.9	-14.7	-15.8	-17.7	-17.9	-18.1	-18.4	-11.3	-14.3
	Volume change (%)	-19.5	-20.5	-15.8	-17.4	-19.5	-20.4	-20.2	-21.1	-12.1	-16.3
KE-951U	Weight change (%)	+32.0	+31.2	-0.2	-0.4	+7.2	+7.7	+33.2	+33.4	-0.6	-1.5
	Volume change (%)	+38.9	+38.5	+0.3	+0.2	+8.3	+9.4	+39.2	+39.8	-0.5	-1.2

Note: The values in the table above are the result of severe tests in which rubber strips were immersed in the base oils, and are not the result of contact with the actual greases. The data presented is intended as a guideline of compatibility; performing identical tests with the actual greases will tend to yield values lower than those shown here.

## For High Vacuum Seals

### ■ HIVAC-G

HIVAC-G features a base oil of refined silicone fluid blended with fine silica powder. It has excellent chemical stability and resistance to heat and oxidation. Volatile content has been reduced to the lowest level possible through advanced refinement methods, making it possible to attain high vacuums of  $10^{-6}$ Torr.

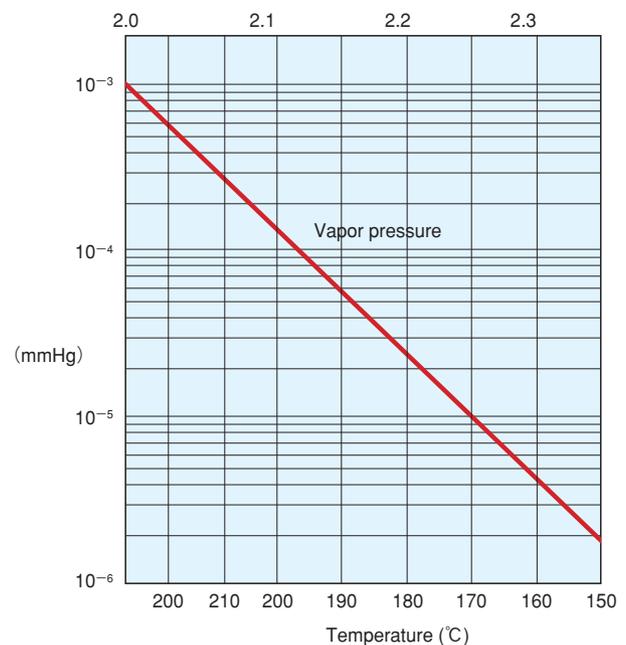
This results in a very good conformability of rubbing parts and gaskets, so this silicone fluid compound is thus used extensively in high vacuum devices.

#### ■ General properties of HIVAC-G

Item		HIVAC-G
Appearance		White grease
Specific gravity 25°C		1.03
JIS K2220	Penetration 25°C/JIS unworked	191
	Penetration 25°C/JIS worked	209
	Oil separation (%) 200°C/24h	0.1
	Dielectric breakdown voltage (kV) 0.1 mm	4
	Volume resistivity (TΩ·m)	900
	Dielectric constant 60Hz	2.82
	Dielectric dissipation factor 60Hz	$2.2 \times 10^{-4}$
	Copper plate corrosion Room temp./24h	Passed
Usage temperature range (°C)		-50 to +200
Volatile content (%) 200°C/24h		0.1
Low-molecular-weight silicone content (ppm) $\Sigma D_3 \sim D_{10}$		Less than 100

(Not specified values)

#### ■ HIVAC-G / Vapor pressure curve



## For Valve Seals

### ■KS65A KS623

Both are ideal for lubrication and sealing of the valves, stopcocks and packing of common chemical equipment.

#### ■General properties of KS65A KS623

Item		KS65A	KS623
Appearance		White grease	
Specific gravity	25°C	1.04	1.03
JIS K2220	Penetration 25°C/JIS worked	221	211
	Oil separation (%) 200°C/24h	1.1	1.9
	Dielectric breakdown voltage (kV) 0.1mm	3.7	Over 1.5
	Volume resistivity (TΩ·m)	2,600	Over 1
	Copper plate corrosion Room temp./24h	Passed	
Usage temperature range (°C)		-50 to +200	
Volatile content (%)	200°C/24h	0.1	0.2
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>		Less than 100	

(Not specified values)

## For Electrical Conduction

### ■KS660 KS660B

KS660 contains carbon in a base oil of highly safe silicone fluid. It is electrically conductive and its properties include high thermo-oxidative stability and chemical resistance.

These silicone fluid compounds are ideal for antistatic sealing of electric and electronic equipment.

#### ■General properties of KS660 KS660B

Item		KS660	KS660B
Appearance		Black grease	
Specific gravity	25°C	1.04	1.00
JIS K2220	Penetration 25°C/JIS unworked	245	291
	Penetration 25°C/JIS worked	247	301
	Drop point (°C)	Over 200	Over 200
	Oil separation (%)	8.0 (200°C/24h)	3.88 (150°C/24h)
	Volume resistivity (Ω·m)	0.83	11
	Thermal conductivity (W/m·°C)	0.38	0.38
	Copper plate corrosion Room temp./24h	Passed	
	Aluminum plate corrosion Room temp./24h	Passed	
Usage temperature range (°C)		-50 to +200	-50 to +200
Volatile content (%)		0.2 (200°C/24h)	0.1 (150°C/24h)
Low-molecular-weight silicone content (ppm) ΣD <sub>3</sub> ~D <sub>10</sub>		Less than 100	

(Not specified values)

## For protecting insulators from salt-air damage

### ■KS63G

KS63G has fine electrical properties and good water repellency. This silicone fluid compound meets JRS specifications.

Applied to insulators, KS63G can prevent flashover accidents caused by damage from salt-air.

#### ■General properties of KS63G

Item	KS63G
Appearance	Green grease
Specific gravity	25°C 1.06
Penetration	25°C/JIS worked 209
Oil separation (%)	150°C/24h 0.8
Dielectric breakdown voltage (kV)	0.25mm 11
Volume resistivity (TΩ·m)	2,300
Dielectric constant	60Hz 2.82
Usage temperature range (°C)	-50 to +200
Volatile content (%)	150°C/24h 0.1
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub> Less than 100

(Not specified values)

## For Rustproof Seals

### ■KS622

KS622 is particularly effective at preventing rust on copper, making it ideal for protecting the terminals of copper wire.

#### ■General properties of KS622

Item	KS622
Appearance	Creamy white grease
Specific gravity	25°C 1.03
Penetration	25°C/JIS worked 268
Oil separation (%)	150°C/24h 2.74
JIS salt spray test	copper plate 35°C/100h No rusting
Usage temperature range (°C)	-50 to +160
Volatile content (%)	150°C/24h 0.44
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub> Less than 100

(Not specified values)

## For Optical Applications

### ■Optseal

Optseal is a grease with high transparency close to that of quartz glass. A 10 mm layer of Optseal has visible light (400-700 nm) transmissivity of over 90%. It is thus ideal for filling the junctions of optical equipment including optoelectronics and optical fiber.

#### ■General properties of Optseal

Item	Optseal
Appearance	High transparency grease
Specific gravity	25°C 1.1
Penetration	25°C/JIS worked 300
Oil separation (%)	200°C/24h 0
Refractive index (n <sub>D</sub> <sup>25</sup> )	1.4690
Usage temperature range (°C)	-40 to +200
Volatile content (%)	200°C/24h 1.1
Low-molecular-weight silicone content (ppm)	ΣD <sub>3</sub> ~D <sub>10</sub> Less than 100

(Not specified values)

#### Applications

- Adhesion of lenses and other optical equipment
- Filling junctions of optoelectronics, optical fiber, etc.
- Filling of cathode ray tubes of projection TVs

# Packaging

Type	Packaging	Tube	Wide-mouth bottle	Syringe	Round can					
	Product name	100g	200g		1kg	2kg	4kg	16kg	18kg	20kg
Grease	G30 (L, M, H)	●			●				●	
	G40 (L, M, H)	●			●					●
	G420				●					●
	FG720 series				●					
	G411				●					
	G501	● (80g)			●			●		
	G6500				●					
	G330 series				●					
	G340 series				●					
	G350 series				●					
	G630 series				●					
	KS609	● (200g)			●	●				
	KS613				●					●
	G747	● (200g)			●					●
	X-23-7795				● (90g)	●				
	G765				● (90g)	●				
	G750				● (150g)	●	●			●
	G751					●				
	X-23-7762					●				
X-23-7783D				●						
Silicone fluid compound	KS62F				●					●
	KS62M				●					●
	KS63W				●					●
	KS64F	●			●					●
	KS64	●			●					●
	KS650N	●			●					
	KS651	●			●			●		
	HIVAC-G	● (50g, 100g)			●					
	KS65A				●					●
	KS623				●					●
	KS660				●					
	KS660B				●					
	KS63G				● (70g)	●		●		●
	Optseal								● (5kg)	
	KS622				●					

Note: These products may be classified as hazardous materials under federal or state fire prevention laws, and must be stored and handled accordingly.

# Safety Data

## Results of toxicity testing of silicone greases and fluid compounds

Item Product name	Skin irritation (human) *1	LD <sub>50</sub> :oral administration (rat) (unit: g/kg)
<b>HIVAC-G</b>	Negative	Greater than 5
<b>KS64</b>	Quasi-negative	Greater than 5
<b>G30M</b>	Quasi-negative	Greater than 5
<b>G40M</b>	Quasi-negative	Greater than 5

As the table at left shows, typical silicone greases and fluid compounds are highly safe (for oral toxicity standards, see table below). For information on special grade products not shown here, please contact Shin-Etsu for details.

\*1 Measured by the Japanese Society for Cutaneous Health.

### Table of oral toxicity standards

#### ●Acute toxicity test

Generally speaking, this test is performed on lab animals to determine the lethal dose of a given substance. It is normally expressed as LD<sub>50</sub> (50% Lethal Dose). The following table shows the degree of toxicity.

#### ●Classification of strength of toxicity

Degree of toxicity	LD <sub>50</sub> : oral administration (rat) (unit: g/kg)
Very high	<0.001
High	0.001~0.05
Medium	0.05~0.5
Low	0.5~5
Very low	5~15
Practically non-toxic	15<

Source:Hodge, H.G. and Sterner, J.H. : American Industrial Hygiene Association Quarterly, 10 : 4, 93, 1943

## Food Sanitation Law

### Test results regarding standards for food and food additives

#### 1. Testing method

Testing performed in accordance with Japan Food Sanitation Law Article 10 Section 1, which outlines food and food additive standards for apparatus and containers made of synthetic resin (Notification No. 20 of the Ministry of Health and Welfare; February 16, 1982) (1) Test methods outlined in general standards regarding apparatus and containers, and the raw materials used to make them.

#### 2. Conditions for creating test samples

Blending                      Coating  
 Sample 0.1 g                      Glass plate 50 cm<sup>2</sup>



#### 3. Example of test results (G-40M)

	Item	Specification value	Result
Materials test	Cadmium	Less than 100 ppm	Less than 1 ppm
	Lead	Less than 100 ppm	Less than 1 ppm
Dissolution test	Heavy metals	Less than 1 ppm	Less than 1 ppm
	Potassium permanganate consumption value	Less than 10 ppm	Less than 10 ppm

Extraction conditions: 60°C/30 min

## Handling Precautions

### Usage and storage and handling

1. Use products after mixing with a spatula or other implement.
2. Thoroughly clean and dry the area where the product is to be used.
3. Do not mix with other oils or greases.
4. After opening the container, be careful to prevent contamination by dirt or other foreign material.
5. Store any unused or unopened product in a cool dark place.

### Health and Safety Information

1. Always wear protective gear (gloves, safety glasses, etc.) when working.
2. If the product gets on the hands or other exposed skin, wipe off with a dry cloth and then wash thoroughly with soap and water.
3. If the product gets on the floor, it will be slippery. Wipe with a dry cloth and spread sand or a similar material, then wipe off completely.
4. Fluorosilicone greases (FG720 series) are virtually harmless. However, if heated to high temperatures above 150°C, trace amounts of highly toxic gas (trifluoropropionaldehyde) will be released. In high temperature conditions, be sure to provide adequate ventilation and wear protective equipment such as gloves, goggles or protective clothing.
5. Fluorosilicone greases (FG720 series) come under appendix Article 15 Section 11 of the Export Trade Control Order, so approval is required for export. Contact Shin-Etsu for details.
6. Silicone greases and fluid compounds may be classified as hazardous materials under federal or state fire prevention laws in your country, and must be stored and handled accordingly.
7. Keep out of reach of children.
8. Always read the Material Safety Data Sheet before using any of these products. MSDS are available from our sales department upon request.

## Evaluation and measurement of thermal properties

Two values that represent the thermal properties of thermal interface materials are thermal conductivity ( $\lambda$ ) and thermal resistance (R).

Heat-dissipation performance is directly proportional to thermal conductivity and inversely proportional to thermal resistance.

Heat-dissipation is also largely dependent on the thermal contact resistance of the interface between the heat-generating component and the heat-radiating component, and not affected only by the thermal conductivity of the thermal interface silicone between them.

- At a constant temperature, thermal conductivity is a value inherent to a particular substance. According to Fourier's Law, in a static state, the proportionality constant is thermal conductivity.

thermal conductivity  $\lambda$

$$Q = \lambda \frac{(T_1 - T_2) A}{L}$$

Therefore

$$\lambda = \frac{Q}{A} \times \frac{L}{(T_1 - T_2)}$$

Q: quantity of transmitted heat   A: cross section area   L: heat transfer distance  
T<sub>1</sub>: temperature of high-temperature side   T<sub>2</sub>: temperature of low-temperature side

- Thermal resistance is the sum of contact resistance plus the resistance present as a quantity of heat (Q) flows between temperatures T<sub>1</sub> and T<sub>2</sub>.

Thermal resistance R

$$R_0 = \frac{T_1 - T_2}{Q} = \frac{L}{\lambda A}$$

In practice

$$R = R_0 + R_s$$

R<sub>0</sub>: inherent thermal resistance of the substance   R<sub>s</sub>: thermal contact resistance

### ■ Measuring thermal conductivity

#### Hot-wire method JIS R 2616

The hot-wire method is a measurement method used with non-curing products (silicone fluid compounds).

An ultra-thin polymer sheet is placed over the test sample, and a probe (hot-wire and thermocouple) is placed on top. Thermal conductivity is determined by measuring temperature change, voltage, current and time.

#### Guarded heat flow meter method ASTM E-1530

The guarded heat flow meter method is a measurement method used with curable products (rubber finished products, RTV rubbers and gels).

A test sample and a calorimeter are placed between a heater and a heatsink. Thermal conductivity is calculated from the temperature difference and heat flow quantity.

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