Shin-Etsu Silicone Products Guide

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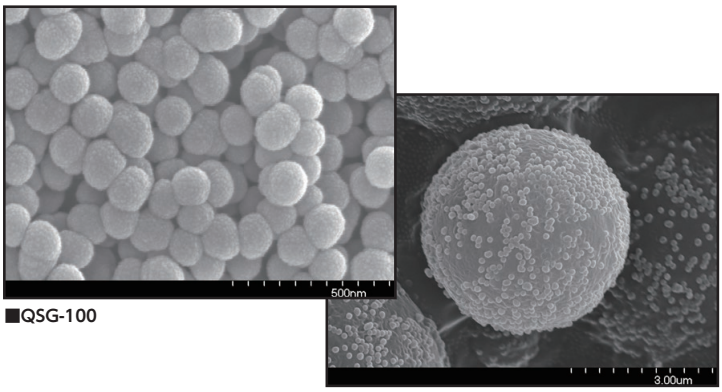
Shin-Etsu Silicone

Spherical-Silica Fine Particles

With very small average particle size, narrow distribution and its hydrophobized surface, Spherical-Silica Fine Particles have a superior flowability, dispersion, water repellency and lubricity.

Features

- Narrow particle size distribution, monodisperse and no aggregation.
- Fine adhesion to various powders and it improves the flowabilitiy



■QSG-100

■Adherence of QSG-100 to styrence particles

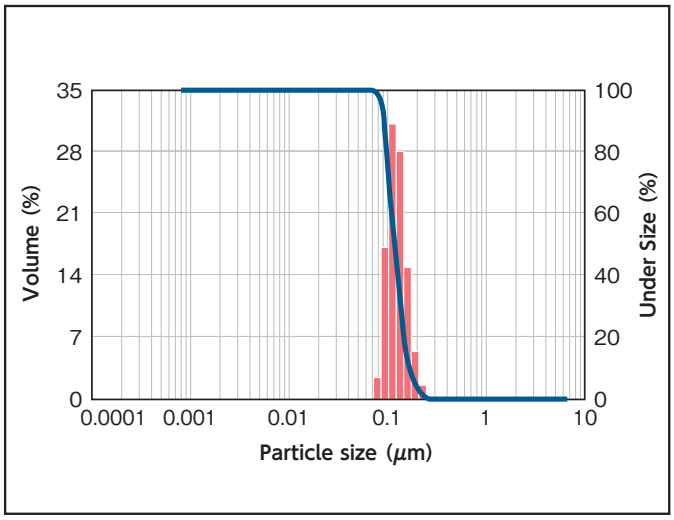
General Properties

Parameter \ Product name		QSG-10	QSG-30	QSG-100	QSG-170
Appearance		White powder			
Shape		Spherical			
Average particle size	nm*	10	30	110	170
Bulk density	g/cm³	0.46	0.46	0.44	0.44
True specific gravity		1.8	1.8	1.8	1.8
Specific surface area	m²/g	172	143	25	16
Hydrophobicity, Methanol wettability	%	67	67	67	67

* The average particles size by dynamic light scattering (Laser Doppler)

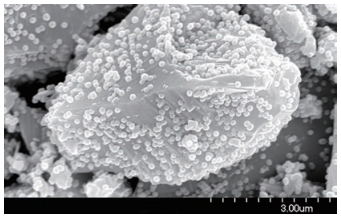
(Not specified values)

Particle Size Distribution QSG-100

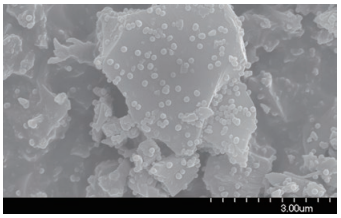


(Not specified values)

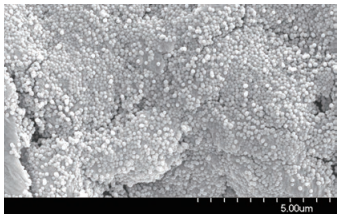
Adhesion State with Various Powders QSG-100



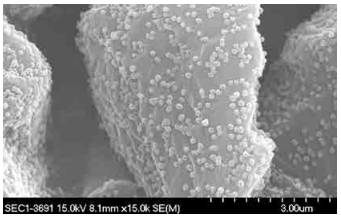
■Metal silicons



■Glass frits



■Surface of Nylons



■Polyester particles

Contact to→ Sales and Marketing Department I Phone: +81-(0)3-3246-5132

Silicones for Acrylic Resin Modification

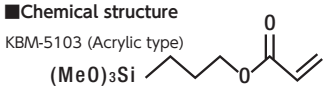
Shin-Etsu can provide a number of products suitable for modification of various types of acrylic resins, including water-based, solvent-based and UV-cure products. These function in various ways and can be used to improve durability (by improving adhesion to substrates, light resistance and heat resistance), for surface modification (e.g. by imparting water repellency and increasing hardness), or for reducing viscosity or increasing fill factor (by improving dispersion of fillers).

Inorganic – Organic Coupling Agent (Alkoxy groups + Acrylic groups)

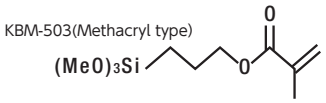
KBM-5103, KBM-503 Monomer Type

■Chemical structure

KBM-5103 (Acrylic type)



KBM-503(Methacryl type)



■Features & Benefits

Features	Benefits
High radical reactivity (especially the acrylics)	Higher strength and durability through improved adhesion

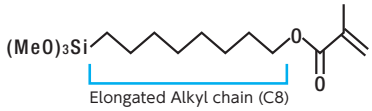
■Comparison with other radically reactive silane coupling agents

R (Functional groups)	Minimum curing dose
Vinyl	>10
Methacryloxy	5
Acrylic	2

*Silicones having acryloxy groups require smaller doses to cure completely than those with vinyl or methacryloxy groups, which is an indication of their exceptionally high radical reactivity.

KBM-5803 Long-chain Spacer Type

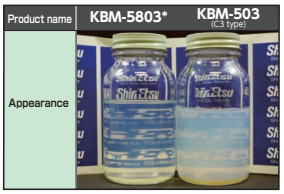
■Chemical structure



■Features & Benefits

Features (Function of longer alkyl chain length (C8))	Benefits
Improved hydrophobicity	Improved dispersion of inorganic fillers (enables lower viscosity, higher fill factors)
	Imparting water and alkali resistance
Improved flexibility	Imparting flexibility

■Comparison of inorganic filler dispersion (compared with C3 type)

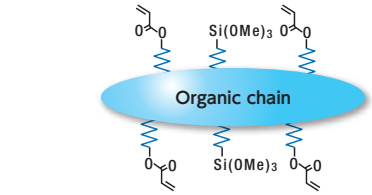


*Left: KBM-5803 by improving dispersibility, transparency was improved

Formulation
Silane treated silica 10wt%
Multifunctional acrylic compounds 90wt%

X-12-1048, X-12-1050 Polymer type

■Chemical structure

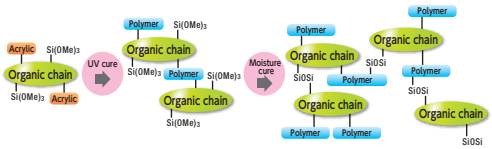


*Functional group equivalent (with Si(OR)3)
X-12-1048 = 1 X-12-1050 = 5

■Features & Benefits

Features	Benefits
High number of functional groups, good reactivity	Improved durability
High number of functional groups	Improved surface hardness
Low volatility	Active ingredient functions even at high temps.
Film forming property	Also works well as a primer
Main chain of organic groups	Excellent compatibility

■Reaction mechanism of dual cure (UV cure / moisture cure) material



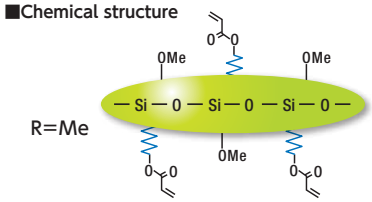
Parameter \ Product name	X-12-1050
Pencil hardness	>3H
Taber abrasion test (⊿Haze, 500g load 100 rotaions)	2.7

(Not specified values)

Silane:Curing agent:Polymerization catalyst=100:5:5 Cured film = 5μm
Curing agent = titanium butoxide Substrate = PET Cosmo Shine A4300 (0.2mm thickness)

KR-513 Siloxane type

■Chemical structure



■Features & Benefits

Features	Benefits
High number of functional groups, good reactivity	Higher strength and durability through improved adhesion
Low volatility	Good reaction stability
Main chain of siloxane skeleton	Durable against heat & light

■Comparison data of volatility with monomer type

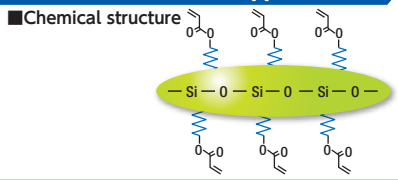
Product name	Volatile content %		
	105℃×3h	150℃×3h	180℃×3h
KR-513	3	6	7
KBM-5103	71	100	100

(Not specified values)

Related materials (siloxane+acrylic groups)

X-12-2475 Siloxane Type

■Chemical structure



■Features & Benefits

Features	Benefits
High number of functional groups	High hardness
Main chain of siloxane skeleton	Durable against heat & light

■Test result of higher hardness

Product name	Pencil hardness	Taber abrasion test (⊿Haze, 500g load 100 rotaions)
X-12-2475	3H	2.5
X-12-2430C	2H	3.0
Blank	H	4.5

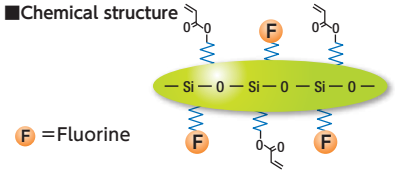
(Not specified values)

Acrylic Coating Material Blend Ratio
Dipentaerythritol triacrylate : 80 wt. part
Hexanediol diacrylate : 20 wt. part
2-Hydroxy-2-methyl-1 phenyl-plopane-1-one : 10 wt. part
The above acrylic coating / Si material = 100 / 50 wt. part

Application / Cure Method
Film thickness : about 20μm
Substrate : POLYCASE made by Sumitomo Bakelite Co., Ltd.
ECK100 clear 2mm thickness
UV curing condition : High-pressure mercury vaper lump 600mJ/cm² Nitrogen atmosphere

X-12-2430C Fluorine Contained Type

■Chemical structure



■Features & Benefits

Features	Benefits
Main chain of siloxane skeleton	Durable against heat & light
High number of functional groups	High hardness
Fluorine content	Imparting anti-stain properties
	Imparting water and oil repellency

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Silicones for Epoxy Resin Modification

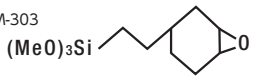
Shin-Etsu can provide a number of products suitable for modification of various types of acrylic resins, including water-based, solvent-based and UV-cure products. These function in various ways and can be used to improve durability (by improving adhesion to substrates, light resistance and heat resistance), for surface modification (e.g. by imparting water repellency and increasing hardness), or for reducing viscosity or increasing fill factor (by improving dispersion of fillers).

Inorganic – Organic Coupling Agent (Alkoxy groups + Epoxy groups)

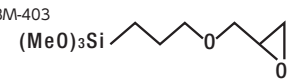
KBM-303, KBM-403 Monomer Type

■Chemical structure

KBM-303



KBM-403



■Features & Benefits

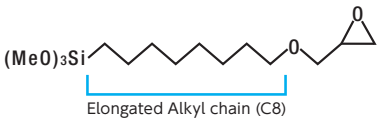
Features	Benefits
Containing epoxy groups	Higher strength and durability through improved adhesion

■Compatible resins with epoxy silane

Resin / Functional groups	Thermoplastic resins										Thermosetting resins								Elastomer / Rubber							
	Polyethylene	Polypropylene	Polystyrene	Acrylic	PVC	Polycarbonate	Nylon	Urethane	PBT, PET	ABS	Melamine	Phenolic	Epoxy	Urethane	Polyimide	Diallyl phthalate	Unsaturated polyester	Furan	Polybutadiene rubber	Nitrile rubber	Epichlorohydrin rubber	Neoprene rubber	Butyl rubber	Polysulfide	Urethane rubber
Epoxy	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+		+	+	+	+

KBM-4803 Long-chain Spacer Type

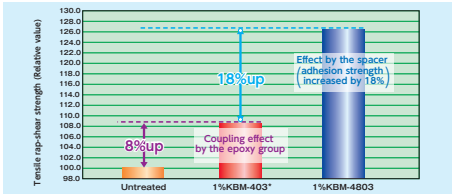
■Chemical structure



■Features & Benefits

Features Function of longer alkyl chain length (C8)	Benefits
Improved hydrophobicity	Improved dispersion of inorganic fillers (enables lower viscosity, higher fill factors)
	Imparting water and alkali resistance
Improved flexibility	Imparting flexibility

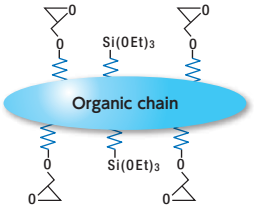
■Epoxy / glass coupling performance evaluation



KBM-403: 3-Glycidoxypropyl trimethoxysilane

X-12-981S, X-12-984S Polymer type

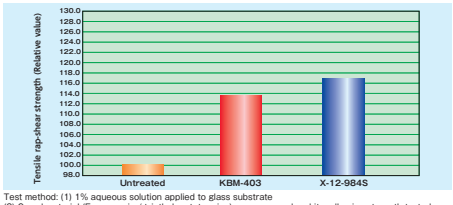
■Chemical structure



■Features & Benefits

Features	Benefits
High number of functional groups, good reactivity	Improved durability
High number of functional groups	Improved surface hardness
Low volatility	Active ingredient functions even at high temps.
Film forming properties	Also works well as a primer
Main chain of organic groups	Excellent compatibility

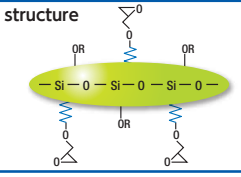
■Epoxy / glass coupling performance evaluation



Test method: (1) 1% aqueous solution applied to glass substrate
(2) Cured material (Epoxy resin / triethylenetetramine) was prepared and its adhesive strength tested.
*Adhesive strength calculated using that of untreated material (100) as the standard.
KBM-403: 3-Glycidoxypropyl trimethoxysilane

KR-516, KR-517 Siloxane type

■Chemical structure



■Features & Benefits

Features	Benefits
High number of functional groups, good reactivity	Higher strength and durability through improved adhesion
Low volatility	Good reaction stability
Main chain of siloxane skeleton	Durable against heat & light

■Comparison data of volatility with monomer type

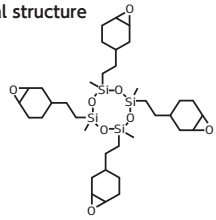
Product name	Volatile content %		
	105℃×3h	150℃×3h	180℃×3h
KR-516	7	15	20
KBM-403	34	96	-

(Not specified values)

Related materials

X-40-2670 Alicyclic epoxy silicone

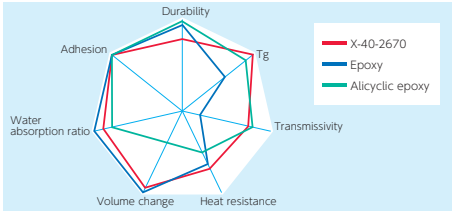
■Chemical structure



■Features & Benefits

Features	Benefits
Alicyclic epoxy groups	High reactivity, high Tg
Siloxane skeleton	Durable against heat & light
Cyclic siloxane structure	Low cure shrinkage
Single structure	Excellent compatibility makes it easy to control reactivity.

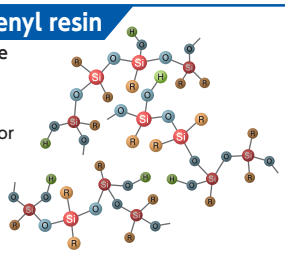
■Comparison chart with epoxy resin



KR-480 High phenyl resin

■Chemical structure

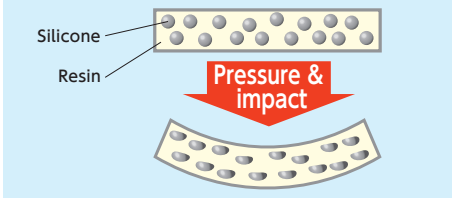
R =Methyl groups or phenyl groups



■Features & Benefits

Features	Benefits
High phenyl content	Excellent compatibility
Siloxane skeleton	Durable against heat & light
	Imparting flame retardancy
High molecular resin structure	Imparting stress relaxation

■Model of improved impact resistance



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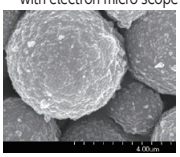
Silicone Powders

Shin-Etsu has developed a unique line of silicone powders which fall into three categories:Hybrid Silicone Powder, Silicone Resin Powder and Silicone Rubber Powder.

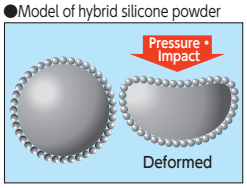
Hybrid Silicone Powder

Form : Rubber powders covered with resin

●KMP-600 by scanning with electron micro scope



●Model of hybrid silicone powder



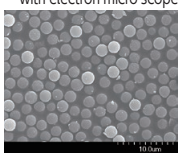
■Features

Heat resistance	+
Weatherability	++
Dispersibility into resins	++
with organic solvents	Rubber part swells

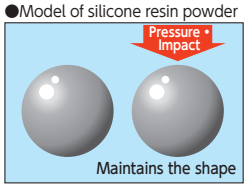
Silicone Resin Powder

Molecular structure : 3D network structure

●KMP-706 by scanning with electron micro scope



●Model of silicone resin powder



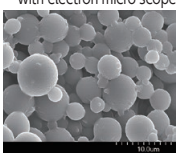
■Features

Heat resistance	++
Weatherability	++
Dispersibility into resins	++
with organic solvents	No swelling

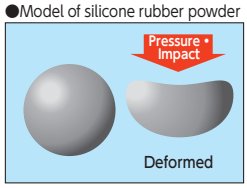
Silicone Rubber Powder*

Molecular structure: Straight-chain crosslinked polymer

●KMP-597 by scanning with electron micro scope



●Model of silicone rubber powder



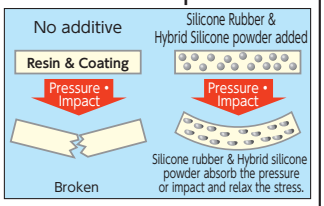
■Features

Heat resistance	+
Weatherability	++
Dispersibility into resins	±
with organic solvents	Swelling

*There are also aqueous dispersion of silicone rubber power.

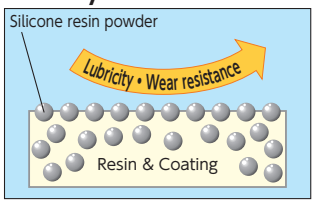
Enhanced Properties

Stress Relaxation • Impact Resistance



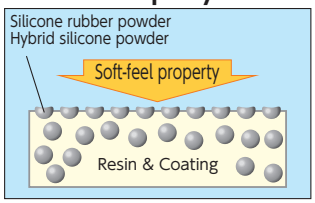
Hybrid powder	++
Resin powder	–
Rubber powder	++

Lubricity • Wear Resistance



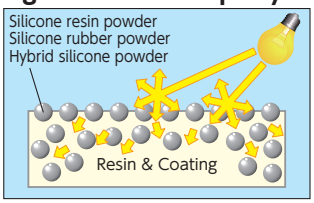
Hybrid powder	++
Resin powder	++
Rubber powder	+

Soft-feel Property



Hybrid powder	++
Resin powder	–
Rubber powder	++

Light Diffusion Property



Hybrid powder	++
Resin powder	++
Rubber powder	++

* ++ : Excellent + : Good ± : Satisfactory – : Poor

General Properties

Parameter / Type	Product name	Shape	Average particle size μm	Particle size distribution μm	True specific gravity	Moisture content %	Rubber hardness Durometer A	Refractive index	
								Rubber part	Resin part
Hybrid silicone powder	KMP-600	Spherical powder	5	1~15	0.99	0.1	30	1.41	1.43
	KMP-601	Spherical powder	12	2~25	0.98	0.1	30	1.41	1.43
	KMP-602	Spherical powder	30	4~60	0.98	0.1	30	1.41	1.43
	KMP-605	Spherical powder	2	0.7~5	0.99	0.1	75	1.42	1.43
	X-52-7030	Spherical powder	0.8	0.2~2	1.01	0.1	75	1.42	1.43
Silicone resin powder	KMP-706	Spherical powder	2	1~4	1.3	1	-	-	1.43
	KMP-701	Spherical powder	3.5	1~6	1.3	1	-	-	1.43
	X-52-1621	Spherical powder	5	1~8	1.3	1	-	-	1.43
	X-52-854	Spherical powder	0.7	0.2~5	1.3	1	-	-	1.43
Silicone rubber powder	KMP-597	Spherical powder	5	1~10	0.97	0.1	30	1.41	-
	KMP-598	Spherical powder	13	2~30	0.97	0.1	30	1.41	-
	X-52-875	Association powder	30	1~100	0.97	0.1	35	1.41	-
	KM-9729*	Emulsion	2	-	-	-	-	-	-
	X-52-1133*	Emulsion	5	-	-	-	-	-	-

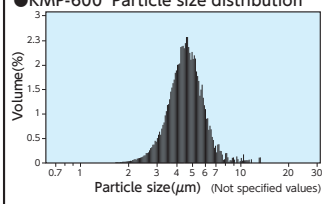
*Aqueous dispersion of silicone rubber power. By drying spherical powders are obtained.

(Not specified values)

Product Data

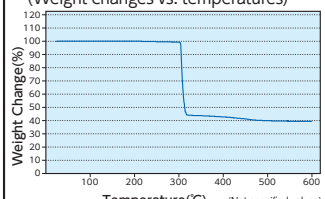
Hybrid silicone powder

●KMP-600 Particle size distribution



●KMP-600 Heat resistance

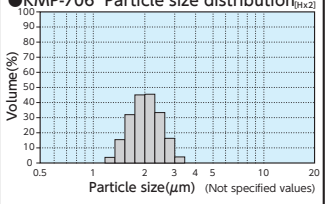
(Weight changes vs. temperatures)



Rate of temperature increase: 10℃/min Atmosphere : Air

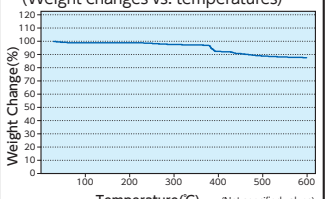
Silicone resin powder

●KMP-706 Particle size distribution



●KMP-706 Heat resistance

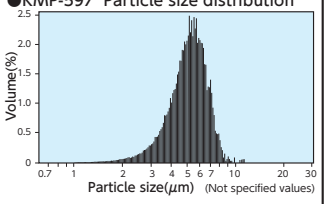
(Weight changes vs. temperatures)



Rate of temperature increase: 10℃/min Atmosphere : Air

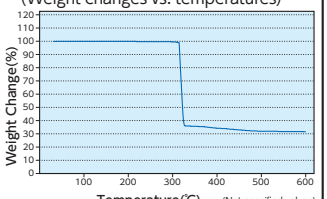
Silicone rubber powder

●KMP-597 Particle size distribution



●KMP-597 Heat resistance

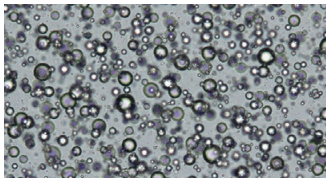
(Weight changes vs. temperatures)



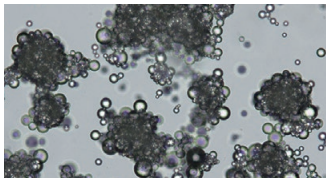
Rate of temperature increase: 10℃/min Atmosphere : Air

Dispersibility

Dispersibility in liquid epoxy resin



●Hybrid silicone powder KMP-601



●Silicone rubber powder *

*Applying a shearing force improves dispersibility of silicone rubber powders in resin.

Contact to→ Sales and Marketing Department I Phone: +81-(0)3-3246-5132

UV Cure Silicone Products

UV Addition Cure Type Liquid Silicone Rubber KER-4690-A/B

KER-4690-A/B is a UV addition cure type liquid silicone rubber.

Features

- The material loses its stickiness and becomes non-flowable after a few minutes of UV exposure.
- Visible light to wavelength 250nm is transmissive before and after cured.
- In the curing process this material is curable under room temperature.
  User does not need to be concerned about volume expansion.

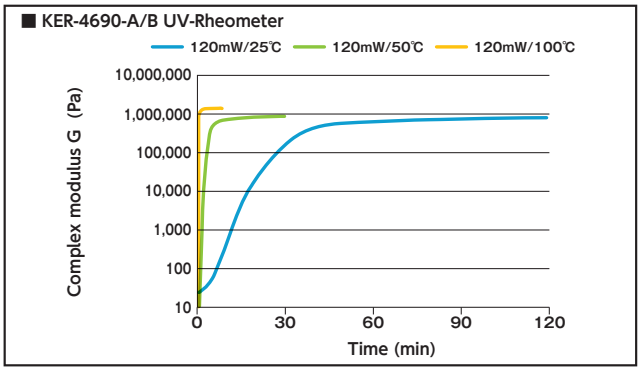
General Properties

Parameter / Grade		KER-4690-A	KER-4690-B
Appearance		Colorless transparent	
Viscosity after mixed	mPa·s	3,000	
Density	g/cm³	1.03	
Hardness Durometer A	23℃	56	
Elongation at break	%	110	
Tensile strength	MPa	7.9	
Tear strength, crescent piece	kN/m	3	
Cure shrinkage	%	0.1	

※ Cure condition : UV2,000mJ/cm2 (365nm) + 23℃ × 24h
A:B mix ratio=1:1

(Not specified values)

Reducing curing time by heating



UV Radical Cure Type Liquid Silicone Rubber KED Series

KED Series is a UV radical cure type liquid silicone rubber.

Features

- Rapid cure by UV irradiation
- Molding can be made owing to non-adhesive type.
- Product line-up with different hardness is prepared.
- Physical properties can be adjusted by mixing KED-1P and KED-2P.

General Properties

Parameter / Product name			KED-1P	KED-2P
ワンポイント			高粘度、低硬度	低粘度、高硬度
Before curing	Viscosity	mm²/s	1,380	540
	Refractive index		1.457	1.462
After curing	Hardness Durometer A		19	64
	Tensile strength	MPa	1.2	6.5
	Elongation at break	%	230	310
	Specific gravity at 25℃		1.044	1.056

Curing conditions
1. Pouring the sample into the case to make its thickness 2,0mm.
2. Irradiating UV light under N_2 atmosphere from the both of the top of the sample and back.
3. The amount of irradiating UV is 2,000mJ/cm² for each side.

(Not specified values)

Contact to→ Sales and Marketing Department Ⅳ Phone:+81-(0)3-3246-5152

Shin-Etsu Chemical Co.,Ltd.

Silicone Division
6-1, Ohtemach 2-chome, Chiyoda-ku Tokyo, Japan

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

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

CM009

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