Liquid Silicone Rubbers for Electronics

Shin-Etsu Silicone

Safe and Eco-friendly

Liquid Silicone Rubber

Making Electrical and Electronic Equipment More Reliable.

Electronic devices and electrical modules are constantly evolving in performance and functionality while becoming smaller and more lightweight. At the same time, "green design" has become the norm. These factors have created a demand for materials that offer higher quality, higher functionality and more eco-friendly properties.

- **Environmentally friendly silicone materials that contribute to carbon neutral Room temperature curing liquid silicone rubber**
- **Heat dissipation technology Inverter heat-dissipation encapsulants for EV and high-thermal-conductivity gap fillers for datacenters**
- **UV delay-curing adhesive that improves the performance of MEMS sensors, image sensors, and other precision devices, reduces stresses, and shortens curing times**
- **Highly reliable silicone encapsulation materials for IGBT modules. These are essential for energy conservation such as wind power generation and high-speed railroads.**
- **Optical silicone materials contributing to Improved reliability of LED devices and in-vehicle displays**

These and many other leading-edge technologies would not exist without liquid silicone rubber. At Shin-Etsu, we're developing liquid silicone rubber products that contribute to more comfortable living and to advancements in eco-friendly electronics technology.

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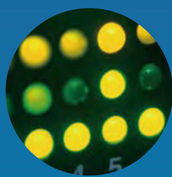
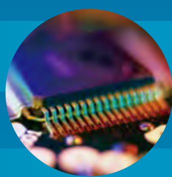




Features of Silicone

Silicones have an amazing array of properties.

Silicones consist of a main chain of inorganic siloxane linkages (Si-O-Si) plus side chains which contain organic groups. **Silicones are hybrid polymers that contain both inorganic and organic components.**

The main chain of a silicone consists of siloxane linkages which are stable and have a high bonding energy.

Compared to organic polymers, which have a carbon skeleton (C-C/bonding energy: 85 kcal/mol), silicones have superior **heat resistance and weatherability** (UV light, ozone).
This is due to the greater stability of siloxane bonds, which have a bonding energy of 106 kcal/mol.

With their long bond length and high bond angle, siloxane bonds have weak intermolecular forces and move freely.

Siloxane bonds have a bond length of 1.64 Å and bond angle of 134°.
Compared to carbon bonds (bond distance: 1.54 Å, bond angle: 110°), they have a long bond distance and high bond angle, and a low rotational energy barrier.
As a result, siloxane bonds move more freely and intermolecular forces are weak.
These characteristics manifest themselves in features of the silicone material, including **softness, gas permeability, cold resistance, and little change in viscosity due to temperature changes**.

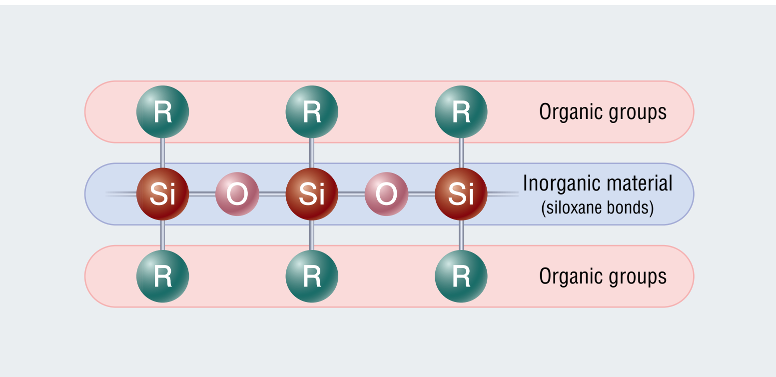
The molecules of silicone polymers are covered by hydrophobic methyl groups, and surface energy is low.

The backbone of a silicone polymer molecule is a twisted helical structure.
The molecules are almost completely covered by hydrophobic methyl groups, and surface energy is low.
This gives rise to unique properties including **water repellency and easy release**.

Moreover, silicones are low-polarity polymers, so they absorb **little moisture**.

Silicones: compounds which feature a main chain of siloxane bonds

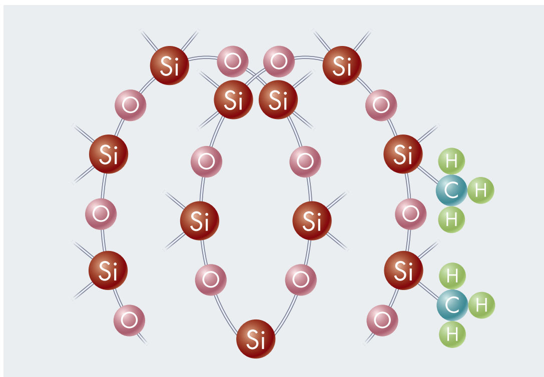
Features attributable to siloxane linkages



- Heat resistance
- Flame resistance
- Chemical stability
- Weatherability
- Radiation resistance
- Electrical properties

Si-O bonds: 106 kcal/mol
C-C bonds: 85 kcal/mol
C-O bonds: 76 kcal/mol

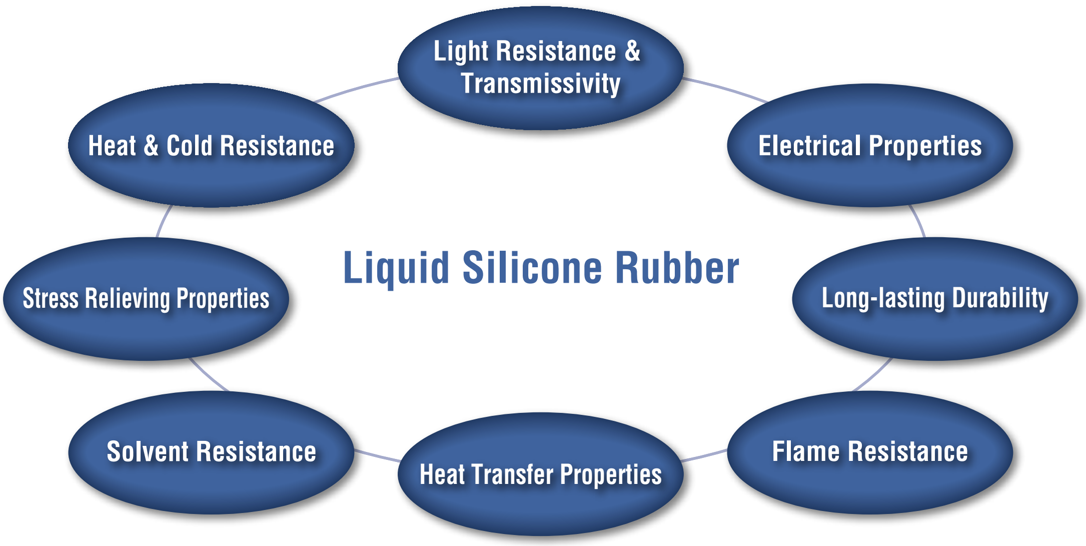
Features attributable to molecular structure



- Water repellency
- Release properties
- Cold resistance
- Compression characteristics

Helical (spiral) structure
Intermolecular forces are weak

Main Property Requirements for Liquid Silicone Rubbers for Electronics



Feature 1 Light Resistance & Transmissivity

Silicone materials can be used for fastening and encapsulation of LEDs and other light receiving/emitting devices without harming the optical characteristics of the optical device.

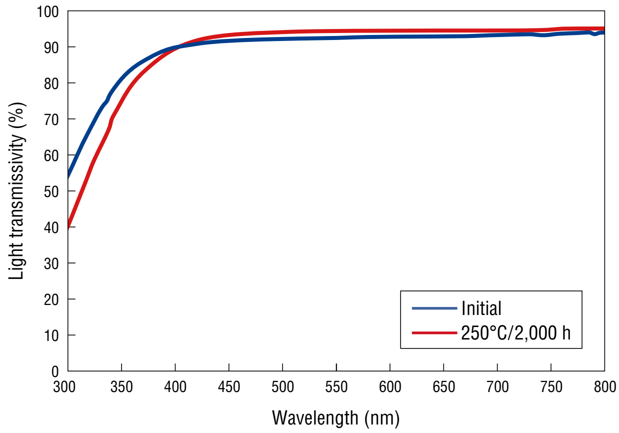
Feature 2 Heat & Cold Resistance

Silicone can be used in temperatures from –50°C to +250°C. Even in continuous use, liquid silicone rubber offers stable performance in a wide temperature range (–40°C to +180°C) and does not lose its rubber elasticity.

Feature 3 Electrical Properties

Silicone exhibits consistent electrical properties even when subjected to environmental changes (temperature, humidity, etc.). This makes silicone a good insulator for high voltage components of transformers and other equipment.

Encapsulation KER-2936-A/B for LED devices
Light transmissivity after heat resistance test



KER-2936-A/B: 100°C × 1 h +150°C × 5 h curing Thickness: 2 mm

3-1. Electric properties of KE-4901-W durability tests

	Initial	After immersion in water for 16 h	60°C/90% × 500 h	150°C × 1,000 h
Volume resistivity TΩ·m	7.9	3.2	4.7	14.4
Dielectric breakdown strength kV/mm	30	27	24	24

(Not specified values)

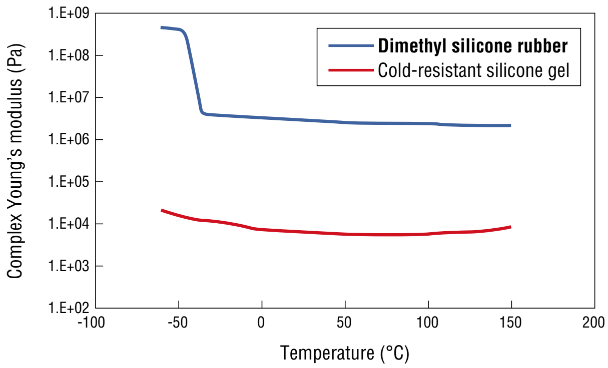
Feature 4

Stress Relieving Properties

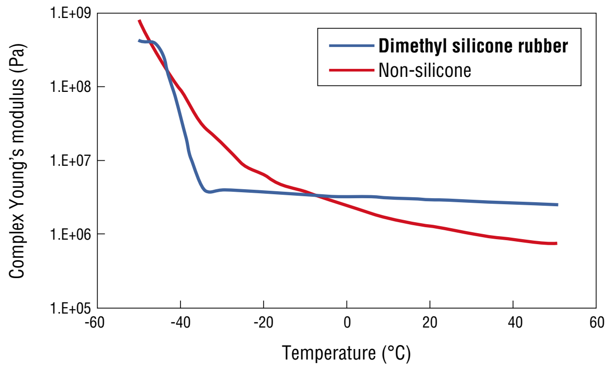
Silicone is used for potting and encapsulation of bonding wires and other components of power semiconductor modules.
Silicone protects electronic parts from stress and is effective across a wide temperature range.

Temperature dependency of complex Young's modulus of liquid silicone

Dimethyl silicone rubber VS Cold resistant silicone gel



Silicone VS Non-silicone polymer



Feature 5

Long-lasting Durability

Endurance test of KE-1885

Item		Initial	150°C × 1,000 h	85°C/85% × 1,000 h	150°C × 30 min↔-40°C × 30 min × 1,000 cycle
Hardness Durometer A		37	57	53	53
Elongation at break %		370	120	180	200
Tensile strength MPa		4.1	4.3	5.0	5.5
Density g/cm³		1.15	1.15	1.15	1.15
Tensile lap-shear strength MPa	Al/Al	2.9	2.4	2.9	2.7
	PBT/PBT	2.8	2.5	2.4	2.4
	PPS/PPS	2.8	2.9	2.1	2.3

(Not specified values)

Feature 6

Solvent Resistance

Change in volume of rubbers caused by various liquids (after 168 h immersion) (Unit: %)

Type of liquid	Temperature °C	Nitrile			Chloroprene	Natural rubber	Styrene butadiene	Butyl	Silicone *	Hypalon
		28%	33%	38%						
Gasoline	50	15	10	6	55	250	140	240	260	85
ASTM #1 oil	50	-1	-1.5	-2	5	60	12	20	4	4
ASTM #3 oil	50	10	3	0.5	65	200	130	120	40	65
Diesel oil	50	20	12	5	70	250	150	250	150	120
Formaldehyde	50	10	10	10	25	6	7	0.5	1	1.2
Ethanol	50	20	20	18	7	3	-5	2	15	5
Glycol	50	0.5	0.5	0.5	2	0.5	0.5	-0.2	1	0.5
Ethyl ether	50	50	30	20	95	170	135	90	270	85
Methyl ethyl ketone	50	250	250	250	150	85	80	15	150	150
Trichloroethylene	50	290	230	230	380	420	400	300	300	600
Carbon tetrachloride	50	110	75	55	330	420	400	275	300	350
Benzene	50	250	200	160	300	350	350	150	240	430
Aniline	50	360	380	420	125	15	30	10	7	70
Phenol	50	450	470	510	85	35	60	3	10	80
Cyclohexanol	50	50	40	25	40	55	35	7	25	20
Distilled water	100	10	11	12	12	10	2.5	5	2	4

* The values above are measured values for common dimethyl silicone rubber. Values will differ depending on the product.

Feature 7

Flame Resistance

There are many UL certified products on the market.
A product's UL certification can be checked by referring to the directory at the following page: http://iq.ul.com/iq/newiq/
Please check the following UL file numbers for details.
UL file numbers: **E48923, E179895, E174951, E255646, E192980**

UL94 flammability ratings criteria

Rating	Criteria
94V-0*	A set of 5 specimens is tested; the flaming combustion time of each specimen must not exceed 10 seconds, and total time of the set must not exceed 50 seconds.
94V-1*	A set of 5 specimens is tested; the flaming combustion time of each specimen must not exceed 30 seconds, and total time of the set must not exceed 250 seconds.
94HB	In this horizontal burning test, combustion must cease before the 100 mm reference mark.

* A rectangular test strip (width: 13.0 mm, length: 125 mm, thickness: as thin as is practical) is suspended vertically. A 20 mm flame is applied to the bottom for 10 seconds. The flame is then removed and the flaming combustion time is measured. When combustion ceases, the flame is again applied in the same manner and combustion time is measured again.

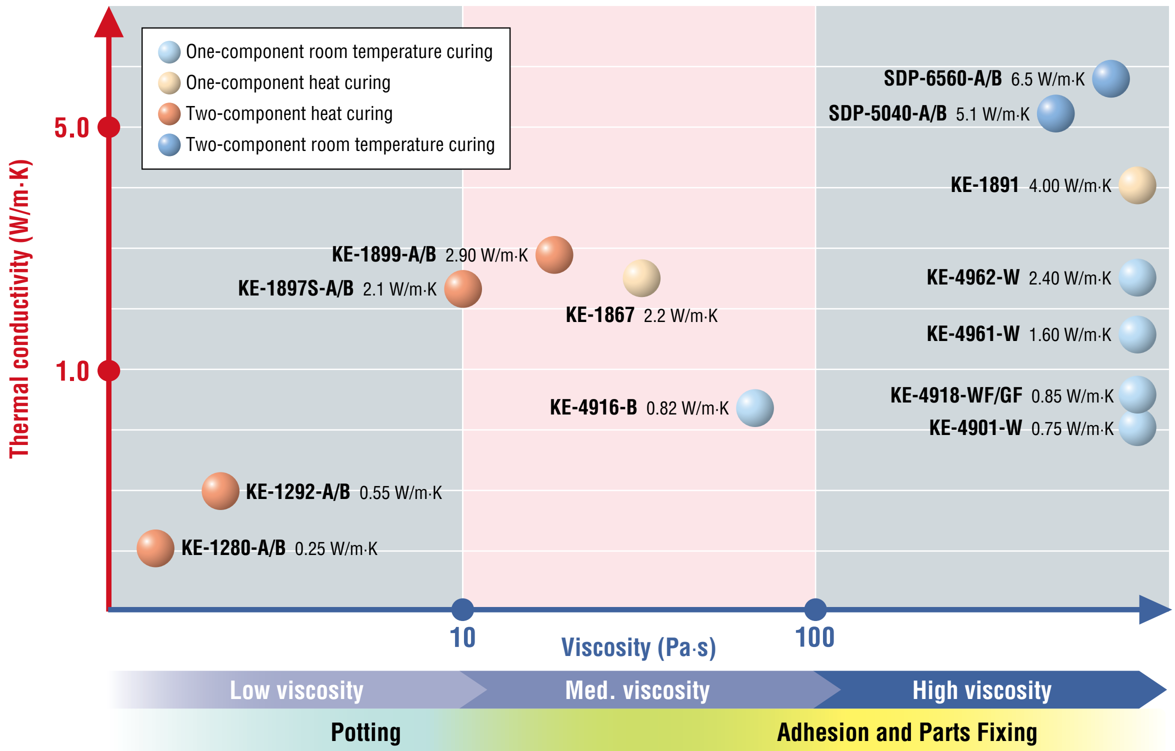
Flammability test Left: Silicone rubber Right: Organic rubber

Feature 8

Heat Transfer Properties

Silicone can help transfer heat generated by electronic devices to heat sinks and housings.
Some Shin-Etsu products that have both flame resistance and heat transfer properties are presented below.
Be sure to choose a product suitable for the intended use.

■ **Products with heat transfer properties that are UL94 V-0 rated**



● Heat resistance evaluation & test method

Thermal conductivity (λ) and thermal resistance (R) are two values which describe the thermal properties of thermal interface materials. The higher its thermal conductivity and lower its thermal resistance, the more effective a material will be as a thermal interface. Heat dissipation from a heat-generating component is influenced not only by the thermal conductivity of the thermal interface silicone placed between the heat-generating part and the heatsink (etc.). It is also influenced to a large extent by thermal resistance, which is a function of the contact thermal resistance at the interfaces between the heat generator, silicone and heat sink and the thickness of the silicone itself.

At a given temperature, thermal conductivity is a value intrinsic to a particular substance. According to Fourier's Law, in a steady state, the proportionality constant is the thermal conductivity.

Thermal conductivity λ

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

Q: heat flow rate A: cross-sectional surface area L: distance of heat transfer
T_1: temperature at high side T_2: temperature at low side

Thermal resistance is the sum of contact resistance plus the resistance as heat flows (Q) from T_1 to T_2.

Thermal resistance R

$$Ro = \frac{T_1 - T_2}{Q} = \frac{L}{\lambda A} \quad \text{In reality} \quad R = Ro + Rs$$

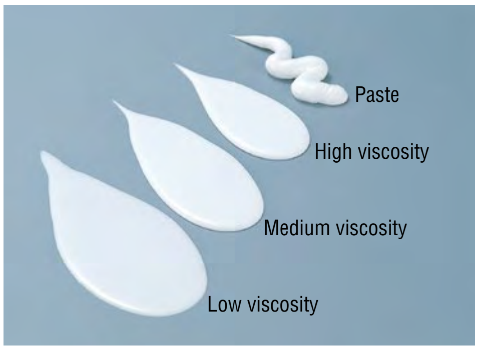
Ro: material's intrinsic thermal resistance Rs: contact thermal resistance

Basic Information about Liquid Silicone Rubber

Types of Liquid Silicone Rubber

		Advantages	Disadvantages
Room Temperature Cure Type	One-component Condensation	● Cures by reacting with atmospheric moisture. ● Easy to handle and relatively low introduction cost.	● It cures from the surface toward the deep part. ● Slow deep curing.
	Two-component Condensation	● Compared with one-component condensation, the curing rate is faster and the deep curing property is also superior. ● Since it is not affected by curing inhibition, it can be used on various substrate.	● Curing time can not be shortened by heating.
	Two-component Addition	● Cures within 24 hours at ambient temperature (23°C). ● Curing time reduction by heating is also possible (within 30 minutes).	● It undergoes curing inhibition. Please see P8.
Heat Cure Type	One-component Addition	● Cures within 60 minutes with heating above 120°C.	● Refrigerated storage and transportation are required. ● It undergoes curing inhibition. Please see P8.
	Two-component Addition (Heat Curing)	● Cures in 30-60 minutes by heating. ● It has a long pot life and can be stored at room temperature.	● It undergoes curing inhibition. Please see P8.
UV Cure Type	UV Condensation (UV + Moisture)	● UV and moisture dual cure types. ● Sites not exposed to UV are auxiliary cured by moisture.	● The expiration date is short.
	UV (Radical)	● Fast curing. The productivity is extremely high. ● The curing shrinkage is smaller than that of acrylic or epoxy system.	● It is susceptible to oxygen inhibition.
	UV Addition (Delayed Curing)	● Adhesion between non UV permeable materials is enabled due to the delayed curing property. ● Small curing shrinkage (less than 0.1%). ● Curing time can be shortened by heating (within 30 minutes).	● Refrigerated storage and transportation are required. ● It undergoes curing inhibition. Please see P8.

＊ The curing conditions vary depending on the environment of use.
In addition, since the adhesion expression rate varies depending on the substrate, please make a prior check with the substrate actually used.



Viscosity and Workability

● Viscosity before Curing

Generally speaking, liquid silicone rubber products start as a liquid and cure to become an elastic body.
The viscosity values listed in this catalog should provide a guideline as to workability.
Flowable, low viscosity products are suitable for potting and coating.
Medium viscosity products and non-flowable high viscosity products (paste consistency) are suitable for sealing and adhesion or fastening of parts.

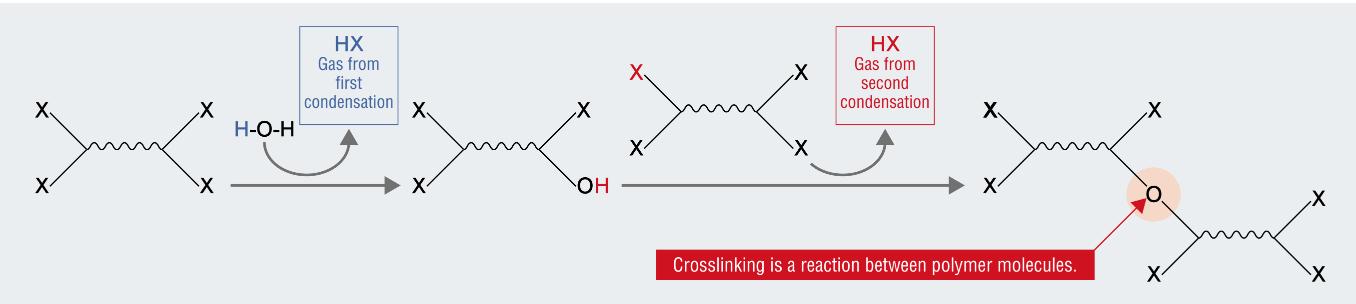
Curing Reactions

Some liquid silicone rubbers cure at room temperature, while others cure with the application of heat. And in each category, products are available in one-component and two-component formats.
Furthermore, the curing reaction may be a condensation reaction or an addition reaction. Each has its own advantages.
When choosing an liquid silicone rubber product, the user must consider a range of factors. These include elements of workability such as viscosity and curing conditions, performance parameters such as hardness, flame resistance and thermal conductivity; and the advantages and disadvantages of the different types of curing reactions.

● Condensation Reaction

These products release reaction byproducts (outgas) as they cure.
Based on the type of reaction byproducts they release, products are categorized as alcohol-cure, or acetone-cure products.
One-component condensation cure products cure by reacting with moisture in the air. The cure reaction starts at the surface in contact with the air and proceeds inward.
Curing speed is dependent on temperature and humidity.
If thickness is 1 mm, it takes about 24 hours for the material to become a fully cured elastic body.
However, it takes about three days to achieve full mechanical strength, and can take up to seven days to achieve the desired electrical properties and other characteristics.
These products are generally not suitable for use as an adhesive for bonding materials together with a large contact area, but may be suitable in certain cases depending on the size and moisture permeability of the substrates.
Two-component condensation cure products cure when the main component and curing agent are mixed together. The reaction occurs throughout the material, and as is the case with one-component products, reaction byproducts are released.

[Note] Irrespective of whether it is a one- or a two-component product, condensation-cure liquid silicone rubber products require moisture to cure, and outgas during the curing process. These products are thus not suitable for applications that involve airtight enclosures.



● Addition Reaction

The base polymer (a silicone polymer which contains vinyl groups) reacts with the curing agent (a silicone polymer which contains hydrogen groups) with the aid of a platinum catalyst. It is through this hydrosilylation reaction that the material cures.
With addition-cure liquid silicone rubber products, the user has greater control over the cure time, which can be useful in terms of increasing productivity.

[Note] However, contact with certain compounds can cause poor curing or adhesion, so these products must be used with a certain amount of care.

$$—Si—CH=CH_2 + H—Si— \xrightarrow{Pt} —Si—CH_2CH_2—Si—$$

Crosslinking is a reaction between the base polymer and curing agent.

Cure inhibition

When using addition-cure liquid silicone rubber products, it is important that the user have a good understanding of the problem of cure inhibition.
The substances that can cause cure inhibition do so in one of the two following ways.

Causes of Poor Curing

1. The platinum catalyst forms complexes with certain other compounds, and the catalytic action is inhibited.
2. The curing agent becomes contaminated with substances it can react with, and the curing agent is consumed.

Cure Inhibitors

- Organic compounds that contain elements which include nitrogen, phosphorus and sulfur.
- Ionic compounds of heavy metals such as tin, lead, mercury, bismuth and arsenic.
- Organic compounds that contain unsaturated groups, such as acetylene groups.

Substances that can React with Curing Agents

- Alcohol, water
- Organic acids such as carboxylic acids

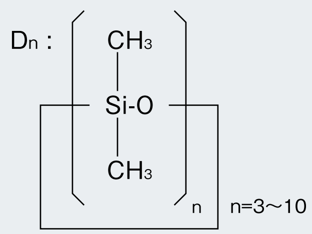
Specific Examples of Cure Inhibition

- Organic rubber: vulcanized rubber, anti-aging agent (e.g. gloves).
- Epoxy & urethane resin: amine- and isocyanate-based curing agents.
- Condensation-cure liquid silicone rubber: use of tin-based catalysts in particular.
- Soft PVC: plasticizers, stabilizers.
- Solder flux.
- Engineering plastics: flame resistance heat resistance improvers, UV absorbers.
- Moisture that has been absorbed by materials which are in contact with the uncured material.
- Outgassing from solder resist or PCB (caused by heating when curing the silicone).

Low-molecular-weight Siloxane and Electrical Contact Failures

● What is low-molecular-weight Siloxane?

Low-molecular-weight (LMW) siloxane is shown in the chemical formula on the right. It is non-reactive cyclic dimethyl polysiloxane (generally D_3–D_{10}) that is volatile, meaning it will vaporize into the air during the cure process and even after curing.
It has been reported that, in certain conditions (described below), LMW siloxane can cause electrical contact failures.



● Reduced LMW Siloxane Products (Designed to Reduce Incidence of Electrical Contact Failures)

These are products in which LMW siloxane has been reduced to a prescribed level. LMW siloxane is known to cause electrical contact failures in certain conditions.
For most Shin-Etsu products, this means a ΣDn (n=3–10) of 300 ppm or less, or 500 ppm or less.
The risk of electrical contact failures is also affected by the conditions described below, so these products do not represent an absolute solution. Nonetheless, reduced LMW siloxane products are still recommended for electrical and electronic applications.

Amounts of LMW siloxane in general products and reduced LMW siloxane products (sample data on uncured material)

D_n	KE-45 (General Product)	KE-4918-WF (Reduced LMW siloxane product)
3	10 >	10 >
4	500	10 >
5	260	10 >
6	240	10 >
7	220	10 >
8	160	10 >
9	170	10 >
10	220	10
ΣDn (n=3–10)	1,770	300 >

KE-4918-WF is a reduced LMW siloxane product with ΣDn (n=3–10) controlled to 300 ppm or less.

(Not specified values)

[GC conditions]	GC: gas chromatography
Device	Capillary gas chromatograph, Shimadzu model GC-14A
Column	DURABOND DB-1701
Column Temp.	50°C → 300°C (15°C/min)
Inj. Temp.	300°C
Carrier Gas	He (30 cm/sec)
Detector	FID
Injection volume	2μl
Extraction solvent	Acetone

● Electrical Contact Failures

A number of substances have been reported to cause contact failures.
Contact failures may be caused by organic materials such as human body oils and organic gases, or inorganic materials such as hydrogen sulfide and ammonia gas.
Manufacturers of electrical and electronic equipment report that LMW siloxane can also cause contact failure at low voltages and low currents.

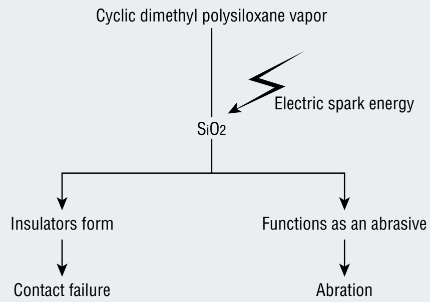
■ Relationship between Load Conditions and Contact Reliability

Effects of load on contact reliability (micro-relay)

Load			Si present on contat surfaces (Y/N)	Contact resistance
1	DC1 V	1 mA	N	No increase observed
2	DC1 V	36 mA	N	Increase of several ohms
3	DC3.5 V	1 mA	N	No increase observed
4	DC5.6 V	1 mA	Y	No increase observed
5	DC12 V	1 mA	Y	Increase of several ohms, some readings of infinity
6	DC24 V	1 mA	Y	Readings of infinity were seen at around 1,500 cycles; at 3,000 cycles, all were infinity
7	DC24 V	35 mA	Y	Readings of infinity were seen at around 3,000 cycles; at 4,500 cycles, all were infinity
8	DC24 V	100 mA	Y	No increase observed
9	DC24 V	200 mA	Y	No increase observed
10	DC24 V	1 A	Y	No increase observed
11	DC24 V	4 A	Y	No increase observed

[Test conditions] Switching frequency: 1 Hz, Temp.: room temperature, Contact force: 13 g
Source: The Institute of Electronics, Information and Communication Engineers, Yoshimura and Itoh EMC76-41 Feb. 18, 1977.

■ Mechanism of contact failure



The main ingredient of liquid silicone rubber is dimethyl polysiloxane $HO\text{-}[Si(CH_3)_2O]_n\text{-}H$, which has a degree of polymerization between 200 and 1,000. The dimethyl polysiloxane obtained in the normal manufacturing process does contain small amounts of cyclic products.This cyclic dimethyl polysiloxane is nonreactive and volatile, and thus will vaporize into the air during the cure process and even after curing. Under certain conditions, this vaporized cyclic dimethyl polysiloxane can cause contact failures, according to the mechanism shown above.

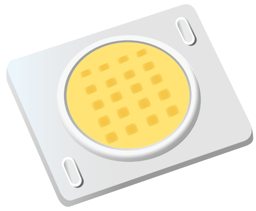
Main Applications for Liquid Silicone Rubber

LED Devices

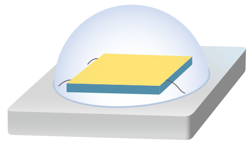
Endowed with high resistance to light and heat, silicone resins have a range of uses in various types of LEDs. Silicones used in LEDs include LED encapsulants, die-bonding adhesives and damming materials. LED encapsulants are used to protect the chips and wires, as a binder for the phosphors, and for molding light guides and lenses. Die-bonding adhesives are used to attach the chips, and damming materials are used for COB applications. The Shin-Etsu product line also includes reflective molding materials for LED packages.

SMD

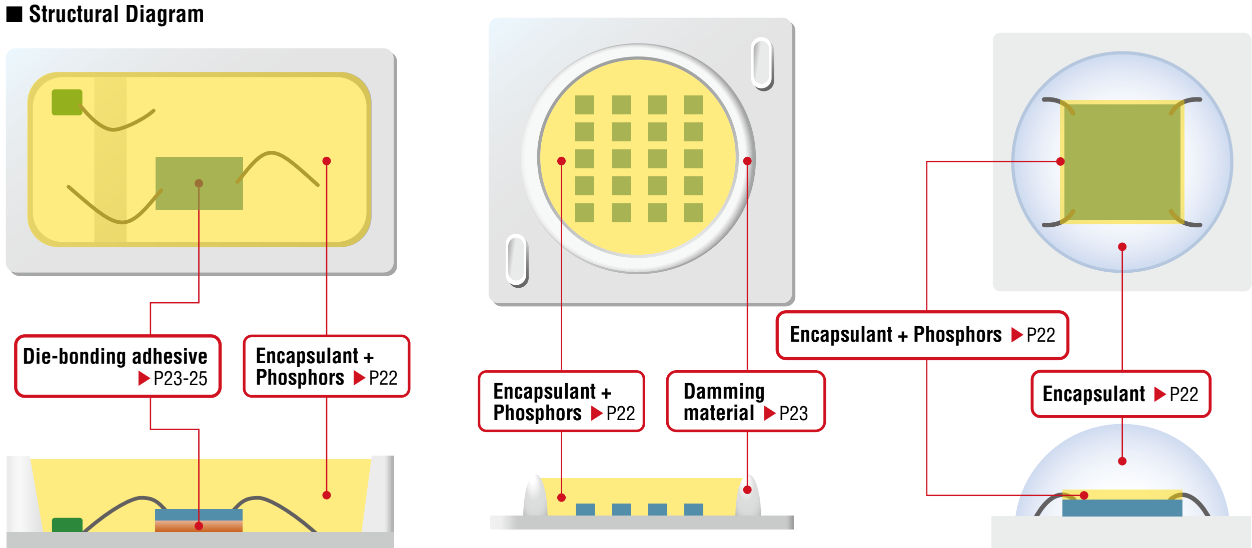
High-density Mounting



Lens Molding



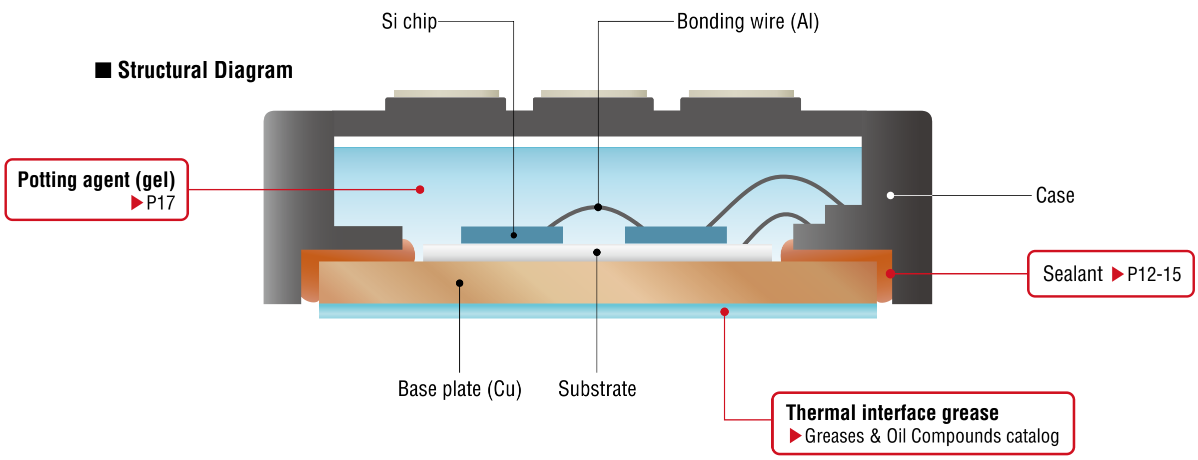
■ Structural Diagram



IGBT Modules

IGBT (Insulated Gate Bipolar Transistor) modules are a primary component of high-capacity inverters. In an IGBT module, a potting agent (gel) is used for electrical insulation and a sealant is used to bond the case to the base plate. In addition, a thermally conductive grease is used to help direct heat away from the IGBT module.
For information on thermal interface greases, please see our Greases & Oil Compounds catalog.

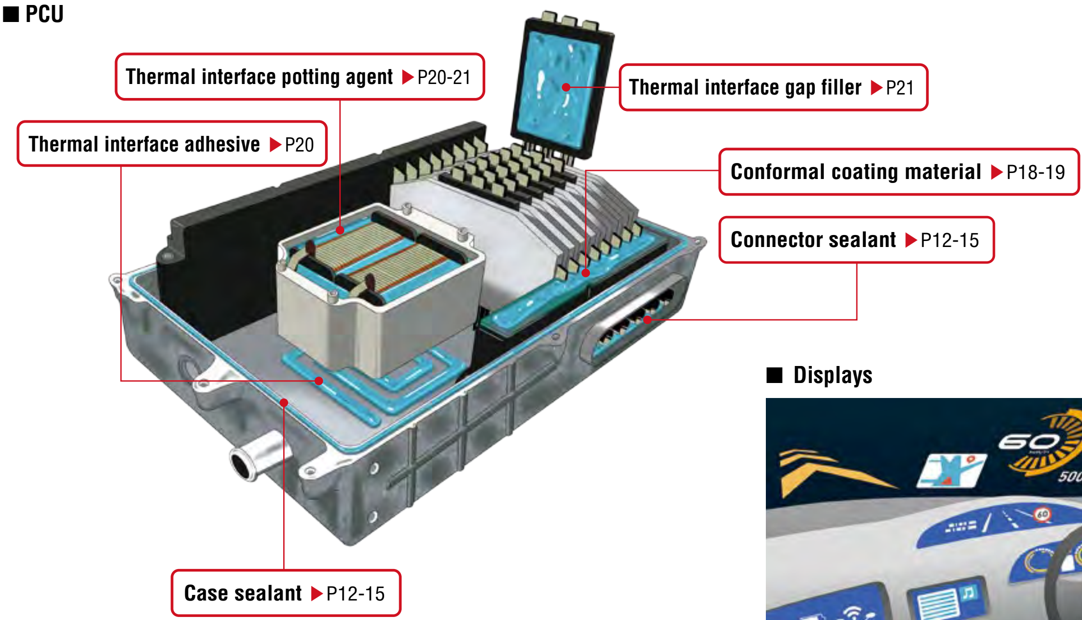
■ Structural Diagram



Car Electronics

Automobiles are being remarkably electrified, and automated driving technology is also dramatically improving. PCU (Power Control Unit) has the functions of boosting the drive voltage, converting the current, and controlling the driving force of the motor. It is installed in electric and hybrid vehicles. Liquid silicone rubber is a product with excellent heat resistance, cold resistance, and various long-term reliability. It can be used as a thermal interface material, case sealant, connector sealant, and conformal coating material, and it contributes to improving the long-term reliability of automobiles and the electrified products that support it. In addition, silicone LOCA (Liquid Optical Clear Adhesive) materials with excellent weather resistance and transparency are used around various displays.

■ **PCU**

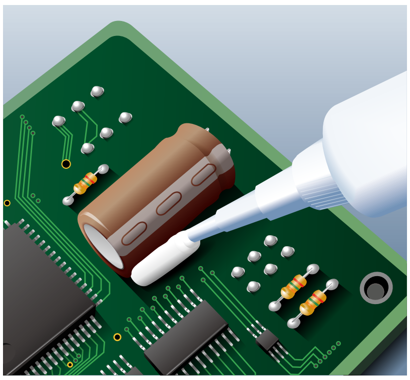


■ **Displays**

Circuit Board Assemblies

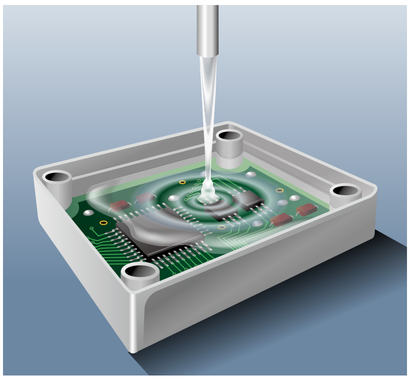
Liquid silicone rubber is used for a variety of purposes in PCBs (Printed Circuit Boards). Sealants are used for bonding and attachment and as a thermal interface material for capacitors, transformers, coils and other electronic components. Potting agents are used to cover over the circuit board, where they provide waterproofing and electrical insulation and act as a thermal interface material. Coating agents are applied to part or all of the circuit board to protect components and circuits from moisture and metallic debris. And for power supply boards, which require a flame resistant material, products that meet UL94 V-0 requirements are used.

Attaching Components



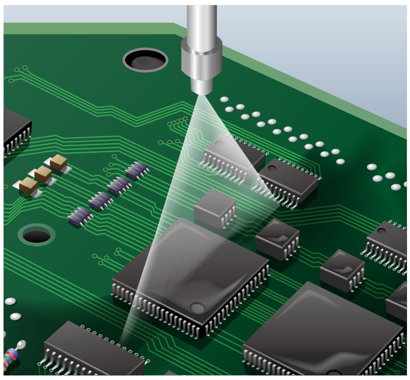
Sealants ▶P12-15

Potting Circuit Boards



Potting agents ▶P16-17
Thermal interface potting agents ▶P20-21

Coating Circuit Boards



Coating agents ▶P18-19

Product Lists

Adhesives and Sealants (Room Temperature Curing)

Item \ Product name	KE-4958-T/W	KE-4956-T/W	KE-4930-G	KE-4951-G	KE-4901-W	KE-4918-WF/GF
Curing method	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing
Reaction mechanism (by-product gas)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)
Brief description	Standard type	Standard type	All purpose use	Flame resistance, filler*2	Flame resistance, fixing power supply components	Flame resistance, fixing power supply components
LMW siloxane content ΣD_3-D_{10}*1 ppm	< 300	< 300	< 300	< 300	< 300	< 300
Flame resistance UL94	—	—	—	V-0	V-0	V-0
Before curing						
Appearance	T:Translucent/W:White	T:Translucent/W:White	Gray	Gray	White	WF:White/GF:Gray
Consistency	Paste	Medium viscosity	Paste	Paste	Paste	Paste
Viscosity Pa·s	Paste	70	Paste	Paste	Paste	Paste
Mix ratio	—	—	—	—	—	—
Tack-free time min	3	14	7	14	8	3
Pot life at 23°C min	—	—	—	—	—	—
Recommended curing conditions	23 ± 2°C/50 ± 5% RH × 7 days					
After curing						
Density g/cm^3	1.05	1.03	1.36	1.40	1.59	1.68
Hardness Durometer A	34	28	30	34	53	80
Tensile strength MPa	2.3	2.0	2.0	1.5	2.6	3.5
Elongation at break %	370	300	350	400	120	50
Volume resistivity TΩ·m	9.5	60	2.1	11	3.4	4.5
Dielectric breakdown strength kV/mm	30	32	26	24	30	27
Relative permittivity 50 Hz	3.0	3.0	4.2	3.8	3.8	4.1
Dielectric dissipation factor 50 Hz	5×10^{-3}	5×10^{-3}	4×10^{-3}	2×10^{-1}	2×10^{-1}	2×10^{-1}
Tensile lap-shear strength MPa	1.5 (Al)	0.6 (glass)	1.0 (PBT)	1.4 (Al)	1.0 (Al)	1.0 (Cu)
Thermal conductivity W/m·K	—	—	—	—	0.75	0.85

*1 Low molecular weight siloxane is measured in cured products.

*2 This product does not inhibit the curing of addition-reaction silicone rubber. Therefore, it can be used in combination with potting materials such as KE-1292-A/B.

(Not specified values)

Bond Test Data : Tensile Lap-shear Strength

(Units: MPa)

Substrate \ Product name	KE-4930-G	KE-4951-G	KE-4958-T	KE-4901-W	KE-270-A/B	KE-1189-A/B
Glass	1.0	1.7	1.6	1.5	0.3	1.3
Aluminum	1.0	1.4	1.5	1.0	0.3	1.1
PBT	1.0	1.4	1.2	1.1	0.2	1.5
PPS	1.1	1.2	0.6	0.6	0.3	0.8
Epoxy	1.0	1.6	1.4	0.9	0.2	1.1
Stainless steel	0.9	0.8	1.6	0.6	0.2	0.9
PC	1.5	0.2	1.0	1.3	0.3	—

(Not specified values)

KE-3412 Heat Resistance Data

Product name	Item	Initial	250°C × 168 h
KE-3412	Hardness Durometer A	34	31
	Elongation at break %	240	270
	Tensile lap-shear strength (Al/Al) MPa	1.3	1.6

(Not specified values)

■ Adhesives and Sealants (Room Temperature Curing)

Item \ Product name	KE-270-A/B KE-270G-A/B	KE-1189-A/B	FE-2000	KE-3412
Curing method	Two-component room temperature curing	Two-component room temperature curing	One-component room temperature curing	One-component room temperature curing
Reaction mechanism (by-product gas)	Condensation (Alcohol)	Addition	Condensation (Alcohol)	Condensation (Acetone)
Brief description	No cure inhibition Initial adhesion expression within 2h*2	Curing time shortened by heating Initial adhesion expression within 2h*2	Oil and solvent resistance	Heat resistance (up to 250°C)
LMW siloxane content ΣD_3-D_{10}*1 ppm	< 300	< 300	—*3	—*3
Flame resistance UL94	—	—	—	—
Before curing				
Appearance	KE-270-A/B:Milky white translucent KE-270G-A:White/B:Black	A:Translucent/B:Milky white	Translucent	Black
Consistency	Medium viscosity	High viscosity	Paste	High viscosity
Viscosity Pa·s	KE-270-A/B=38/30 KE-270G-A/B=30/70	A:90/B:140	Paste	90
Mix ratio	100:100	100:100	—	—
Tack-free time min	6	30	6	6
Work time (reference) min	9 (Flow stop time)	—	—	—
Recommended curing conditions	23 ± 2°C/50 ± 5% RH × 3 days	23 ± 2°C/50 ± 5% RH × 24 h	23 ± 2°C/50 ± 5% RH × 7 days	
After curing				
Density g/cm³	1.02	1.04	1.35	1.06
Hardness Durometer A	32	9	40	35
Tensile strength MPa	1.0	1.5	1.9	2.7
Elongation at break %	160	820	140	270
Volume resistivity TΩ·m	79	19	—	155
Dielectric breakdown strength kV/mm	28	18	—	28
Relative permittivity 50 Hz	2.8	2.8	—	35
Dielectric dissipation factor 50 Hz	4.3×10^{-4}	3×10^{-4}	—	7.4×10^{-4}
Tensile lap-shear strength MPa	0.3 (Al)	1.5 (PBT)	0.8 (Al)	1.0 (Al)
Thermal conductivity W/m·K	—	—	—	—

*1 Low molecular weight siloxane is measured in cured products. *2 Adhesion rate varies with the substrate. It does not guarantee adhesion within 2 hours. *3 This product is not a low molecular siloxane reduction product. (Not specified values)

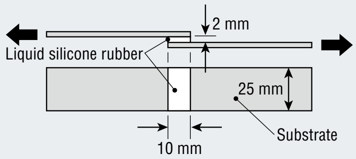
■ KE-270-A/B, KE-1189-A/B Curability Data

Item \ Curing conditions / Product name	23°C × 2 h		23°C × 4 h		23°C × 6 h		23°C × 24 h		60°C × 30 min	
	KE-270-A/B	KE-1189-A/B	KE-270-A/B	KE-1189-A/B	KE-270-A/B	KE-1189-A/B	KE-270-A/B	KE-1189-A/B	KE-270-A/B	KE-1189-A/B
Hardness Durometer A	16	5	21	5	23	5	32	10	—	7
Tensile lap-shear strength (substrate) MPa	0.3 (Aluminum) CF40	1.3 (PBT) CF90	0.3 (Aluminum) CF100	1.2 (PBT) CF100	0.3 (Aluminum) CF100	1.1 (PBT) CF100	0.3 (Aluminum) CF100	1.5 (PBT) CF100	—	1.4 (PBT) CF100

* The rate of curing and adhesion development varies depending on the environment and the substrate. Please confirm with a sample in advance. (Not specified values)
CF=Cohesion Failure e.g. CF100 = cohesion failure 100%

Tensile lap-shear strength test method

Liquid silicone rubber samples were cured as described in the figure, then tested using a lap-shear strength tester.



Cure conditions:
Condensation-cure type 23±2°C/50±5% RH × 7 days
Addition cure-type 120℃ × 1 h
Liquid silicone rubber thickness: 2 mm
Bonding surface: 10 × 25 mm
Pull rate: 50 mm/min

■ Adhesives and Sealants (Heat Curing)

Item \ Product name	KE-1884	KE-1885	KE-1875	KE-1812	KE-1835-S
Curing method	One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing
Reaction form	Addition	Addition	Addition	Addition	Addition
Brief description	Low temperature curing	Low temperature curing	All purpose use	Flame resistance high thixotropic	Flame resistance high strength
LMW siloxane content ΣD_3-D_{10}*1 ppm	< 100	< 100	< 300	< 300	—
Flame resistance UL94	—	—	—	HB	HB
Before curing					
Appearance	White	White	Black	Translucent	White
Consistency	Medium viscosity	High viscosity	Paste	Paste	Paste
Viscosity Pa·s	55	100	80*3	Paste	120
Recommended curing conditions	100°C × 1 h*2		120°C × 30 min	120°C × 1 h	
After curing					
Density g/cm³	1.22	1.14	1.06	1.05	1.25
Hardness Durometer A	35	36	27	23	40
Tensile strength MPa	3.5	3.5	2.4	2.3	4.0
Elongation at break %	230	300	390	400	370
Volume resistivity TΩ·m	10	10	1.0	2.1	11
Dielectric breakdown strength kV/mm	25	25	24	21	29
Relative permittivity 50 Hz	3.1	3.1	—	—	3.3
Dielectric dissipation factor 50 Hz	1×10^{-3}	1×10^{-3}	—	—	5×10^{-3}
Tensile lap-shear strength MPa	1.9 (PBT)	2.0 (PBT)	2.1 (Al)	1.3 (PBT)	3.0 (Al)

*1 Low molecular weight siloxane is measured in cured products.
*2 Our quality-assurance terms are 120°C × 1 h.
*3 Shear viscometer

(Not specified values)

■ Adhesion Test Data: Tensile Lap-shear Strength

(Units: MPa)

Substrate \ Product name	KE-1875	KE-1885	KE-8101	KE-1812	KE-1858-D2
Glass	2.2	2.2	4.8	1.4	1.7
Aluminum	2.1	2.1	5.5	1.2	1.7
PBT	1.8	2.0	4.6	1.3	1.5
PPS	1.9	1.6	4.9	1.2	1.1
Epoxy	1.4	1.7	4.1	1.2	2.2
Stainless steel	1.9	2.2	4.6	1.2	1.5

(Not specified values)

■ IO-SEAL-300 LLC Resistance Test Data

Item \ Curing conditions	Initial	500 h	1,000 h
Tensile lap-shear strength (Al/Al) MPa	1.3	1.4	1.2

Test conditions: Tensile lap-shear strength is measured after immersion in LLC.
LLC: TOYOTA SUPER LONG LIFE COOLANT
(50/50 dilution weight ratio in tap water)
Temperature conditions: 120°C

(Not specified values)

■ Primer for Addition Cure Type Liquid Silicone Rubber

General Properties

Item \ Product name	PRIMER-PI
Appearance	Yellow
Viscosity at 25°C mm²/s	0.8
Non-volatile content 105°C x 3 h %	5.0
Solvent	Ethyl acetate
Standard drying conditions	23°C × 30 min

(Not specified values)

Adhesive Properties with Various Adherend

Adherend	PRIMER-PI	Adherend	PRIMER-PI
PI	+	Ceramic	+
PPS	+	Tin plate	±
PBT	+	Ni	+
Polycarbonate	+	SUS	+
Acrylic	+	Cr	+
Nylon	+	Cu	+
Glass epoxy	+	Sn	+

Adhesives and Sealants (Heat Curing)

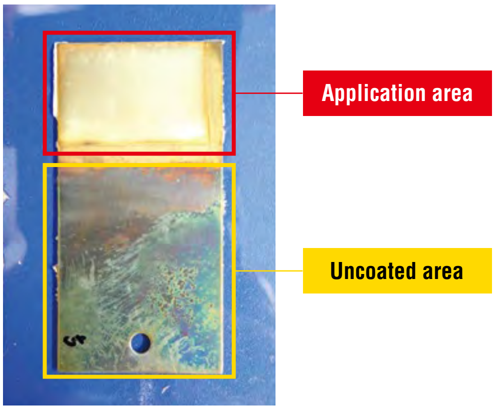
Item \ Product name	KE-8101	IO-SEAL-300	M-BARRIER-02	KE-1858-D2	FE-61
Curing method	One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing
Reaction form	Addition	Addition	Addition	Addition	Addition
Brief description	High strength	LLC resistance*3	Sulfurization prevention	Cure inhibition counter part product Storage at room temperature possible	Oil resistance
LMW siloxane content ΣD_3-D_{10}*1 ppm	< 100	—	< 300	—	—
Flame resistance UL94	—	—	—	—	—
Before curing					
Appearance	Gray	White	Milky white	White	Grayish white
Consistency	High viscosity*2	Medium viscosity	Medium viscosity	Medium viscosity	Medium viscosity
Viscosity Pa·s	72	50	27	45	60
Recommended curing conditions	120°C × 1 h	100°C × 1 h*4	150°C × 1 h	120°C × 1 h	
After curing					
Density g/cm^3	1.15	1.23	1.48	1.24	1.43
Hardness Durometer A	64	31	27	52	25
Tensile strength MPa	6.2	2.8	1.4	5.0	1.7
Elongation at break %	250	270	150	150	170
Volume resistivity TΩ·m	150	—	—	—	2.0
Dielectric breakdown strength kV/mm	40	—	28.2	—	18
Relative permittivity 50 Hz	—	—	3.66	—	6.5
Dielectric dissipation factor 50 Hz	—	—	1×10^{-3}	—	1×10^{-2}
Tensile lap-shear strength MPa	5.5 (Al)	1.5 (PPS)	0.8 (Al)	1.7 (Al)	1.9 (Al)

*1 Low molecular weight siloxane is measured in cured products.
*2 Shear viscometer
*3 LLC=Long Life Coolant
*4 Our quality assurance terms are 120°C × 1 h.

(Not specified values)

Sulfuration-resistant Silicone Sealant M-BARRIER-02 Sulfurization Test

It suppresses the permeation of hydrogen sulfide and can be expected to have the effect of preventing the sulfidation of electronic substrates.



Apply material on Ag plate
Test conditions: H_2S=15 ppm/40°C × 90% RH × 48 h

KE-1858-D2 Cure Inhibition Validation Data

This product is not affected by S and N compounds, which are cure inhibitors.

Products	KE-1858-D2 (cure inhibition countermeasure)	Conventional product
Contact surface with butyl rubber (containing S compound)	Cure	Does not cure
Contact surface with an amine (N compound) attached metal	Cure	Does not cure

Heating conditions: 120°C × 1 h

(Not specified values)

A material is coated on a butyl rubber and an amine-attached metal which serve as a curing inhibitor, and the presence or absence of curing is confirmed under a predetermined curing condition.

Potting Agents (Rubber)

Item \ Product name	KE-260-A/B	KE-1292-A/B	KE-1280-A/B	KE-1282-A/B	KE-1283-A/B	KE-109E-A/B	KE-106F
Curing method	Two-component room temperature curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing
Reaction mechanism (by-product gas)	Condensation (Alcohol)	Addition	Addition	Addition	Addition	Addition	Addition
Brief description	Rapid cure, no cure inhibition	Flame resistance	Low specific gravity, flame resistance	Low hardness	Flame resistance, low-hardness, for LED displays	Transparent, low elastic, flame resistance	Transparent, high strength
LMW siloxane content ΣD_3-D_{10}* ppm	< 300	< 300	—	< 500	—	—	—
Flame resistance UL94	—	V-0	V-0	—	V-1	HB	—
Before curing							
Appearance	A:Black/B:White	A:Black B:Grayish white	A:Black B:Milky white	A:Black B:Grayish white	A:Black B:Milky white	A/B:Transparent	KE-106F/CAT-106F: Transparent
Viscosity Pa·s	A:2.3/B:3.3	A:5.0/B:2.0	A:2.0/B:1.3	A:2.8/B:1.6	A:2.6/B:1.3	A/B=1:1	2.6
Mix ratio	100:100	100:100	100:100	100:100	100:100	100:100	100:10
Pot life min	1 h (Flow stop time)	48 h	480	240	300	240	120
Recommended curing conditions	23 ± 2°C/ 50 ± 5% RH × 3 days	80°C x 2 h	120°C x 1 h	90°C x 2 h	80°C x 2 h	100°C x 1 h	150°C x 30 min
After curing							
Density g/cm^3	1.00	1.48	1.01	1.32	0.96	1.00	1.02
Hardness Durometer A	27	37	24	11	10 (Asker C)	25	52
Tensile strength MPa	0.7	1.8	0.6	0.7	0.2	1.3	5.9
Elongation at break %	130	140	140	160	300	140	100
Volume resistivity TΩ·m	2.7	13	1.0	1.0	1.0	6.0	56
Dielectric breakdown strength kV/mm	23	30	25	24	24	23	29
Relative permittivity 50Hz	2.9	2.8	4.1	3.2	4.0	2.8	3.0
Dielectric dissipation factor 50 Hz	8.0×10^{-4}	6×10^{-4}	1×10^{-3}	1×10^{-3}	1×10^{-3}	6×10^{-4}	3×10^{-4}
Tensile lap-shear strength MPa	0.4 (Al)	0.6 (Glass epoxy)	0.2 (Al)	0.4 (Al)	0.2 (Al)	0.2 (Al)	—
Thermal conductivity W/m·k	—	0.55	0.25	0.4	—	—	—

* Low molecular weight siloxane is measured in cured products.

(Not specified values)

Two-component Room Temperature Cure Potting Agent KE-260-A/B Curability Data

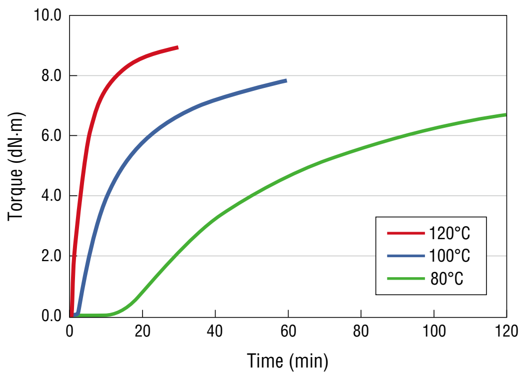
Item \ Time	23°C × 1 day	23°C x 2 days	23°C × 3 days
Hardness Durometer A	23	25	27
Elongation %	140	120	130
Tensile strength MPa	0.65	0.67	0.66
Tensile lap-shear strength (Al/Al) MPa	0.20 (CF100)	0.30 (CF100)	0.39 (CF100)

(Not specified values)

30 minutes after potting
Consistency: Liquid

3-5 hours after potting
Consistency: Rubber elastic body

Two-component Heat Cure Potting Agent KE-1292-A/B Curability Data



KE-260-A/B cures quickly at room temperature after mixing two components of A and B. After potting, it cures within 3-5 hours at 23°C and becomes a rubber elastic body. It does not require heating and has excellent deep section curability, making it suitable as a potting material for electronic components. Because it is a condensation reaction type, it is not affected by curing inhibition.

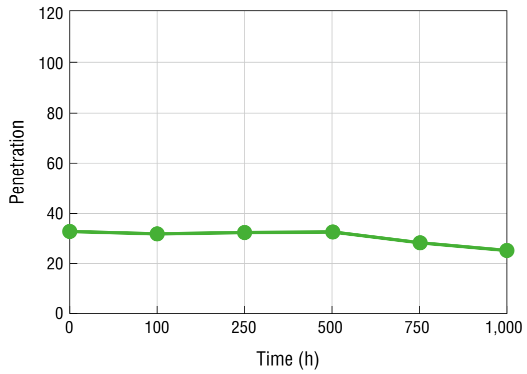
Potting Agents (Gel)

Item \ Product name	KE-1051J-A/B	KE-1063-A/B	KE-1056	KE-1061	KE-1013-A/B	KE-1066-A/B
Curing method	Two-component room temperature curing	Two-component room temperature curing	One-component heat curing	One-component heat curing	Two-component heat curing	Two-component heat curing
Reaction form	Addition	Addition	Addition	Addition	Addition	Addition
Brief description	Room temperature curing	Heat and cold resistance	Cold resistance	Heat and cold resistance	Reduced LMW siloxane products	For IGBT modules
LMW siloxane content ΣD3-D10* ppm	—	—	—	—	< 300	—
Flame resistance UL94	—	—	—	—	—	—
Before curing						
Appearance	A/B:Transparent	A/B:Pale yellow	Colorless slightly cloudy	Colorless transparent	A/B:Transparent	A:Pale yellow transparent B:Colorless slightly cloudy
Viscosity Pa·s	A:0.9/B:0.6	A:0.9/B:0.6	0.8	0.8	A/B=0.4:0.4	A:0.9/B:0.5
Mix ratio	100:100	100:100	NA	NA	100:100	100:100
Pot life min	60	240	NA	NA	120	—
Recommended curing conditions	23°C × 24 h	23°C × 24 h	130°C × 30 min	120°C × 30 min	120°C × 1 h	80°C × 1 h
After curing						
Density g/cm³	0.97	0.99	0.98	0.97	—	0.99
Hardness Durometer A	65 (Penetration)	60 (Penetration)	90 (Penetration)	90 (Penetration)	60 (Penetration)	30 (Penetration)
Tensile strength MPa	NA	NA	NA	NA	NA	NA
Elongation at break %	NA	NA	NA	NA	NA	NA
Volume resistivity TΩ·m	10	8.0	8.0	3.0	5.0	9.0
Dielectric breakdown strength kV/mm	14	14	14	14	14	16
Relative permittivity 50Hz	3.0	3.0	3.0	3.0	3.0	3.0
Dielectric dissipation factor 50 Hz	5×10^{-4}	5×10^{-4}	5×10^{-4}	5×10^{-4}	5×10^{-4}	5×10^{-4}
Tensile lap-shear strength MPa	—	—	—	—	—	0.2
Thermal conductivity W/m·k	—	—	—	—	—	—

* Low molecular weight siloxane is measured in cured products. (Not specified values)

High Reliability Silicone Gel for Power Modules KE-1066-A/B

KE-1066-A/B is a highly reliable silicone gel with excellent heat and cold resistance. Hardness (penetration which is hardness of gel) hardly changes after 230°C x 1,000 hours.



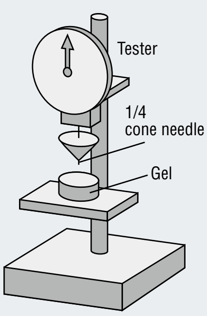
Appearance of the Encapsulant after Exposure to High Temperature (200°C × 10,000 h)

Before testing | **KE-1066-A/B** | General gel

No defects such as cracks, voids, or peeling are found in the gel after the durability test.

Hardness (Penetration)

Silicone gel has a modulus of 10^5 Nm/m² or less, so it cannot be measured with a typical rubber-hardness meter. Normally, measure the hardness (penetration) by the method shown in the figure on the right. There is also a correlation between penetration and elastic modulus.



Measurement method
Test method for consistency: JIS K 2220, 1/4 cone
Total load: 9.38 g

Conformal Coating Materials

Item \ Product name	MR-COAT-02F	KE-4971	KE-4955-T/W	KE-4920-B	KE-4914-G
Curing method	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing
Reaction mechanism (by-product gas)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)
Brief description	Solvent dilution✻2 high hardness	Low viscosity	Low viscosity	Low viscosity	Flame resistance
LMW siloxane content ΣD_3-D_{10}✻1 ppm	< 300	< 300	< 300	< 300	< 300
Flame resistance UL94	UL94 V-0 (UL746E) equivalent	V-0 (UL746E)	—	—	V-0
Before curing					
Appearance	Colorless transparent	Pale yellow transparent	T:Translucent W:White	Black	Gray
Viscosity at 23°C Pa·s	0.3	0.5	5	3.5	3
Tack-free time min	5 (200 μmt)	5	10	7	20
Recommended curing conditions	23 ± 2°C/50 ± 5% RH × 7 days				
After curing					
Density g/cm^3	1.13	0.98	1.01	1.00	1.13
Hardness Durometer A	70	20	29	26	27
Tensile strength MPa	3.0	0.4	1.1	1.0	0.8
Elongation at break %	500	110	170	200	150
Volume resistivity TΩ·m	10	10	30	—	3.0
Dielectric breakdown strength kV/mm	27	30	28	—	30
Relative permittivity 50 Hz	2.8	1.9	3.0	—	3.0
Dielectric dissipation factor 50 Hz	2×10^{-3}	6×10^{-3}	4×10^{-3}	—	3×10^{-3}
Tensile lap-shear strength MPa	—	0.1 (Glass epoxy)	0.2 (Glass)	—	0.3 (Glass)

✻1 Low molecular weight siloxane is measured in cured products. ✻2 MR-COAT-02F non-volatile content about 69 wt% (Not specified values)

Silicone Conformal Coating MR-COAT-02F

Thin-layer film formation is possible because it is solvent-diluted type and low-viscosity (300 mPa·s). Isoparaffin is used as the diluent solvent, and it is more safe than toluene and xylene.

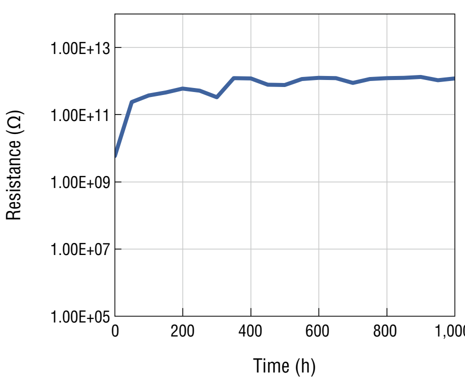
UV Curable Silicone Conformal Coating KUV-3433-UV

This is a coating material that forms a cured coating in a short time by UV radiation.
✻ After UV exposure, there is a tacky feeling on the surface. However, it will not be several days.

Elastmeric Silicone Conformal Coating KE-4971

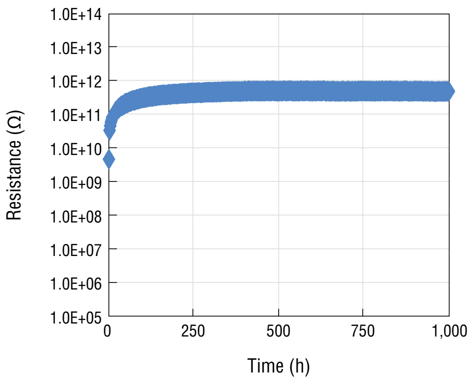
Thin-layer film formation is possible due to its low viscosity while being solvent-free.

MR-COAT-02F Migration Data



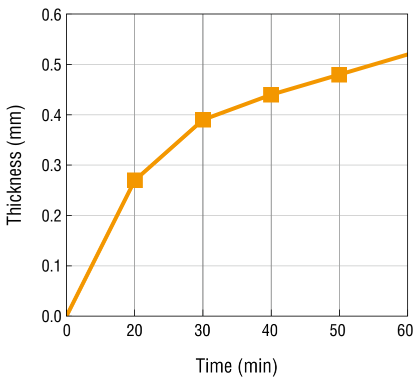
Application thickness: 200 μm, substrate: skewer-type electrode
Standing conditions: 60°C/90% RH-1,000 h
Applied voltage: 100 V

KUV-3433-UV Migration Data



Measurement result of 200 μm coating film thickness

KE-4971 Curability Data



Curing conditions: 23°C/50%RH

Conformal Coating Materials

Item \ Product name	KE-1871	KE-1846	KE-1886	M-BARRIER-01	KE-4835	KUV-3433-UV
Curing method	One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing	UV + Moisture curing	UV curing
Reaction mechanism (by-product gas)	Addition	Addition	Addition	Addition	Radical + Condensation (Alcohol)	Radical polymerization
Brief description	Heat resistance	Low temperature curing	Low temperature curing	Sulfur barrier	Curable under dark section (Combined condensation reaction)	UV fast curing oxygen-inhibiting reduction
LMW siloxane content ΣD_3-D_{10}*1 ppm	—	< 100	< 100	< 300	—	< 300
Flame resistance UL94	—	—	—	—	—	—
Before curing						
Appearance	Pale yellow translucent	Milky white	Milky white	Milky white	Milky white translucent	Translucent
Viscosity at 23°C Pa·s	0.9	7	14	7.5	6	0.8
Tack-free time min	NA	NA	NA	NA	NA	NA
Recommended curing conditions	150°C × 30 min	100°C × 1 h*2		150°C × 1h	*3	*4
After curing						
Density g/cm^3	1.01	1.02	1.03	1.47	1.01	1.01
Hardness Durometer A	27	25	29	22 (Asker C)	27	25
Tensile strength MPa	2.2	3.0	2.9	0.7	1.1	0.6
Elongation at break %	180	180	160	220	105	140
Volume resistivity TΩ·m	20	1.0	10	5.2×10^{2}	—	—
Dielectric breakdown strength kV/mm	27	10	25	—	—	—
Relative permittivity 50 Hz	2.9	25	3.1	3.3	—	—
Dielectric dissipation factor 50 Hz	2×10^{-4}	—	1×10^{-3}	1×10^{-2}	—	—
Tensile lap-shear strength MPa	0.2 (Al)	0.3 (Al)	0.6 (PBT)	0.7 (Al)	0.3 (Glass)	—

*1 Low molecular weight siloxane is measured in cured products. *2 Our quality-assurance terms are 120°C × 1 h. (Not specified values)
*3 KE-4835 Recommended curing conditions: 100 mW (metal halide lamp 365 nm) × 20 sec + 23°C/50%RH × 3 days
*4 KUV-3433-UV Recommended curing conditions: 100 mW (metal halide lamp 365 nm) x 40 sec. After UV irradiation, there is a tacky feeling. However, it will not be several days. After the surface tack disappears, the rubber physical properties are measured.

Curing Coating Valve CV-12

- Achieves a sharp coating edge without scattering to avoid areas prohibited for coating
- Applicable viscosity range 1-100 mPa·s

Spray Coating Valve Liquid Spray Valve System SV-6 series

- Uniform film thickness by dedicated nozzle
- Low-pressure atomization prevents scattering.
- Cylindrical inner surface coating specifications are also available.

Full Automatic Substrate Coating System COATING MASTER FCD1000

- Compatible with complex coating shapes with high-density mounting for precision coating
- Equipped with dual-head function to separate curtain coating and spot coating

● **Manufactured by Musashi Engineering, Inc.**
https://www.musashi-engineering.co.jp/

Curtain Coating SV70

- Linear coating with no uneven or scattered coating at the start and end of coating and side is possible
- Compatible with high-speed coating to realize drastic tact reduction

Spray Coating SV01CS

- Spray-controlled high-viscosity materials can be used up to 10,000 cps.
- Achieves high-precision non-contact spraying with reduced scattering

● **Manufactured by SAN-EI TECH LTD.**
https://www.san-ei-tech.co.jp/

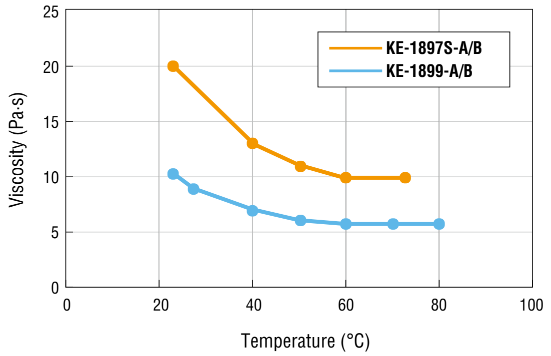
Thermal Interface Materials (Adhesives / Sealants, Potting Materials)

Item \ Product name	KE-4916-B	KE-4961-W	KE-4962-W	KE-1867	KE-1891	KE-8002 -A/B	KE-8006 -A/B	KE-1897S -A/B
Curing method	One-component room temperature curing	One-component room temperature curing	One-component room temperature curing	One-component heat curing	One-component heat curing	Two-component room temperature curing	Two-component room temperature curing	Two-component heat curing
Reaction mechanism (by-product gas)	Condensation (Alcohol)	Condensation (Alcohol)	Condensation (Alcohol)	Addition	Addition	Addition	Addition	Addition
Brief description	Adhesive semi-sag	Adhesive Non-flowing	Adhesive Non-flowing	Adhesive Non-flowing	Adhesive Non-flowing	Adhesive Non-flowing	Adhesive Flowable	Adhesive Flowable
Thermal conductivity W/m·K	0.82	1.6	2.4	2.2	4	1.7	2.2	2.1
Recommended Use	Adhesive seal	Adhesive seal	Adhesive seal	Adhesive seal	Adhesive seal	Adhesive seal	Potting	Potting
LMW siloxane content ΣD_3-D_{10}* ppm	< 300	< 300	< 300	< 300	< 300	< 300	< 300	< 300
Flame resistance UL94	V-0	V-0	V-0	V-0	V-0	V-0 equivalent	V-0 equivalent	V-0
Before curing								
Appearance	Black	White	White	Gray	Grayish white	A:White/B:Gray	A:Gray/B:White	A:Gray/B:White
Consistency	High viscosity	Paste	Paste	Medium viscosity	Paste	Paste	Low viscosity	Low viscosity
Viscosity Pa·s	90	NA	NA	70	NA	A:66/B:81	A:12/B:7.5	A:13/B:7.0
Tack-free time min	7	1	2	NA	NA	NA	NA	NA
Mix ratio	NA	NA	NA	NA	NA	100:100	100:100	100:100
Workable time (reference) at 23°C min	NA	NA	NA	24 h	—	2 h	2 h	48 h
Recommended curing conditions	23 ± 2°C/50 ± 5% RH × 7 days			120°C × 1 h		23°C × 24 h		120°C × 1 h
After curing								
Density g/cm³	1.62	2.34	2.65	2.92	3.06	2.78	2.75	2.78
Hardness Durometer A	62	80	88	75	96	56	23	15
Tensile strength MPa	2.4	3.9	4.4	2.1	5.3	1.3	0.4	0.3
Elongation at break %	60	60	30	60	10	50	39	80
Volume resistivity TΩ·m	3.0	1.0	1.0	1.2	3.4	0.2	—	0.1
Dielectric breakdown strength kV/mm	30	24	25	23	25	25	—	17
Relative permittivity 50Hz	4.2	4.3	4.9	6.7	—	7.0	—	6.0
Dielectric dissipation factor 50Hz	1×10^{-1}	1×10^{-1}	1×10^{-1}	4.5×10^{-3}	—	8×10^{-3}	—	1×10^{-2}
Tensile lap-shear strength (Al/Al) MPa	1.2	0.7	0.8	0.8	0.8	0.6	0.3	0.2

* Low molecular weight siloxane is measured in cured products.

(Not specified values)

KE-1897S-A/B, KE-1899-A/B Mixed Viscosity Temperature Dependence



KE-8002-A/B Adhesion Expression Rate

	23°C × 6 h	23°C × 8 h	23°C × 12 h	60°C × 30 min
Tensile lap-shear strength (Al/Al) MPa	Uncured	0.5	0.6	0.6

(Not specified values)

SDP-9550-A/B Dielectric Constant Frequency Characteristics

Item \ Product name	SDP-9550-A/B					
Frequency	100 Hz	1 kHz	10 kHz	100 kHz	500 kHz	1 MHz
Dielectric constant	11.39	10.34	9.76	9.18	8.53	8.29

(Not specified values)

Thermal Interface Materials (Potting Materials, Gap Fillers)

Item \ Product name	KE-1899-A/B	KE-8001-A/B	G-1000	SDP-3560-A/B	SDP-5040-A/B	SDP-6560-A/B	SDP-9550-A/B
Curing reaction	Two-component heat curing	Two-component heat curing	One-component room temperature curing	Two-component room temperature curing	Two-component room temperature curing	Two-component room temperature curing	Two-component room temperature curing
Reaction mechanism (by-product gas)	Addition	Addition	Condensation (Acetone)	Addition	Addition	Addition	Addition
Brief description	Adhesive and flowable	Adhesive and flowable	Non-adhesive non-flow	Non-adhesive non-flow	Non-adhesive non-flow	Non-adhesive non-flow	Non-adhesive non-flow
Thermal conductivity W/m·K	2.9	3.2	2.4	3.7	5.1	6.5	9.5
Recommended Use	Potting	Potting	Gap filler	Gap filler	Gap filler	Gap filler	Gap filler
LMW siloxane content ΣD_3-D_{10}[*1] ppm	< 300	< 300	< 300	< 300	< 300	< 300	< 300
Flame resistance UL94	V-0	V-0 equivalent	—	V-0 equivalent	V-0	V-0	V-0 equivalent
Before curing							
Appearance	A:Gray/B:White	A:Gray/B:White	White	A:White/B:Sky blue	A:Grayish white/ B:Pink	A:Grayish white/ B:Pink	A:Gray B:Light pink
Consistency	Low viscosity	Low viscosity	Paste	Paste	Paste	Paste	Paste
Viscosity Pa·s	A:26/B:17	A:33/B:20	80[*2]	A:98/B:109[*2]	A:181/B:162[*2]	A:282/B:288[*2]	A:197/B:255[*2]
Tack-free time min	NA	NA	3	NA	NA	NA	NA
Mix ratio	100:100	100:100	NA	100:100	100:100	100:100	100:100
Workable time (reference) at 23°C min	48h	48h	NA	240	240	240	240
Recommended curing conditions	120°C/1 h		23 ± 2°C/ 50 ± 5% RH × 7 days	25°C × 24 h			
After curing							
Density g/cm^3	2.99	3.04	3.04	3.10	3.27	3.34	3.05
Hardness Durometer A	16	53	40 (Asker C)	60 (Shore 00)	42 (Shore 00)	61 (Shore 00)	54 (Shore 00)
Tensile strength MPa	0.3	1.0	—	0.2	0.1	0.1	0.1
Elongation at break %	60	30	—	50	30	20	40
Volume resistivity TΩ·m	0.3	0.28	—	0.02	0.03	0.03	0.01
Dielectric breakdown strength kV/mm	17	19	14	15	21	20	14
Relative permittivity 50Hz	—	7.0	—	—	—	—	—
Dielectric dissipation factor 50Hz	—	9×10^{-3}	—	—	—	—	—
Tensile lap-shear strength (Al/Al) MPa	0.2	0.5	NA	NA	NA	NA	NA

*1 Low molecular weight siloxane is measured in cured products. *2 Malcolm viscometer

(Not specified values)

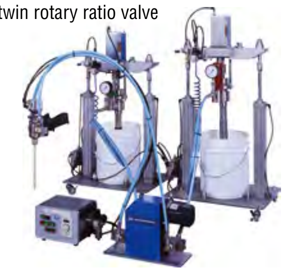
MPP-3 Two-component Thermal Interface Material Application System MPP-3-GF-MINI

- Compatible with supply of pail cans.
- Discharge method is volumetric type.
- Accurate mix ratio control is possible.

● **Manufactured by Musashi Engineering, Inc.**
https://www.musashi-engineering.co.jp/

ECO-FLOW-R

- Volumetric mixing and discharging from a pail can is possible.
  It contributes to the reduction of material loss
- Stable discharge rate is achieved by adopting a twin rotary ratio valve



● **Made by Naka Liquid Control Co., Ltd.**
https://www.nlc-dis.co.jp/

MP-202 KN-J Type

- For potting materials with high filler fill
- Continuously measurable snake pump system with high durability against filler
- Timer can be used to control a small amount of discharge.

● **Manufactured by Nippon Sosey Kogyo Corporation**
https://www.sosey.co.jp/

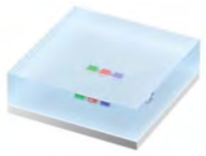
■ For LED Devices (Encapsulants)

Item \ Product name	KER-2936-A/B	KER-2937-A/B	KER-6020-A/B	KER-6110-A/B	ASP-1120-A/B	ASP-2031-A/B	SCR-1016A/B
Curing method	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing	Two-component heat curing
Reaction form	Addition	Addition	Addition	Addition	Addition	Addition	Addition
Brief description	For high power	For high power	For middle power	For middle power	Gas barrier	Gas barrier	Gas barrier
Recommended use	Encapsulant	Encapsulant	Encapsulant	Encapsulant	Encapsulant	Encapsulant	Encapsulant
Refractive index (pre-cure) 23°C/589 nm	1.41	1.41	1.43	1.43	1.55	1.57	1.52
Before curing							
Appearance	A:Pale yellow transparent/ B:Colorless transparent	A:Pale yellow transparent/ B:Colorless transparent	A:Colorless transparent/ B:Colorless transparent to colorles slightly cloudy	A:Colorless transparent to creamy white translucent/ B: Colorless transparent	A:Colorless to pale yellow transparent B: Colorless transparent to creamy white translucent	A/B: Colorless transparent	A/B:Colorless transparent to pale yellow
Viscosity Pa·s	A:6.8/B:5.0	A:25.1/B:4.0	A:4.4/B:3.0	A:1.0/B:10.0	A:1.6/B:0.6	A:2.0/B:4.2	A:12/B:0.03
Mix ratio	100:100	100:100	100:100	100:100	100:100	1:4	100:100
Recommended curing conditions — 1st cure*	100°C × 1-2 h						
Recommended curing conditions — 2nd cure	150°C × 2 h		120°C × 2 h	150°C × 4 h			150°C × 5 h
After curing							
Density g/cm³	1	1.03	1.03	1.1	1.15	1.2	1.1
Hardness — Shore D	—	—	—	38	—	74	71
Hardness — Durometer A	30	50	15	88	65	—	—
Tensile strength MPa	1.8	7.1	0.5	5.4	2.5	—	—
Elongation at break %	180	170	200	50	65	—	—
Light transmissivity 400 nm/2 mm %	91	91	85	88	89	88	88
Softening point °C	-40	-40	-40	20	20	40	40
Coefficient of thermal expansion ppm — $\alpha 1$	—	—	—	70	80	75	70
Coefficient of thermal expansion ppm — $\alpha 2$	420	340	500	190	250	200	220
Oxygen transmissibility cc/m²·day	54,000	47,000	22,000	880	320	150	150

* 1st cure at 100°C for 1-2 hours is particularly effective in relieving internal stresses when used as an encapsulant.

(Not specified values)

■ Silicone for LED Devices



High transparent silicone for chip encapsulation

High transparent silicone for lens molding

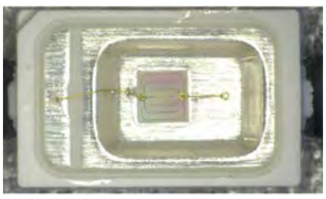
Silicone for light reflectors

■ Silver-plated Anti-sulfidation Coating Material S-BARRIER-04

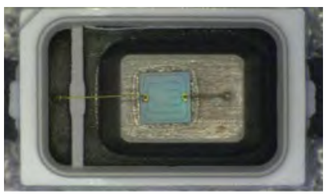
It is a coating material for anti-sulfidation purposes with high gas barrier properties.
By using it in combination with the encapsulation material, the anti-sulfidation effect of silver plating can be obtained.

Sulfur exposure test
Test methods

- 0.2 g of sulfur powder (S_8) is placed in a 100 g glass bottle, and LED packages are suspended in hollows and sealed.
- 70°C × 24 h exposure



Coated with S-BARRIER-04



No coating

For LED Devices (Die-bonding Materials, Reflector Materials (Dam Materials), Ag Plated Anti-sulfulization Materials)

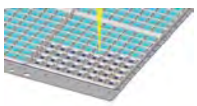
Item / Product name		KER-3001-K5	KER-3201-T3	KER-2020-DAM	KCR-H2800-M	KCR-M1000-A/B	S-BARRIER-04	AIR-7072F-A/B
Curing method		One-component heat curing	One-component heat curing	One-component heat curing	One-component heat curing	Two-component heat curing	One-component heat curing	Two-component heat curing
Reaction form		Addition	Addition	Addition	Addition	Addition	—	Addition
Brief description		High die share	Thermal conductivity	Dispenser application	Molding dicing	Dispenser coating and self-leveling properties	Gas barrier	Transmits light with a wavelength greater than 700 nm
Recommended use		Die bonding material	Die bonding material	Reflector material (Dam material)	Reflector material	Reflector material	Ag plated sulfurization measures	Infrared devices (Device encapsulation)
Refractive index (pre-cure) 23°C/589 nm		—	—	—	—	—	—	—
Before curing								
Appearance		Creamy white translucent	Creamy white translucent	White	White	A/B:White	Colorless transparent	A:Black/B: Colorless transparent to colorless slightly cloudy
Viscosity	Pa·s	34	25	Non-flowing	12	A:23/B:20	6 mm^2/s	A:42/B:0.04
Mix ratio		NA	NA	NA	NA	1:4	NA	100:100
Recommended curing conditions	1st cure*	—	—	—	—	—	50°C × 30 min	—
	2nd cure	150°C × 2 h	150°C × 2 h	120°C × 1 h	150°C × 4 h	150°C × 2 h	180°C × 30 min	150°C × 4 h
After curing								
Density	g/cm^3	1.14	2.58	1.2	1.71	1.47	—	1.07
Hardness	Shore D	61	77	—	68	29	—	70
	Durometer A	—	—	61	—	—	—	—
Tensile strength	MPa	—	—	5.7	—	9.3	—	10
Elongation at break	%	—	—	120	—	60	—	40
Light transmissivity 400 nm/2 mm	%	60	—	—	—	—	—	—
Softening point	°C	—	—	—	25	-40	—	—
Coefficient of thermal expansion ppm	α1	—	—	—	65	—	—	—
	α2	220	80	270	140	220	—	—
Oxygen transmissibility	$cc/m^2·day$	—	—	—	—	—	—	—

* 1st cure at 100°C for 1-2 hours is particularly effective in relieving internal stresses when used as an encapsulant.

(Not specified values)

Process of Silicones for LED Devices


Molding to lead frame


Application of the encapsulant by a dispenser


Molding onto wafer


The device is singulated by dicing

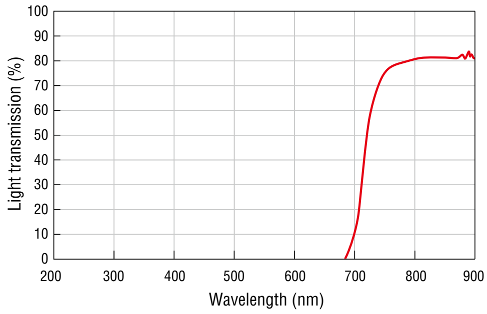

Molded into any shape (e.g. LED lenses)


The device is singulated by dicing

Infrared Device Encapsulant AIR-7072F-A/B

Since AIR-7072F-A/B blocks light below 650 nm and transmits light above 700 nm, it can be used as an encapsulant for infrared-device elements.

AIR-7072F-A/B Optical Transmission Data




Macro lens by transfer molding

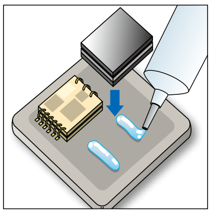
For MEMS, Sensors / Precision Components

Item \ Product name	KER-2201	KER-6201	FE-78-A/B	KER-6020-F	KER-6020-F2
Curing method	One-component heat curing	One-component heat curing	Two-component heat curing	One-component heat curing	One-component heat curing
Reaction form	Addition	Addition	Addition	Addition	Addition
Brief description	Standard Silicone gel	Cold resistance (-60°C >) Silicone gel	Oil-resistant Silicone gel	Cold resistance (-60°C >)	Cold resistance (-60°C >) High thixotropic
Usage	Protection of electrodes such as pressure sensors	Protection of electrodes such as pressure sensors	Protection of electrodes such as pressure sensors	Low elastic die bonding material Chip and wire protection	Low resilience die bonding material
LMW siloxane content ΣD_3-D_{10}*	—	—	—	< 500	< 500
Before curing					
Appearance	Colorless transparent	Colorless slightly cloudy	Colorless transparent	Creamy white translucent	Creamy white translucent
Viscosity Pa·s	0.8	0.8	A:0.8/B:0.6	23	100
Mix ratio	NA	NA	100:100	NA	NA
Recommended curing conditions	100°C × 2 h			150°C × 1 h	
After curing					
Density g/cm³	0.97	0.98	1.22	1.06	1.09
Hardness Shore D	NA	NA	NA	NA	NA
Hardness Durometer A	NA	NA	NA	20	30
Hardness Penetration	65	90	65	NA	NA
Tensile strength MPa	NA	NA	NA	1.1	1.7
Elongation at break %	NA	NA	NA	220	200
Volume resistivity TΩ·m	10	8.0	0.005	53.9	35.5
Dielectric breakdown strength kV/mm	14	14	14	25	26
Relative permittivity 50 Hz	3.0	3.0	7.0	2.9	3.1
Dielectric dissipation factor 50 Hz	5×10^{-4}	5×10^{-4}	1×10^{-2}	4.9×10^{-4}	6.8×10^{-4}

* Low molecular weight siloxane is measured in cured products.

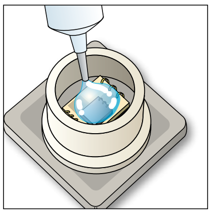
(Not specified values)

Application



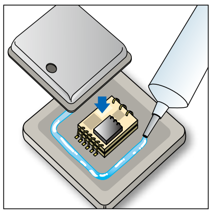
Low elastic die bonding material

- **KER-6020-F**
  Low temperature property
- **KER-6020-F2**
  Low temperature property
- **KER-4410**
  UV delayed curing



Chip encapsulant

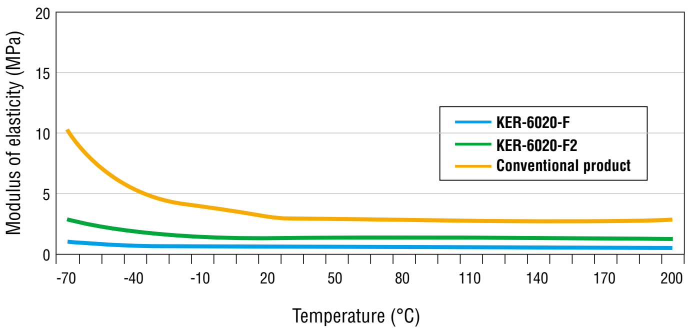
- **KER-2201**
  Standard product
- **KER-6201**
  Low temperature property
- **FE-78-A/B**
  Oil resistance



Lid sealant

- **X-32-3965BK**
  Low elasticity
- **SCR-3400-S12**
  High strength (Modified silicone)

Temperature Dependence of Modulus (KER-6020-F, KER-6020-F2)



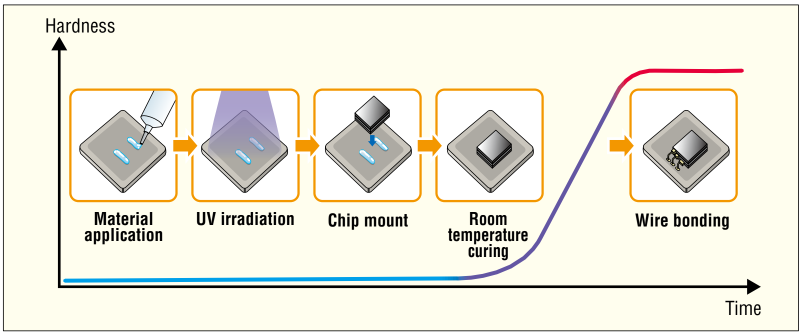
For MEMS, Sensors / Precision Components

Item \ Product name		KER-4410	X-32-3965BK	SCR-3400-S12	X-32-4081-1	KER-4304-3UV	X-32-3855
Curing method		UV delayed curing	One-component heat curing	One-component heat curing	One-component heat curing	UV curing	UV delayed curing
Reaction form		UV addition	Addition	Addition	Addition	Radical polymerization	UV addition
Brief description		UV delayed curing	High thixotropic High Elongation	Ultra-high strength Modified silicone	Solvent-free Ag paste	UV fast curing Oxygen-inhibiting product	UV delayed curing
Usage		Parts fixing, Low elastic die bonding material	Part fixing, Lid seal	Part fixing, Lid seal	Conductive adhesive	Glass lid seal	Automotive LOCA*5 Material
Thermal conductivity	W/m·K	—	—	—	4.3	—	—
LMW siloxane content ΣD_3-D_{10}*1		< 500	< 300	< 300	< 300	< 300	—
Before curing							
Appearance		Colorless slightly cloudy	Black	Creamy white translucent	Grayish white	Pale yellow transparent	Colorless transparent
Viscosity	Pa·s	60	Paste	26	78*3	60	10
Mix ratio		NA	NA	NA	NA	NA	NA
Recommended curing conditions		*2	150°C × 30 min	150°C × 4 h	120°C × 1 h	*4	*2
After curing							
Density	g/cm³	1.08	1.05	1.10	5.21	1.12	0.97
Hardness	Shore D	NA	NA	80	NA	NA	NA
Hardness	Durometer A	15	25	NA	73	58	NA
Hardness	Penetration	NA	NA	NA	NA	NA	30
Tensile strength	MPa	2.3	2.9	—	1.4	4.6	—
Elongation at break	%	350	500	—	24	80	—
Volume resistivity	TΩ·cm	—	—	—	4.1×10^{-4}(Ω·cm)	—	—
Dielectric breakdown strength	kV/mm	—	—	—	—	—	—
Relative permittivity	50 Hz	—	—	—	—	—	—
Dielectric dissipation factor	50 Hz	—	—	—	—	—	—

*1 Low molecular weight siloxane is measured in cured products. *2 KER-4410 & X-32-3855 Recommended curing conditions: 100 mW × 30s+23°C × 24 h *3 Shear viscometer (Not specified values)
*4 KER-4304-3UV Recommended curing conditions: 100 mW × 80 s (UV-LED 365 nm) *5 LOCA=Liquid Optical Clear Adhesive

UV Delayed Curing Adhesive - KER-4410 -

Since there is a time lag (open time) from UV radiation to curing, the substrate can be bonded after UV irradiation. Because it cures at room temperature (23°C), it is suitable as a base material with low heat resistance and an adhesive material for electronic devices that dislike stress deformation caused by heating.



KER-4410 Adhesion Expression Ratio

After UV radiation, the base material should be bonded within 15 minutes.
In a 23°C environment, adhesive force develops in a few hours.
Heating can also shorten the curing time.

Item \ Conditions	3,000 mJ/cm² (100 mW/cm² × 30 s)				
	23°C				80°C
	1 h	2 h	3 h	24 h	1 h
Tensile lap-shear strength (Al/Al) MPa	0.04	0.9	1.6	3.4	3.9
Hardness Durometer A after curing	Gel	Gel	4	14	15

(Not specified values)

Packaging Options / Product Index

Product name	Packaging	Storage temperature	RoHS	Page
FE-2000	120 g tube 330 mL cartridge	1–30°C	○	P13
G-1000	200 g tube 330 mL cartridge	1–30°C	○	P21
KE-3412	330 mL cartridge	1–30°C	○	P13
KE-4901-W	330 mL cartridge	1–30°C	○	P12
KE-4914-G	330 mL cartridge	1–30°C	○	P18
KE-4916-B	330 mL cartridge 20 kg can	1–30°C	○	P20
KE-4918-WF/GF	330 mL cartridge	1–30°C	○	P12
KE-4920-B	330 mL cartridge	1–25°C	○	P18
KE-4930-G	330 mL cartridge	1–25°C	○	P12
KE-4951-G	330 mL cartridge	1–30°C	○	P12
KE-4955-T/W	330 mL cartridge	1–25°C	○	P18
KE-4956-T/W	330 mL cartridge	1–25°C	○	P12
KE-4958-T/W	330 mL cartridge	1–25°C	○	P12
KE-4961-W	330 mL cartridge 20 kg can	1–30°C	○	P20
KE-4962-W	330 mL cartridge 20 kg can	1–30°C	○	P20
KE-4971	1 kg can, 18 kg can	1–25°C	○	P18
MR-COAT-02F	15 kg can	1–30°C	○	P18
KE-260-A/B	A/B 1 kg can	1–30°C	○	P16
KE-270-A/B	A/B 1 kg can	1–30°C	○	P13
KE-270G-A/B	A/B 1 kg can	1–30°C	○	P13
KE-1051J-A/B	A/B 1 kg can, 18 kg can	1–30°C	○	P17
KE-1063-A/B	1 kg can, 16 kg can	1–30°C	○	P17

Product name	Packaging	Storage temperature	RoHS	Page
KE-1189-A/B	330 mL cartridge	1–30°C	○	P13
KE-8002-A/B	1 kg can	1–30°C	○	P20
KE-8006-A/B	1 kg can	1–30°C	○	P20
SDP-3560-A/B	900 g cartridge 20 kg can	1–30°C	○	P21
SDP-5040-A/B	900 g cartridge 20 kg can	1–30°C	○	P21
SDP-6560-A/B	900 g cartridge 20 kg can	1–30°C	○	P21
SDP-9550-A/B	900 g cartridge 20 kg can	1–30°C	○	P21
FE-61	130 g tube, 1 kg can	0–10°C	○	P15
IO-SEAL-300	1 kg can	0–10°C	○	P15
KCR-H2800-M	50 g syringes	-10–10°C	○	P23
KE-1056	1 kg can, 15 kg can	0–10°C	○	P17
KE-1061	1 kg can, 16 kg can	0–10°C	○	P17
KE-1812	330 mL cartridge	0–10°C	○	P14
KE-1835-S	1 kg can	0–10°C	○	P14
KE-1846	1 kg can, 18 kg can	0–10°C	○	P19
KE-1858-D2	1 kg can	1–30°C	○	P15
KE-1867	200 g glass bottle, 330 mL cartridge, 1 kg can, 2 kg can	0–10°C	○	P20
KE-1871	1 kg can, 15 kg can	0–10°C	○	P19
KE-1875	330 mL cartridge	0–10°C	○	P14
KE-1884	100 g tube 1 kg can, 20 kg can	0–10°C	○	P14
KE-1885	100 g tube 1 kg can, 20 kg can	0–10°C	○	P14
KE-1886	100 g tube 1 kg can, 20 kg can	0–10°C	○	P19

Product name	Packaging	Storage temperature	RoHS	Page
KE-1891	300 g can, 1 kg can 20 kg can	0–10°C	○	P20
KE-8101	400 g can	0–10°C	○	P15
KER-2020-DAM	50 g syringes	-10–10°C	○	P23
KER-2201	1 kg bottle	-10–10°C	○	P24
KER-3001-K5	10 g syringes	-10–10°C	○	P23
KER-3201-T3	10 g syringes	-10–10°C	○	P23
KER-6020-F	30 g syringes	-10–10°C	○	P24
KER-6020-F2	10 g syringes	-10–10°C	○	P24
KER-6201	1 kg bottle	-10–10°C	○	P24
M-BARRIER-01	1 kg can, 20 kg can	-10–10°C	○	P19
M-BARRIER-02	330 mL cartridge 20 kg can	-10–10°C	○	P15
S-BARRIER-04	400 g bottle	1–30°C	○	P23
SCR-3400-S12	6 g syringes	-10–10°C	○	P25
X-32-3965BK	40 g syringes	-10–10°C	○	P25
X-32-4081-1	20 g syringes	0–10°C	○	P25
AIR-7072F-A/B	A/B 1 kg bottle	A:0–10°C B:1–30°C	○	P23
ASP-1120-A/B	A/B 1 kg bottle	A:1–30°C B:0–10°C	○	P22
ASP-2031-A/B	A:100 g bottle B:800 g bottle	A/B:1–30°C	○	P22
FE-78-A/B	A/B 1 kg bottle	A/B:1–30°C	○	P24
KCR-M1000-A/B	A:200 g bottle B:800 g bottle	A/B:1–30°C	○	P23
KE-1013-A/B	1 kg can, 16 kg can	A/B:1–30°C	○	P17
KE-1066-A/B	16 kg can	A/B:1–30°C	○	P17

Product name	Packaging	Storage temperature	RoHS	Page
KE-106F	900 g can, 18 kg can	1–30°C	○	P16
KE-109E-A/B	A/B 1 kg can, 16 kg can	A/B:1–30°C	○	P16
KE-1280-A/B	A/B 1 kg can, 18 kg can	A/B:1–30°C	○	P16
KE-1282-A/B	A/B 1 kg can, 20 kg can	A/B:1–30°C	○	P16
KE-1283-A/B	A/B 1 kg can, 9 kg can	A/B:1–30°C	○	P16
KE-1292-A/B	A/B 1 kg can, 20 kg can	A/B:1–30°C	○	P16
KE-1897S-A/B	1 kg can, 20 kg can	A/B:1–30°C	○	P20
KE-1899-A/B	1 kg can, 20 kg can	A/B:1–30°C	○	P21
KE-8001-A/B	1 kg can, 20 kg can	A/B:1–30°C	○	P21
KER-2936-A/B	A/B 500 g bottle	A/B:1–30°C	○	P22
KER-2937-A/B	A/B 1 kg bottle	A/B:1–30°C	○	P22
KER-6020-A/B	A/B 1 kg bottle	A/B:1–30°C	○	P22
KER-6110-A/B	A/B 1 kg bottle	A/B:1–30°C	○	P22
SCR-1016-A/B	A/B 1 kg bottle	A/B:1–30°C	○	P22
KE-4835	330 mL cartridge	1–30°C	○	P19
KUV-3433-UV	1 kg can, 18 kg can	1–30°C	○	P19
KER-4304-3UV	30 g syringes	1–30°C	○	P25
KER-4410	30 g syringes	0–10°C	○	P25
X-32-3855	1 kg bottle	-10–10°C	○	P25

One-component room temperature curing / One-component heat curing
Two-component room temperature curing / Two-component heat curing
UV + moisture curing / UV curing / UV delayed curing

■ Precautions Related to Storage

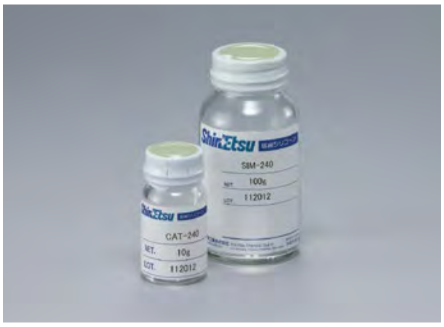
1. Store in accordance with the strage temperature, out of direct sunlight.
2. Once products have been opened, the entire contents should be used at one time whenever possible. If some remains, be sure to seal the container completely.

Packaging

We offer a variety of packaging options, based on product characteristics and for optimal usability.

Some of the available packaging options

Syringes



Glass bottles

Tubes / cartridges

1 kg cans

Plastic bottles

Metal cans (pail cans / round cans / square cans)

Plastics

Grade	Flame Class	RTI		
		Elec.	Imp.	Str.
IO-SEAL-300	HB	150	150	150
KE-109E-A/B	HB	150	150	150
KE-1280-A/B	V-0	150	150	150
KE-1292-A/B	V-0	150	150	150
KE-1812	HB	150	150	150
KE-1835-S	HB	150	150	150
KE-1867	V-0	150	150	150
KE-1899-A/B	V-0	150	150	150
KE-1891	V-0	150	150	150
KE-1897S	V-0	150	150	150
KE-4901-W	V-0	105	105	105
KE-4914-G	V-0	105	105	105
KE-4916-B	V-0	105	105	105
KE-4918-WF	V-0	105	105	105
KE-4918-GF	V-0	105	105	105
KE-4951-G	V-0	105	105	105
KE-4961-W	V-0	105	105	105
KE-4962-W	V-0	105	105	105
KER-6020-F	HB	150	150	150
SDP-5040-A/B	V-0	150	150	150
SDP-6560-A/B	V-0	150	150	150
KE-1283-A/B/C＊1	V-1	105	105	105

＊1 Company name: SHIN-ETSU SILICONE TAIWAN CO., LTD.

Coating for use on Printed Wireing Boads

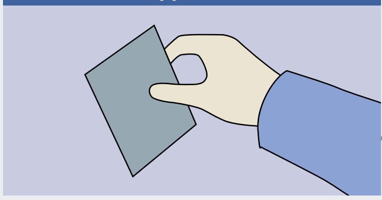
Grade	Flame Class
KE-4971＊2	V-0

＊2 Company name: SHIN-ETSU SILICONES OF AMERICA, INC.

Instructions for Use

Usage Instructions for One-component Liquid Silicone Rubbers

Clean the application surface



Clean the surface of all rust, oil, dirt, grime and other substances that may interfere with adhesion using sandpaper or a solvent (toluene, xylene, other). When cleaning plastics with solvents, use caution as some solvents may damage plastics.

To save for later use

Tubes

Remove the nozzle and seal tightly. Clean residue out of the nozzle using a solvent.

Cartridges

Product should be used all at once if possible. If product remains, seal tightly before storage. If tightly sealed, the product can be kept for several days.

Tubes

Open the tube and load it into the dispenser cartridge .

Cartridges

Cut the nozzle tip and load the cartridge into the dispenser cartridge.

Application can be done by machine or by hand

Photo provided by Musashi Engineering Inc.

Usage Instructions for Two-component Liquid Silicone Rubbers

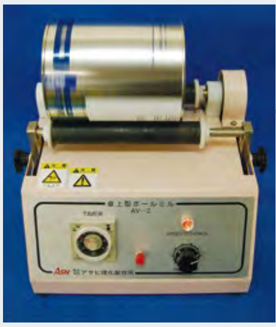
Before use

For Two-component liquid silicone rubbers, please check the mix ratio thoroughly.
All ratios are given in parts by weight. Put the base polymer (A) into a container, followed by the curing agent (B). Mix thoroughly until evenly mixed throughout.
Be sure to deaerate the product after mixing. When using a planetary-centrifugal type mixer/deaerator, friction within the product can cause a sharp rise in temperature. Also be aware that with certain low viscosity products, there may be some settling of the fillers during storage. Before use, first agitate well to disperse the fillers and then proceed to mixing the two components.

To store

Be sure to seal the product tightly before storage. Use a solvent or other cleaning agent to clean stirrers, containers and other tools used in the mixing process after use.

Stir before use



Fillers may settle to the bottom of the container, so be sure to stir thoroughly with a suitable implement prior to use.

Weigh

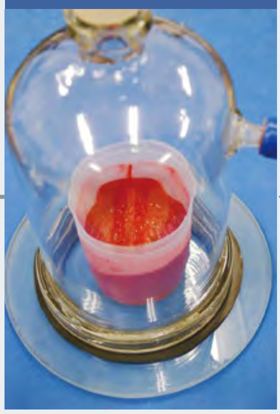
Weigh out both the base polymer and curing agent.

Combine

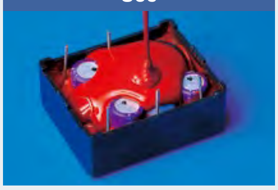
Mix

Combine the base polymer and curing agent, and mix until color is uniform and consistent.

Deaerate



Use



After mixing and deaeration, immediately pour into place.

Handling Precautions

Handling Precautions

1. One-component condensation-cure liquid silicone rubbers cure by reacting with moisture in the air, and curing starts at the surface. Curing speed is affected by temperature, humidity and other conditions. These products do not have particularly good deep-section cure properties, and are thus not suitable for adhesive applications in which the contact area is large. Additionally, if the product is used when humidity is above 100% and water droplets form on the rubber during the cure process, a hydrolysis reaction will proceed ahead of the crosslinking curing reaction, in which case the rubber may have reduced strength or exhibit surface tack after curing.
2. Although they are not featured in this catalog, certain one-component condensation-cure liquid silicone rubber products (including acetic acid-release and oxime-release types) may cause metal corrosion. Acetic acid-release types can cause rust, while oxime-release types can cause corrosion of copper-based metals in airtight conditions. The user should thus conduct a preliminary test with a sample to determine whether the product is suited to the intended application.
3. Condensation-cure liquid silicone rubbers will show a temporary decline in dielectric properties during the cure process. In most cases, however, the rubber will recover and exhibit its intrinsic dielectric properties when fully cured.
4. If product gets on the floor, it will become slippery. Wipe the product to remove completely.
5. Condensation-cure liquid silicone rubber products should not be used in places where completely airtight conditions will be created.
6. Condensation-cure liquid silicone rubbers may yellow over time, but their other characteristics will not be affected.
7. Addition-cure liquid silicone rubber products may not cure properly if they are contaminated with or come in contact with certain cure-inhibiting substances (e.g. sulfur, phosphorus, nitrogen compounds, water, organometallic salts). See “Cure inhibitors” on p.8.
8. Addition-cure liquid silicone rubber products should not be used in high humidity conditions, as this can result in curing problems or poor adhesion.
9. Be aware that addition-cure liquid silicone rubber products release tiny amounts of hydrogen gas as they cure.
10. The cure properties, physical properties, and adhesiveness of UV-cure products may vary depending on the wavelength and intensity of the light source, the irradiation angle, and the thickness of the material. In particular, increasing the intensity and shortening the irradiation time can have significant effects on the material's physical properties, even if the cumulative light dose is the same. Be sure to experiment and determine which curing conditions will work best.
11. The UV dose required to cure the UV-cure products completely will vary depending on the amount applied and the application area.

Precautions for Using

1. Please contact your sales representative if you have any questions regarding the handling and use of these products.
2. Be sure to clean the substrate to remove dirt, grime, moisture and oil from the surface.
3. When using two-component products, be sure to measure, mix, stir and deaerate thoroughly. If these steps are not done properly, it may adversely affect the properties of the rubber.
4. When using an air gun applicator, be sure to set the pressure at a safe and suitable level, around 0.2–0.3 MPa MAX.
5. KE-260-A/B, KE-270-A/B, KE-270G-A/B and KE-1189-A/B cure quickly at room temperature. When using these products, use of a special dispenser is recommended.
6. KE-260-A/B, KE-270-A/B, KE-270G-A/B liquid A contains curing agents. The curing agents undergo hydrolysis when exposed to moisture, meaning it is best to use the entire contents of the container soon after opening.

Safety and Hygiene

1. Be sure there is adequate ventilation when using condensation-cure liquid silicone rubber products. As condensation-cure liquid silicone rubber products cure, acetic acid-cure products release acetic acid; alcohol-cure products release methanol; oxime-cure products release methyl ethyl ketoxime (MEKO); and acetone-cure products release acetone. If you experience unpleasant symptoms when using these products, move to an area with fresh air.
2. Uncured liquid silicone rubber products may irritate skin and mucous membranes. Take care to avoid eye contact or prolonged contact with the skin. In case of accidental eye contact, immediately flush with water for at least 15 minutes and then seek medical attention. In case of skin contact, wipe off immediately with a dry cloth and then wash thoroughly with soap and water. Contact lens wearers must take special care when using liquid silicone rubber: if uncured liquid silicone rubber enters the eye, the contact lens may become stuck to the eye.
3. Never touch or rub the eyes while working with these products. Users should wear safety glasses and take other appropriate steps to protect their safety.
4. If product gets on the floor, it will become slippery. Wipe the product to remove completely.
5. These liquid silicone rubber products are classified as Class 4 Hazardous Materials or Designated Combustibles (combustible solids and synthetic resins) under the Fire Service Act of Japan. In your country, other laws may apply. Be sure that storage of these products is done in accordance with local laws with regard to labeling and other issues.
6. Keep out of reach of children.
7. Be sure to read the Safety Data Sheets (SDS) for these products before use. SDS are available from the Shin-Etsu Sales Department.

Precautions Related to Storage

1. Store at room temperature (1–30°C), out of direct sunlight. Note that certain products must be kept at 1–25°C. If the product label says “keep refrigerated”, it should be kept at temperatures of 10°C or below. See P26-P27 for storage temperature.
2. Once products have been opened, the entire contents should be used at one time whenever possible. If some remains, be sure to seal the container completely.
3. After prolonged storage of products with low vistosity and high specific gravity, oil may have separated, but it does not mean there is a problem with product. Stir the product well before using.

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- Users are solely responsible for making preliminary tests to determine the suitability of products for their intended use. Statements concerning possible or suggested uses made herein may not be relied upon, or be construed, as a guaranty of no patent infringement.
- For detailed information regarding safety, please refer to the Safety Data Sheet (SDS). Please download the SDS from our website.
  If the SDS is not listed on the website, please contact the sales department.
  SDS download URL :
  https://www.shinetsusilicone-global.com/support/sdstds
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- Users must never use the silicone products described herein for the purpose of implantation into the human body and/or injection into humans.
- Users are solely responsible for exporting or importing the silicone products described herein, and complying with all applicable laws, regulations, and rules relating to the use of such products. Shin-Etsu recommends checking each pertinent country's laws, regulations, and rules in advance, when exporting or importing, and before using the products.
-

The Development and Manufacture of Shin-Etsu Silicones are based on the following registered international quality and environmental management standards.

MS CM003 · MS CM009

Gunma Complex	ISO 9001 (JCQA-0004	ISO 14001 JCQA-E-0002)
Naoetsu Plant	ISO 9001 (JCQA-0018	ISO 14001 JCQA-E-0064)
Takefu Plant	ISO 9001 (JQA-0479	ISO 14001 JQA-EM0298)

https://www.shinetsusilicone-global.com/

This is an edited version of the product data released on Jan. 2025.

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