Held inside Highly-functional Material Week

7th Paint & Coating Expo OSAKA

— COATING JAPAN —

Shin-Etsu Silicone Products Guide

Silicones Making Resins Highly Functional

Components of Resins and Coatings

Base Resins

Apply on the substrate as resin itself.

Improve other resins and impart them with the properties of silicones.

Additives

Modify the surface conditions of coatings.

Pigments & Fillers

Modify the surface of fillers to improve coating performance.

4 Usage

- Usage ① Silicone Based Resins
- Usage ② Resin Hybridization Agents
- Usage ③ Surface Modifiers for Coating
- Usage ④ Surface Modifiers for Pigments & Fillers

Shin-Etsu

Shin-Etsu Silicone

Silicones Making Resins Highly Functional

Resin compositions are mainly composed of "Base Resins," "Additives," and "Pigments & Fillers." Shin-Etsu Silicone has the following four uses and products for these three components to enhance the functionality of various resins.

INDEX

Heat Resistance

Ultra High Heat Resistant Silicone Fluid

X-25-3004

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department I
Phone : +81-3-6812-2406

■ Features and Benefits

・It can be used for long periods of time in high temperature environments of **300℃**. (Conventional product heat resistance temperature is **250℃**.)

■ Application Examples

・Heating medium oil for oil baths, circulating heating, etc.
・Lubricating oil for automotive components that require higher temperatures

■ Appearance

X-25-3004

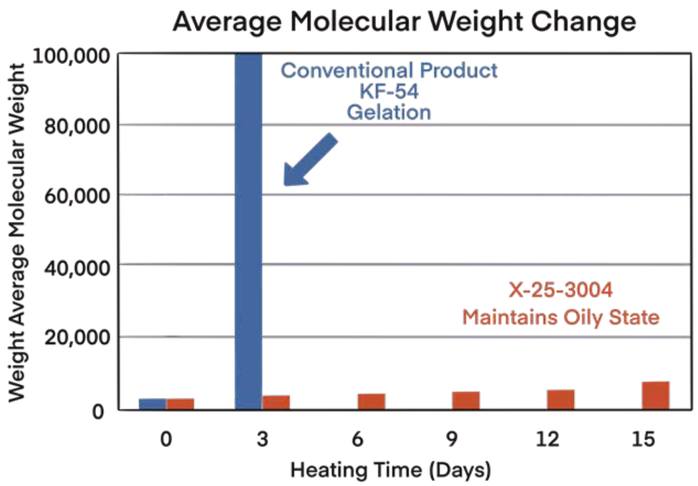
KF-54
(Conventional Product)

■ General Properties

Item \ Produc Name	X-25-3004
Appearance	Paleyellow transparent
Viscosity mm²/s	400
Specific gravity	1.07
Refractive index	1.503
Vlatile content 150℃×24h %	0.1

(Not specified values)

■ Heat Resistant Test Results at 300℃



Test method:
1. Collect 25g of sample into a 100mL beaker
2. Heated to 300℃ in open air condition

Release Property

Solventless Silicone Release Coatings for Plastic Films

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

・Solvent-free silicone release agents usually do not adhere to films, but by using adhesion improver X-92-263, it is possible to achieve adhesion while maintaining easy releasability.

■ Applications

・Release agents for films

■ General Properties

	Formulation				Appearance of formulation bath	Haze※ %
	KNS-320A	X-92-263	X-62-1387	CAT-PL-56		
1	100	—	—	2	Transparent	2.4
2	100	10	—	2	Cloudiness	2.4
3	—	—	100	2	Transparent	2.3

＊Haze: Measured on coated film (coating weight: 0.7 g/m² , PET)　Addition of X-92-263 does not change the transparency of the film.　(Not specified values)

	Label aging 25° C, 70 g/cm² ,1 day		Label aging 70° C, 20 g/cm² ,1 day		Anchorage		
	Release force N/25mm	Subsequent adhesion %	Release force N/25mm	Subsequent adhesion %	Initial	60°C,90%RH	
						1 day	3 days
1	0.10	105	0.13	102	-	-	-
2	0.09	104	0.13	103	+	+	+
3	0.47	99	2.5	99	+	+	+

Substrate: 38 μm PET film　Curing conditions: 120° C x 30 s　Coating weight: 0.7 g/m²　Liner aging: 25° C x 1 day　Tape: TESA-7475　(Not specified values)

Film coated with release agent

Release Property

Emulsion-Type Silicone Release Coatings for Plastic Films

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- Solvent-free release film manufacturing process.
- Anchorage to film substrates is improved by an anchorage promoter.

■ General Properties

Main component	Features	Release force N/50mm	Silicone migration	Anchorage		
				PET film	PE laminate	Glassine
X-52-6015	Tight release	1.50	None	++	+	+
X-52-6068	Middle release	0.35	None	+	+	+
KM-3951 (Conventional product)	Easy release	0.15	None	-	+	+

(Not specified values)

Additive	Characteristic	Standard additive amount
CAT-PM-10A	Catalyst for addition curing emulsions	5%
X-92-236	Crosslinker emulsion, improved curability and subsequent adhesion	1 -2.5%

(Not specified values)

■ Anchorage Promoter

・Formulation : KM-3951 / Water / CAT-PM-10A / Anchorage promoter = 100 / 700 / 5 / x

Anchorage promoter mix ratio x	Anchorage (Initial)	Release force N/25mm	Subsequent adhesion %
0	-	0.21	89
2.0	+	0.15	90

PET film substrate, coating weight 0.10 g/m² , 150 °C x 30 s cure, tesa7475 tape release force 25°C, 70gf/cm², 20h
Initial anchorage can be improved by adding 0.5 parts of anchorage promoter.

(Not specified values)

■ Applications

・Release agents for papers or films

Appearance of emulsion products

Release agents for stickers

Release Property

UV Cure Release Coating Silicone (Acrylic type)

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

Features and Benefits

- Easily control release force by mixing KF-2005 and X-62-7989.
- Fast cure, aging-less can save time for delivery.
- UV cure machine can save space for cure process comparing with thermal cure machine.
- Solvent-less, eco-friendly products

General Properties

Item \ Product name		KF-2005	X-62-7989
Appearance		Colorless transparent to paleyellow translucent	Colorless transparent to paleyellow translucent
Viscosity	mPa・s	400	200
Release force		Medium to easy	Easy
Classification		Base polymer	Additives for easy release

※Omnirad 1173 (photoinitiator) was added at 5%.
Use in combination with X-62-7989 for easy release
(X-62-7989 cannot be used alone.)

(Not specified values)

Release Force and Subsequent Adhesion Properties

Treatment bath composition / Item		KF-2005	100	90	80
		X-62-7989	0	10	20
Release force	N/25mm		0.10	0.08	0.07
Subsequent adhesion rate	%		99	95	95
Anchorage to substrate			+	+	+

Substrate: PEK
Coating amount: About 1.0g/m^2
Adhesive tape: TESA-7475

Treatment bath condition: Silicone/Omnirad 1173 = 100/5
UV cure conditions: Approximately 100mJ/cm^2 (365nm)
Laminate conditions: 25℃×70g/cm^2×1 day

(Not specified values)

Applications

- Thermal paper release liner
- Release liners for receipts
- Release liners for electronic components

Release liner for smartphone parts

Thermal paper release liner

Release Property

Ultra-Easy Release Silicone Release Coatings for Plastic Films (Solvent Type)

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- Ultra-easy release is possible while maintaining a high subsequent adhesion.
- High anchorage to film substrates

■ Applications

- Release agents for films

■ General Properties

Item / Product name	Appearance	Non-volatile content %	Viscosity mPa・s	Solvent
X-62-2888	Colorless transparent to paleyellow translucent	30	10,000	Toluene
X-62-2892	Colorless transparent to paleyellow translucent	30	7,000	Toluene

(Not specified values)

Item / Product name	Label aging 25°C, 70g/cm² ,1 day		Label aging 70°C, 20g/cm² ,1 day		Anchorage
	Release force N/25mm	Subsequent adhesion %	Release force N/25mm	Subsequent adhesion %	
KS-847T	0.15	100	0.24	99	+
X-62-2888	0.09	94	0.15	95	+
X-62-2892	0.08	94	0.09	93	+

Substrate: 38 μm PET film　Curing conditions: 120° C x 30 s　Coating weight: 0.2 g/m²　Liner aging: 25° C x 1 day　Tape: TESA-7475

(Not specified values)

Adhesiveness　High Transparency　Impact Absorption

High Concentration, Solvent-Free Silicone Pressure Sensitive Adhesive

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- It can be diluted with any solvent. High concentration coating is possible, making it easy to create thick films.
- The silicone layer cushions the impact.
- Highly transparent and durable.

■ Applications

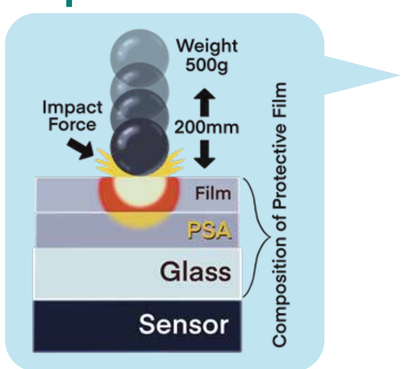
- Adhesive tape, adhesive sheet
- Shock absorbing film for displays
- Potting

■ General Properties

Item / Product name	Type	Silicone content %	Viscosity 25°C Pa・s	Sticky force N/25mm		Holding power mm		Ball tack No.	Total light transmittance % (Blank:90.4)	HAZE (Blank:1.0)	Hardness Asker C
				Room temperature	100°C×1h	Room temperature	100°C×1h				
X-40-3326	Low adhesion	100	50	0.05	0.21	0.01	0.00	<3	91.7	0.8	30
X-40-3340	Medium adhesion	100	55	1.1	1.74	0.00	0.00	10	91.3	0.7	10
X-40-3331-2	High adhesion	75	35	9.6	12.3	0.17	0.02	44	90.5	0.7	5

*PSA/CAT-PL-56=100/0.5, Substrate：PET25μm, Adhesion Thickness：100μm, Cure conditions： 130 °C×1 min　　(Not specified values)

■ Measure Method of Impact Force



■ Impact Absorption

Composition of protective film	Thickness of adhesive μm	Impact force※1 kN	Impact force ratio※2
Film + X-40-3340 + Glass	500	13.8	0.40
Film + X-40-3326 + Glass	500	10.9	0.32
Film (PET 50μm) + Glass		34.2	1.00

(Not speficied values)

*1 Impact force: The smaller the value, the better the impact absorption performance.
*2 Impact force ratio: Ratio of impact force when film (PET 50μm) + glass is set to 1.0.

Water Based　Water Repellency

Water-based Water-repellent Coating Agent (Fluorine-free)

Product Usage

Silicone Based Resins

KR-4000GE

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- It is an emulsion type of silicone resin (KR-4000G).
- Curing proceeds at room temperature without the need for a catalyst.
- Compared to conventional silicone RESIN emulsions, it has high water repellency.
- Compared to conventional silicone OIL emulsions, it has high durability.

■ Application Examples

- Antifouling coating agent

■ General Properties

Product name	KR-4000GE
Type	Methyl type resin emulsion
Viscosity at 25℃　mPa・s	300～2,000
pH	6～8
Active ingredient　%	55 (Water solution)
Recommended usage	Wipe application (thin film application)

(Not specified values)

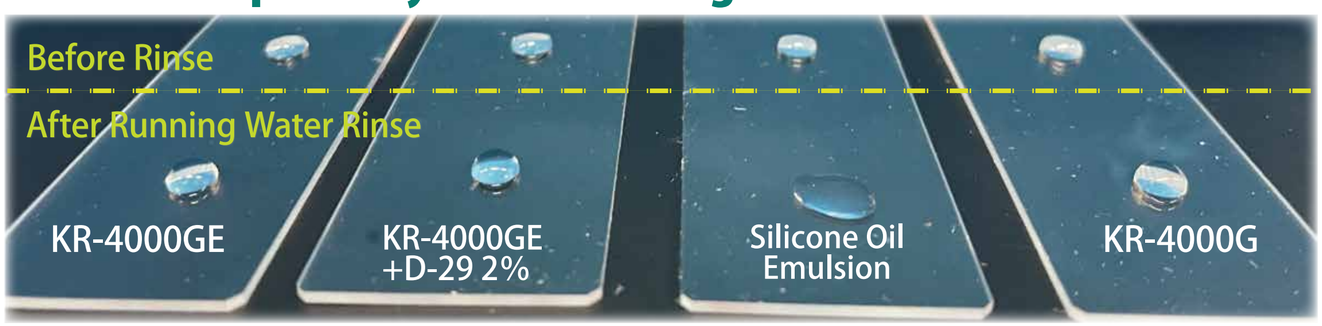
■ Coating Properties

Product name		KR-4000GE	KR-4000GE +D-29 2%※1	Silicone Oil Emulsion※2	KR-4000G※3
1 day after application	Water contact angle (2μL)	95	97	101	101
	Water fall angle (20μL)	44	44	39	37
	Magic marker cissing	+	+	-	+
Rinse under running water *4	Water contact angle (2μL)	100	101	63	100
	Water fall angle (20μL)	45	40	54	39
	Magic marker cissing	+	+	-	+

*1 Ti catalyst made by Shin-Etsu Chemical Co., Ltd.
Water repellency is observed even in aqueous solution after 3 months of mixing
*2 Water-based water-repellent coating made by Shin-Etsu Chemical Co., Ltd.
*3 Solvent-based water-repellent coating made by Shin-Etsu Chemical Co., Ltd.
*4 Rinse under running water for 10 minutes, then wipe off with tissue.

(Not specified values)

■ Water Repellency after Running Water Rinse



* The upper side is unwashed, and the lower side is after 10 minutes of running water rinse, wiping with tissue, and then dripping 0.02 mL of water onto it.

PR POINT

Although it is water-based, it has high water-repellent durability.

Emulsifier-free | Water Based | Weather Resistance | Rapid Cure | Heat Resistance | Stain Resistance

Silicone Industry's First Product※
※Researched by Shin-Etsu Chemical Co., Ltd. As of May 2024

Emulsifier-free Water-based Rapid Curing Silicone Resin

Product Usage

Silicone Based Resins

KRW-6000 Series

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- It is a water-dispersed type of silicone resin.
- A film is formed as the water evaporates at room temperature.
- It does not contain organic solvents, and the only component generated during the curing reaction is **WATER**.
- **No emulsifiers are used**, and a 100% silicone film can be formed.
- It cures at room temperature, but **the curing time can be shortened by heating for a few minutes.**
- It forms a coating that has excellent weather resistance, heat resistance, and stain resistance.

■ Applications

- Resin binder
- Photocatalytic paint binder
- Highly weather-resistant paint

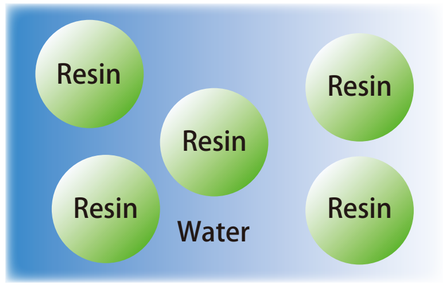
■ General Properties

Item \ Product name		KRW-6000	KRW-6001
Film hardness		Hard	Soft
Viscosity at 25℃	mm²/s	2～2,000	
pH		7～9	
Active ingredient	%	30 (Water solution)	
Recommended film thickness	μm	<10	<50

(Not specified values)

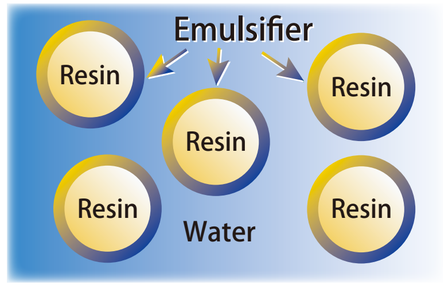
■ Structure Model

KRW-6000 Series



VS

Conventional Silicone Resin Emulsion



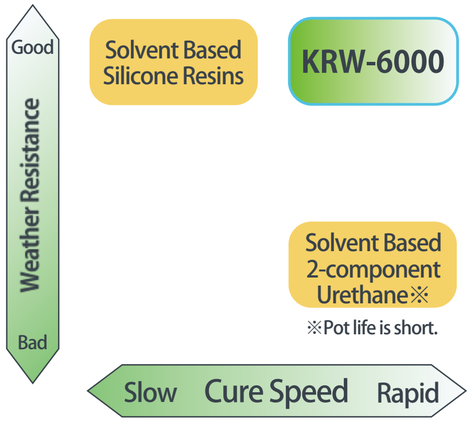
By introducing a special structure, **Emulsifier-free**

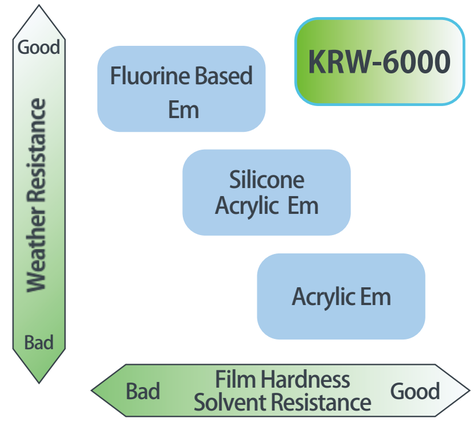
Strongly hydrophobic, emulsifier is essential.

→ Expected properties = Improved weather resistance, heat resistance, water resistance, and moisture resistance

■ Advantages Over Other Resins

The KRW-6000 series forms a coating that cures quickly and has excellent weather resistance.
It is a water-based, one-component type, so it has a long pot life.





Emulsifier-free | Water Based | Weather Resistance | Rapid Cure | Heat Resistance | Stain Resistance

Silicone Industry's First Product※
※Researched by Shin-Etsu Chemical Co., Ltd. As of May 2024

Emulsifier-free Water-based Rapid Curing Silicone Resin

Product Usage

Silicone Based Resins

KRW-6000 Series

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Comparison Data of KRW-6000 Series with Other Resins

● Rapid Curability

Conditions & Item \ Product name		KRW-6000	KRW-6001	KR-242A※1	Solvent based 2-component urethane
Room temperature	Tack-free	< 5min	< 5min	< 5min	< 5min
	Pot life	> 3 months	> 3 months	> 3 months	1 day
Room temperature × 1 week	Solvent resistance	±	±	-	+
	Pencil hardness	3B	5B	6B	H
80℃×10 min	Solvent resistance	+	±	-	+
	Pencil hardness	F	3B	4B	2B
120℃×3 min	Solvent resistance	+	+	-	-
	Pencil hardness	F	B	4B	3B
150℃×1 min	Solvent resistance	+	+	-	-
	Pencil hardness	F	B	2B	3B
100℃×10min → Room temperature × 1 week	Solvent resistance	+	+	-	+
	Pencil hardness	2H	F	B	2H

Substrate：Polished steel sheet, Bar coater #14 (Not specified values)
Solvent resistance evaluation criteria：Acetone & toluene rubbing 50 times : Passed = + 、
Only toluene rubbing passed = ±, Acetone & toluene rubbing both failed = -
* 1 Shin-Etsu product solvent based resin *2 Solvent-based acrylic polyol + HDI nurate

PR POINT **Curing properties comparable to solvent-based two-component urethane**

● Coating Properties

Item \ Product name	KRW-6000	Acrylic Em※2	Silicone Acrylic Em※3	Fluorine-based Em※4
Pencil hardness 750g load	F	HB	3B	6B
Acetone rubbing test 50 times	Passed	Failed	Failed	Failed
Methanol rubbing test 50 times	Passed	Failed	Failed	Failed
Initial gloss	77	68	86	78
Heat yellowing YI 200℃×24h	<10	50	70	70
Weather resistance 5 years equivalent※1	+	-	+	+
Weather resistance 10 years equivalent※1	+	-	-	-

Substrate：Polished steel sheet , Bar coater #14, (Not specified values)
After drying under condition of 100℃×10min, cure for 1 week under room temperature.
※1 Gloss retention ratio after accelerated weather resistance test with SUV
>80% ＝ +、<80% ＝ -
※2 Acrylic Em：One-component lacquer-type acrylic emulsion
Recommended curing conditions：Room temperature × 1 week
※3 Silicone Acrylic Em: One-component siloxane-urethane composite emulsion
Recommended curing conditions：Room temperature × 1 week or 140℃×20min
※4 Fluorine-based Em: One-component fluororesin emulsion
Recommended curing conditions：Room temperature × 1 week

PR POINT **Excellent solvent resistance, yellowing resistance, and weather resistance equivalent to or better than fluorine-based products**

Product Usage

Silicone Based Resins

High Hardness | Flexibility Crack Resistance | Permanent Marker Stain Resistance | Water Repellency

High Hardness, Water Repellency, Anti-fouling Coating Agents

X-88-2003A / X-88-2005

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- Excellent water repellency, water sliding property, and permanent marker stain resistance.
- Rapid curing, one-component dealcoholization condensation reaction type.
- By using Primer-MP, it adhere to PP(Polypropyrene).
- X-88-2003A has both high hardness and crack resistance.
- X-88-2005 is an deethanolization type, but can form a film in a short time.

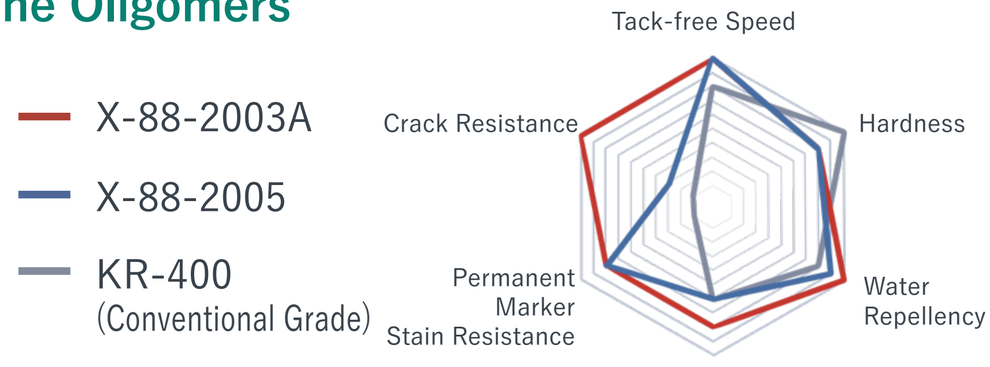
■ General Properties

Product name		X-88-2003A	X-88-2005	KR-400 (Conventional grade)
Tack-free min		<30	<30	30-60
Pencil hardness After 7 days		4H	4H	8H
Water contact angle※1 (2μL) °		107	104	92
Water fall angle※2 (20μL) °		27	38	32
Crack resistance	Room temperature	Good	Good	Good
	150°C×2h After heat resistance test	Good	Poor	Poor
	SUV Test after 1 year equivalent	Good	Poor	Poor
Permanent marker stain resistance		Good	Good	Poor
Generated alcohol		Methanol	Ethanol	Methanol
Adhesion to PP (by using PRIMER-MP)		Good	Good	Poor

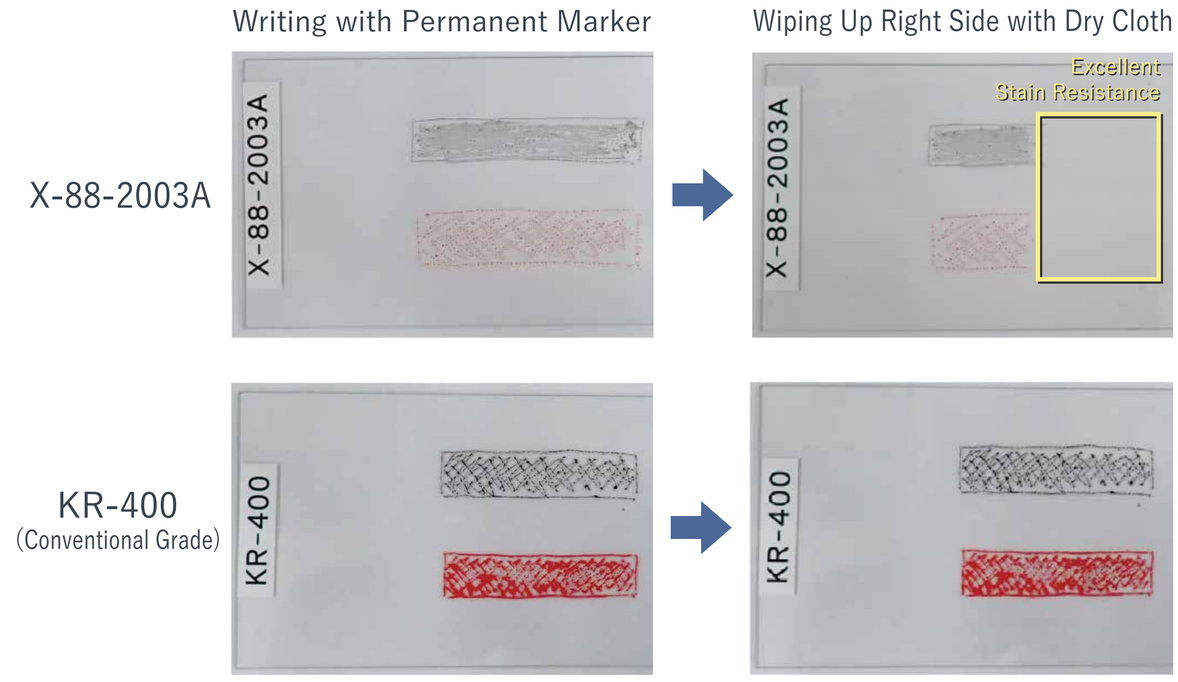
※1 Higher value means good performance.
※2 Lower value means good performance.

(Not specified values)

■ Comparison with General-Purpose Silicone Oligomers



■ Permanent Marker Stain Resistance



Substrate：Soda Glass

High Hardness　Low Warp

Photo-Curing Hard Coating Agent

X-48-5030 / X-48-5031

Product Usage

Silicone Based Resins

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- Solvent-free photo-curing hard coating agent.
- Forms a coating film with excellent scratch resistance and low warpage when exposed to light in the atmosphere.
- It can be used for coating applications that require low viscosity, such as spray coating.
- Normal product (X-48-5030) and high weather resistant product (X-48-5031) are available.
- Recommended cure conditions = High pressure mercury lamp (in air): 2,400mJ/cm^2

■ Applications

- Hard coating of organic resin parts (PMMA, PC, PET, etc..)

■ General Properties / Film Properties

Coating Physical Properties※1	X-48-5030	X-48-5031	Comparative paint (DPHA/HDDA/Photoinitiator※3 =85/15/5)
Viscosity　mPa・s	40	60	520
Pencil hardness　750g	2H	2H	2H
Steel wool resistance※2	Good	Good	Good
Taber test (500 g × 500 rotation)	⊿Hz = 5.0	⊿Hz = 6.8	⊿Hz = 12.3
Low warp property	Good	Good	Poor

(Not specified values)

※1 Coating conditions: Each sample was coated on a polycarbonate substrate with a bar coater (#8)
→ Light irradiation (in air, high-pressure mercury lamp: 2,400 mJ/cm^2)
※2 #0000, 200 g, No scratches after 10 cycles: Good, Scratches: Bad
※3 DPHA: dipentaerythritol hexaacrylate, HDDA: hexanediol diacrylate, Photoinitiator: Omnirad-1173 (manufactured by IGM Resins)

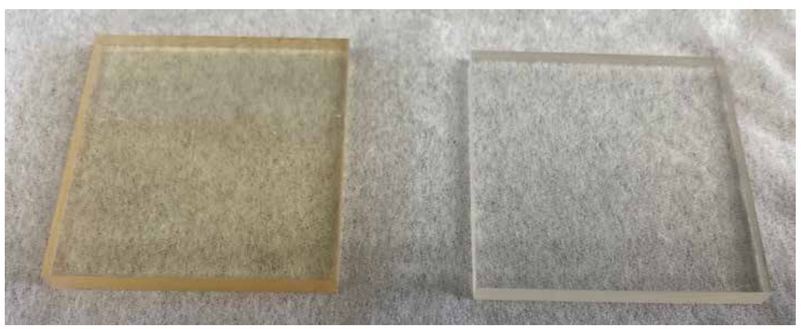
■ Warpage Comparison

(Substrate: PET Film)

Comparative paint　　X-48-5030

■ Weather Resistance Comparison

(After SUV weather resistance test equivalent to 2 years)



Comparative paint　　X-48-5031

Reduced LMW Siloxane | Film Forming Property | Water Repellency | Weather Resistance

Cationic Silicone Film-Forming Emulsion

Product Usage

Silicone Based Resins

X-52-8500DA / X-52-8499D / KM-9804

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

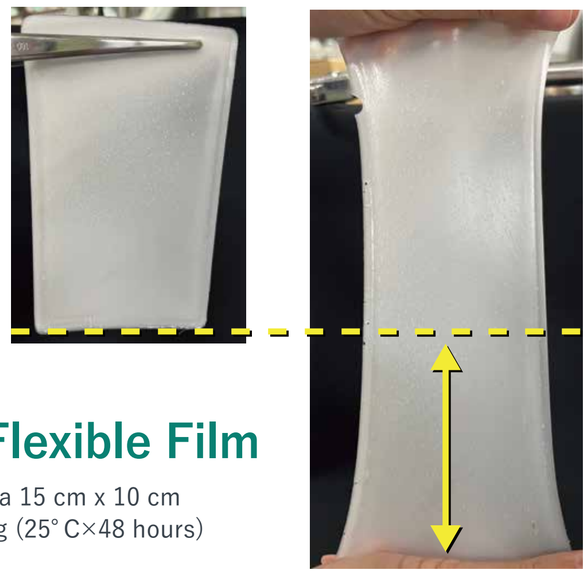
- Each cyclic siloxane content is less than 0.1% (in the product).
- Forms a silicone film after drying
- Does not contain metallic catalysts such as tin catalysts

■ Application

- Textile treatment agent
- Binder for chemical solution (cationic aids, etc.)
- Top coating agent for resin molded products

■ Appearance of Emulsion and Film

〈Emulsion Appearance 〉 〈Film Appearance〉※1



Flexible Film

＊1: Weigh 20 g of X-52-8499D on a 15 cm x 10 cm polypropylene tray. → Air drying (25° C×48 hours) → Heating (105° C×1 hour)

■ General Properties

Item \ Product name		KM-9772 (Conventional product)	X-52-8500DA	X-52-8499D	KM-9804
Features	Ionic	Anion	Cation		
	Metal catalyst	None	None		
	Cyclic siloxane ($D_4/D_5/D_6$)※2	0.1% or more for each	Less than 0.1% each		
	Film strength improver	Containing	Containing	None	None
Emulsion physical properties	Appearance	Creamy white	Creamy white	Creamy white	Creamy white
	Non-volatile content (105°C×3h) %	40	41	46	46
	pH	4.8	5.3	5.3	5.4
	Viscosity at 25°C mPa・s	10	7	16	15
※3 Film physical properties	Hardness Asker C	25	47	23	-※4
	Tensile strength MPa	0.63	0.60	0.41	-※4
	Elongation at break %	640	560	650	-※4

(Not specified values)

※2 : D4 : Octamethylcyclotetrasiloxane, D5 : Decamethylcyclopentasiloxane, D6 : Dodecamethylcyclohexasiloxane

※3 : Weigh 20 g of emulsion on a 15 cm x 10 cm polypropylene tray → Air drying (25°C x 48 hours) → Heating (105°C x 1 hour)

※4 : Film physical properties cannot be measured because the internal phase silicone of the emulsion is gel with fluidity.

The properties of the silicone film can be adjusted.
Please contact us if you are interested.

Frame Retardancy　High Transparency

Silicone-Based Flame Retardants for Polycarbonate

Product Usage

Resin Hybridization Agents

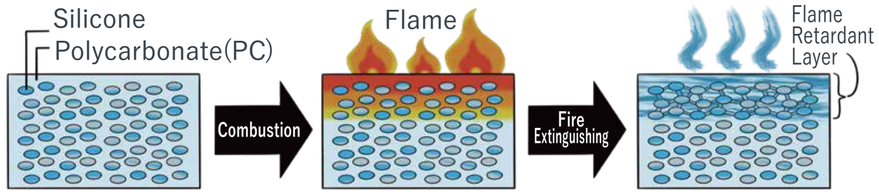
KR-2710 / KR-481 / KR-480

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- These silicones exhibit flame retardancy when used **in combination with a sulfonate.**
- **Formulated without fluorine additives**, it achieves **UL94 V-0 flame retardancy** while maintaining transparency.
- Compared to other flame retardants, the addition amount is small and it is less likely to decompose due to heat, making it possible to **design recyclable resins**.

■ Estimated Flame Retardant Mechanism



Excellent dispersibility
▶ Compatible and dispersible to PC

Phenyl group is carbonized.
Cross linking between PC and silicone.
▶ Flame retardant layer is formed.

■ General Properties

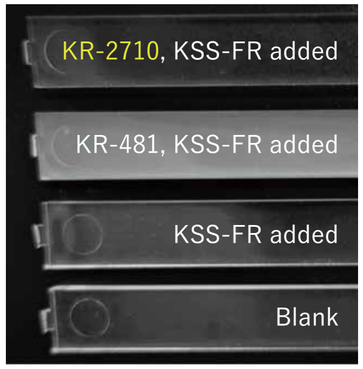
Item \ Product name	KR-2710	KR-481	KR-480
Functional groups	-Me/Ph/H	-Me/Ph	-Me/Ph
Structure	Straight chain	Branch	Branch
Appearance	Colorless transparent liquid	White flake	White flake
Active ingredient %	100	100	100
Softening point ℃	-	130	90
Refractive index	1.52	1.56※	1.54※
Viscosity mm²/s	50	-	-
Transparency when adding to PC	+(Transparent)	±(Relatively transparent)	-(Not transparent)

*Estimated value　(Not specified values)

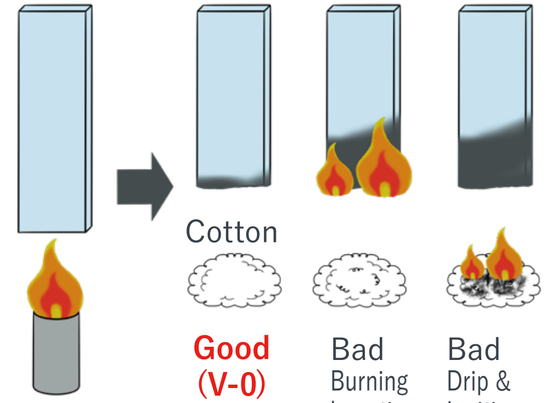
■ Transparency when Adding Polycarbonate

Compared to KR-481 (conventional product), **KR-2710 does not impair transparency** even when added to PC.

Test piece thickness : 2mm
Polycarbonate:
NOVAREX M-7027U



■ UL94 Combustion Test (Image Diagram)



■ Mixing Examples and Flame Retardant Test Results

Component	Product name	MVR	Test piece1	Test piece2	Test piece3	Test piece4
PC	TARFLON IR-2500*1	8	90	90	-	-
	NOVAREX M-7027U*2	3	-	-	90	90
	TARFLON FN-2200*1	12	10	10	10	10
Silicone	**KR-2710**		-	2	-	2
Additive	KSS-FR (Non-fluorine char catalyst)		0.2	0.2	0.2	0.2
	ADK STAB PEP-36 (Antioxidant)		0.1	0.1	0.1	0.1
	ADK STAB AO-50 (Antioxidant)		0.1	0.1	0.1	0.1
	RIKESTER EW-440A (Release agent)		0.1	0.1	0.1	0.1
Appearance of test pieces			Transparent	Transparent	Transparent	Transparent
UL94 Test result (Thickness = 3 mm)			V-2	**V-0**	-	-
UL94 Test result (Thickness = 2 mm)			Not applicable	V-2	V-2	**V-0**

* The unit is parts by mass.　*1 Made by Idemitsu Kosan Co.,Ltd　(Not specified values)
*2 Made by Mitsubishi Engineering-Plastics Corporation

Low Cure Shirinkage

Flexibility Crack Resistance

Organofunctional Cyclic Siloxane Materials

Product Usage

Resin Hybridization Agents

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

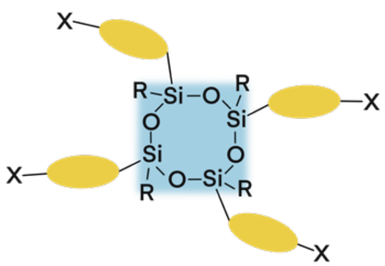
- Stress relaxation
- Reduced cure shirinkage

■ Applications

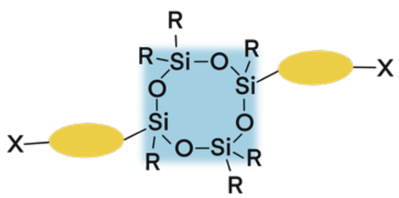
- Reactive binder
- Reactive diluent
- Cross-linker for resin modification

■ General Structures

【Tetra Functional Type】



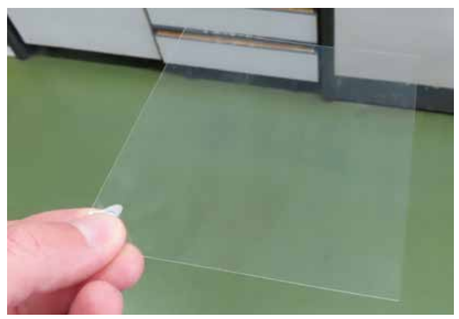
【Dual Functional Type】



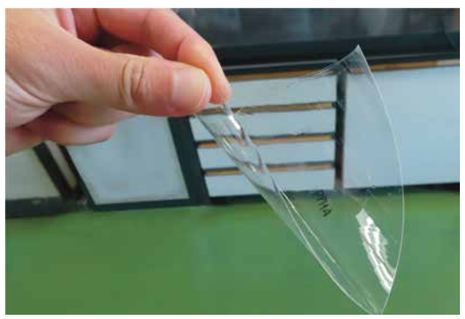
= Organic chain R = Alkyl Groups
X = Reactive Functional Groups

■ UV Cure Film Cure Shrinkage Relaxation Evaluation

X-48-5140B



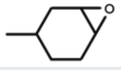
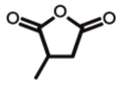
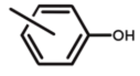
Comparison: DPHA (Hexafunctional acrylic)



A composition containing 2 wt% of a photoinitiator is applied to a PET film and cured at 600 mJ/cm² under N2 atmosphere.

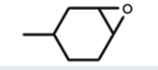
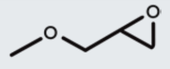
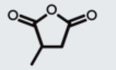
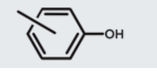
■ General Properties

【Tetra Functional Type】

Product name	Active ingredient %	Organic functional groups X	Functional group structure	Consistency at room temperature	Viscosity 25°C, mPa・s	Functional group equivalent g/mol
KR-470	100	Alicyclic epoxy		Transparent liquid	3,000	200
X-40-2701	100	Glycidyl		Transparent liquid	100	160
X-48-9670 PMA70	70 PGMEA solution	Succinic anhydride		Transparent liquid	500	270
X-48-1140	100	Primary alcohol	-CH_2-OH	Transparent liquid	100	190
X-48-5040P	100	Methacrylic		Transparent liquid	70	200
X-48-5140B	100	Acrylic		Transparent liquid	50	200
X-48-9504	100	Phenol		Transparent liquid	400,000	190

(Not specified values)

【Dual Functional Type】

Product name	Active ingredient %	Organic functional groups X	Functional group structure	Consistency at room temperature	Viscosity 25°C, mPa・s	Functional group equivalent g/mol
X-40-2678	100	Alicyclic epoxy		Transparent liquid	120	290
X-40-2728	100	Glycidyl		Transparent liquid	30	270
X-48-6942	100	Primary amine	-CH_2-NH_2	Transparent liquid	30	250
X-48-9672	100	Succinic anhydride		Transparent liquid	2,400	300
X-48-1142	100	Primary alcohol	-CH_2-OH	Transparent liquid	100	260
X-48-5042P	100	Methacrylic		Transparent liquid	16	310
X-48-5142B	100	Acrylic		Transparent liquid	20	310
X-48-9502	100	Phenol		Transparent liquid	1,000	250

(Not specified values)

Flexibility
Crack Resistance

Water Repellency
Antifouling Property

Weather Resistance

Water Repellent, Stain Resistant, High Weather Resistant
Hydroxyl Group-Containing Silicone Modifier
X-48-1900 Series

Product Usage

Resin Hybridization Agents

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- These are silicone oligomers containing alcoholic hydroxyl groups.
- Resin modification is possible by simply mixing at room temperature (cold blending), eliminating the need for large synthesis equipment.
- It has excellent resin compatibility and is unlikely to bleed out or separate during curing.

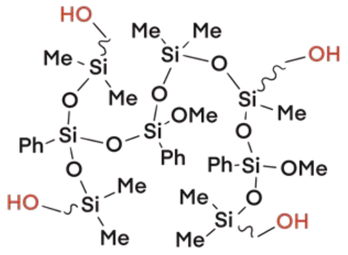
■ Applications

- Resin modifier

■ Applicable Resins

- Polyurethane
- Polyester
- Melamine resin, etc.

■ Structure Model

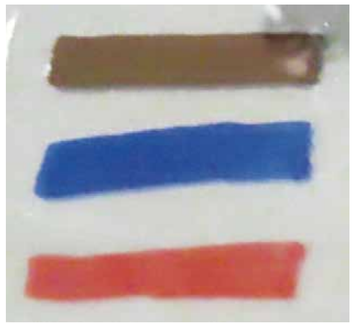
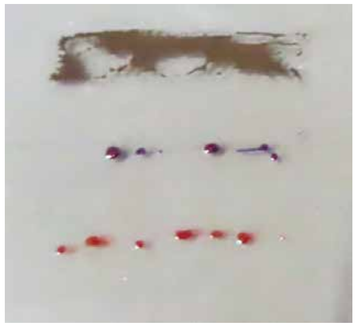


■ General Properties

Product name	X-48-1901	X-48-1903L	X-48-1904S
Imparting properties	Flexibility Adhesion	Water repellency Stain resistance	Weather resistance
Additional properties	Excellent compatibility	Reduced addition amount	Excellent compatibility
Appearance	Colorless transparent liquid	Slightly white cloudy liquid	Colorless transparent liquid
Active ingredient %	100	100	50
Viscosity at 25℃ mm^2/s	1,000	4,000	20
Solvent	Not contained	Not contained	Toluene
Recommended addtion amount wt%	1~10	0.5~5	5~50
Water solubility (Appearane of 50% water solution)	Good (Dispersion)	Bad (Precipitation)	Bad (Separation)

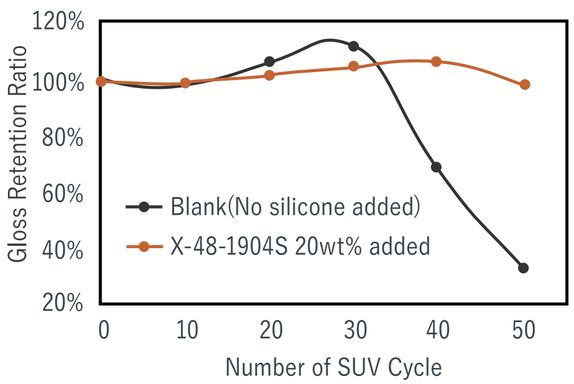
(Not specifed values)

■ Antifouling / Water Repellency Test

Item \ Conditions	Non additive	X-48-1903L 1wt % added
Appearance		
Water contact angle 2μL °	90	101

【Test conditions】 Paint:2-component polyurethane paint (Not specified values)
Film thickness:14μm, Substrate:glass plate
Write with permanent marker Mackey (manufactured by Zebra Co., Ltd.)

■ Weather Resistant Test (Gloss Retention Ratio)



【Test conditions】
Paint:2-component polyurethane paint
Film thickness:30μm
Substrate:Polyesther coated steel plate
Gloss retention ratio:
Calculated from 60 degree specular gloss measurement
SUV test:
1 cycle=UV(90mW)irradiate for 4h
→Darkness 4h→Condensation 4h
※10 cycles equals one year's worth of UV irradiation

Stress Relief
Impact Resistance

Surface Slipperiness
Abrasion Resistance
Flexibility (Feeling)

Light Diffusivity
Matteness

Silicone Powder

Product Usage

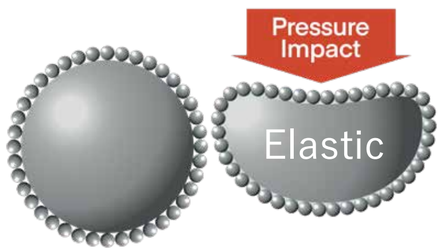
Resin Hybridization Agents

Surface Modifiers for Coating

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

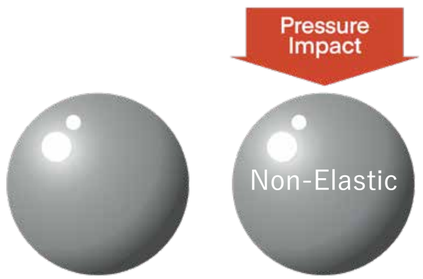
3 Types of Products

Hybrid Silicone Powder



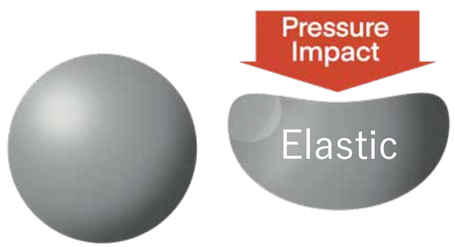
Composition:
Rubber powder coated with resin particles

Silicone Resin Powder



Composition:
Three-dimensional
crosslinked product

Silicone Rubber Powder



Composition:
Crosslinked product
of linear molecules (silicone)

How to Use

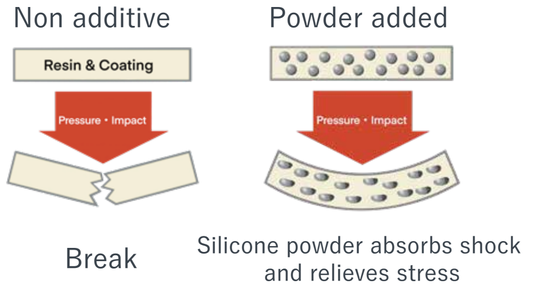
- Used by adding to resins, coating agents, etc.
- Recommended addition amount (estimate): 1~10wt%

Applications

- For synthetic resin:
  They improve impact resistance and abrasion resistance and add light diffusivity, etc.
- For paints, inks and coatings:
  They improve surface slipperiness, flexibility (feeling) and matte properties, etc.

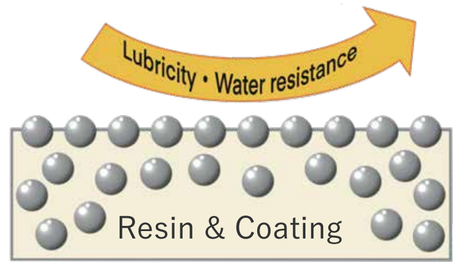
Enhanced Properties

Stress Relaxation Impact Resistance



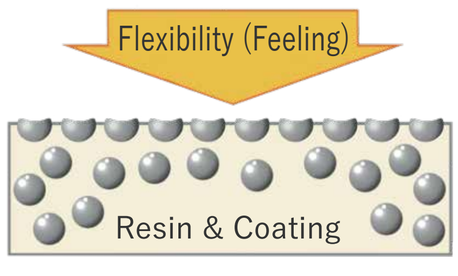
Hybrid Silicone Powder	++
Silicone Resin Powder	±
Silicone Rubber Powder	++

Surface Slipperiness Abrasion Resistance



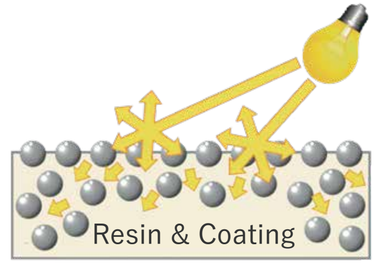
Hybrid Silicone Powder	++
Silicone Resin Powder	++
Silicone Rubber Powder	+

Flexibility (Feeling)



Hybrid Silicone Powder	++
Silicone Resin Powder	-
Silicone Rubber Powder	++

Light Diffusivity Matte Property



Hybrid Silicone Powder	++
Silicone Resin Powder	++
Silicone Rubber Powder	++

Dispersibility　Water Repellency

Highly Reactive Surface Modifier

Product Usage

Surface Modifiers for Pigments & Fillers

X-88-398

Contact → Sales and Marketing Department II
Phone : +81-3-6812-2407

■ Features and Benefits

- It has a cyclic silazane structure.
- Surface treatment is possible by simply mixing with the target object, without requiring prior hydrolysis.

■ Applications

- Imparting surface water repellency and improving filler dispersibility

■ Chemical Structure

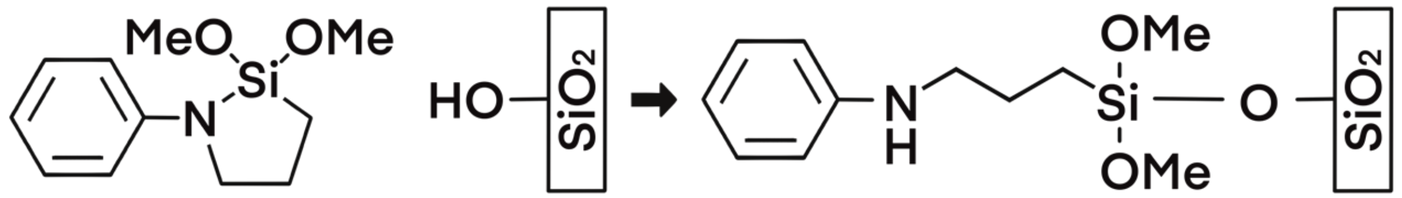
X-88-398

■ General Properties

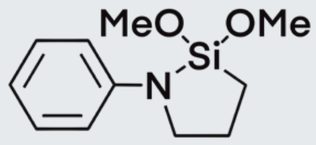
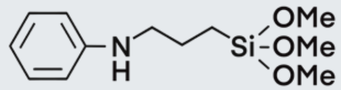
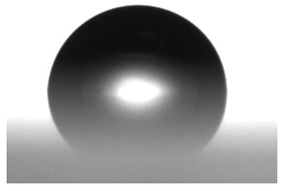
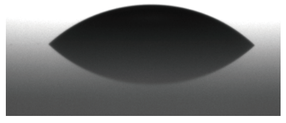
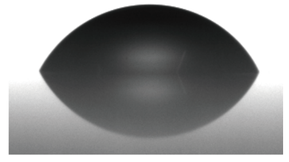
Item \ Product name	X-88-398
Active ingredient %	100
Viscosity at 25°C mm²/s	7.5

(Not specified values)

■ Reaction Model



■ Surface Treatment Data

Item \ Product name	X-88-398	KBM-573	KBM-573 Hydrolyzate
Chemical structure			–
Surface treatment condition			
Water contact angle 5μL	90.0 °	43.6 °	58.9 °

(Not specified values)

Test condition:
① After surface treatment by immersing a glass substrate in X-88-398/toluene solution, the water contact angle was measured.
② After surface treatment by immersing a glass substrate in KBM-573/toluene solution, the water contact angle was measured.
③ After surface treatment by immersing a glass substrate in a hydrolysis solution of KBM-573/MeOH/H_2O, the water contact angle was measured.

Shin-Etsu Chemical Co., Ltd.
4-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo, 100-0005 Japan

Silicone Division
Sales and Marketing Department I
Phone : +81-(0)3-6812-2406 Fax : +81-(0)3-6812-2414

Sales and Marketing Department II
Phone : +81-(0)3-6812-2407 Fax : +81-(0)3-6812-2414

Shin-Etsu Silicones of America, Inc.
1150 Damar Drive, Akron, OH 44305, U.S.A.
Phone : +1-330-630-9860 Fax : +1-330-630-9855

Shin-Etsu do Brasil Representação de Produtos Químicos Ltda.
Rua Coronel Oscar Porto, 736 - 8° Andar - Sala 84,
Paraíso São Paulo, SP Brasil CEP: 04003-003
Phone : +55-11-3939-0690 Fax : +55-11-3052-3904

Shin-Etsu Silicones Europe B.V.
Bolderweg 32, 1332 AV, Almere, The Netherlands
Phone : +31-(0)36-5493170 Fax : +31-(0)36-5326459
(Products & Services: Products for Cosmetics Application)

Germany Branch
Kasteler Str. 45, 65203 Wiesbaden, Germany
Phone : +49-(0)611-71187290
(Products & Services: Products for Industrial Applications)

Shin-Etsu Silicone International Trading (Shanghai) Co., Ltd.
29F Junyao International Plaza, No.789,
Zhao Jia Bang Road, Shanghai 200032, China
Phone : +86-(0)21-6443-5550 Fax : +86-(0)21-6443-5868

Guangzhou Branch
Room 2409-2410, Tower B, China Shine Plaza, 9 Linhexi Road,
Tianhe, Guangzhou, Guangdong 510610, China
Phone : +86-(0)20-3831-0212 Fax : +86-(0)20-3831-0207

Shin-Etsu Silicone Korea Co., Ltd.
GT Tower 15F, 411, Seocho-daero, Seocho-gu,
Seoul 06615, Korea
Phone : +82-(0)2-590-2500 Fax : +82-(0)2-590-2501

Shin-Etsu Silicone Taiwan Co., Ltd.
Hung Kuo Bldg. 11F-D, No. 167, Tun Hua N. Rd.,
Taipei, 105406 Taiwan, R.O.C.
Phone : +886-(0)2-2715-0055 Fax : +886-(0)2-2715-0066

Shin-Etsu Singapore Pte. Ltd.
1 Kim Seng Promenade #15-05/06 Great World City
East Tower, Singapore 237994
Phone : +65-6743-7277 Fax : +65-6743-7477

Shin-Etsu Silicones Vietnam Co., Ltd.
Unit 4, 11th Floor, A&B Tower, 76A Le Lai Street,
Ben Thanh Ward, District 1, Ho Chi Minh City, Vietnam
Phone : +84-(0)28-35355270

Shin-Etsu Silicones India Pvt. Ltd.
Unit No. 403A, Fourth Floor, Eros Corporate Tower,
Nehru Place, New Delhi 110019, India
Phone : +91-11-43623081 Fax : +91-11-43623084

Shin-Etsu Silicones (Thailand) Ltd.
7th Floor, Unit 7F, Harindhorn Tower, 54 North Sathorn
Silom, Bangrak, Bangkok 10500, Thailand
Phone : +66-(0)2-632-2941 Fax : +66-(0)2-632-2945

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

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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).
- The silicone products described herein have been designed, manufactured and developed solely for general industrial use only; such silicone products are not designed for, intended for use as, or suitable for, medical, surgical or other particular purposes. Users have the sole responsibility and obligation to determine the suitability of the silicone products described herein for any application, to make preliminary tests, and to confirm the safety of such products for their use.
- 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.
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The Development and Manufacture of Shin-Etsu Silicones are based on the following registered international quality and environmental management standards.

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)