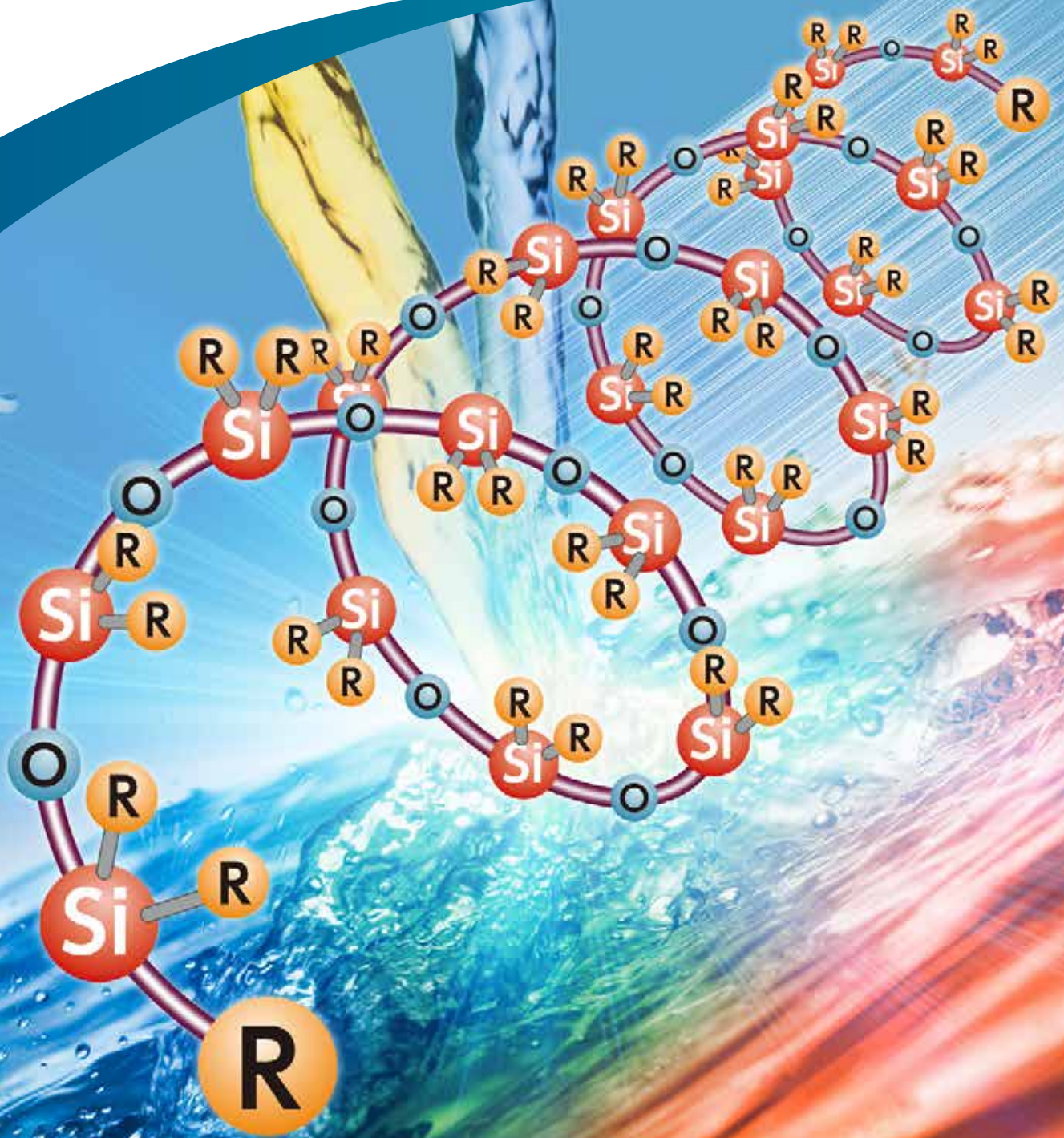


# Modified Silicone Fluid for Resin Modification



*Dual-end type*  
*Side-chain type*  
*Single-end type*

# What is Modified Silicone Fluid for Resin Modification?

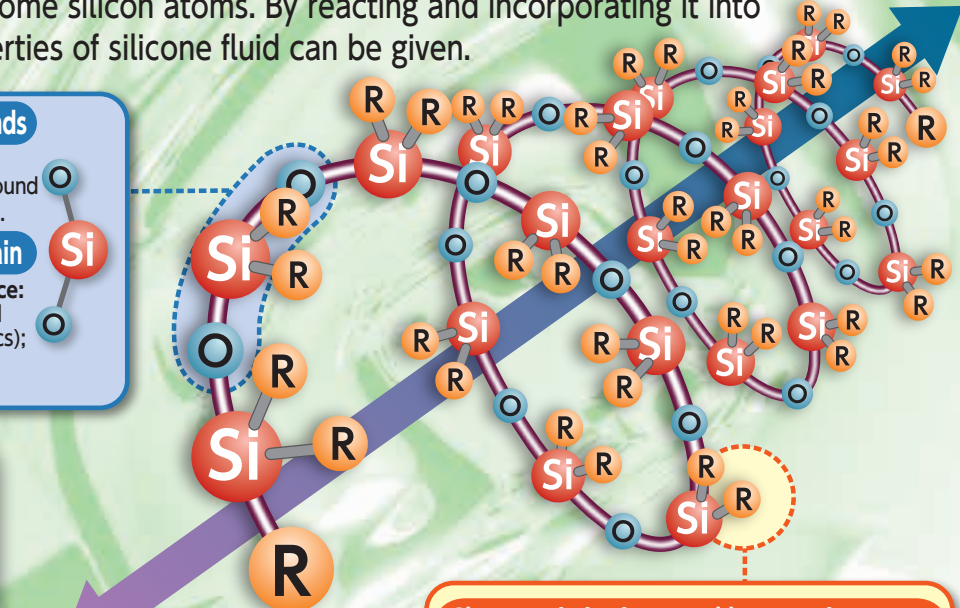
Modified silicone fluid for resin modification is a silicone fluid that incorporates various organic and reactive functional groups into some silicon atoms. By reacting and incorporating it into other resins, the excellent properties of silicone fluid can be given.

**Features of materials with siloxane bonds**

- **High bonding energy (106 kcal/mol):**  
Resists breakdown from heat and light. Around 25% higher bonding energy than C-C bonds.

**Features of materials with siloxane chain**

- **Helical molecule & low intermolecular force:**  
Excellent water repellency, defoaming, and release properties (interfacial characteristics); gas permeable. Physical properties are not strongly temperature dependent.



- Length of siloxane chains can be controlled**
- Flexible, expanding and contracting helical structure
  - Strong and difficult to break
  - Has a reactive functional group bonded to other organic resins
  - Lower surface energy
  - Water-shedding

**Characteristics imparted by organic groups**

- **Primary Organic Groups**
  - Methyl groups: hydrophobicity
  - Phenyl groups: compatibility with resins, heat resistance
  - Polyether groups: hydrophilicity
  - Alkoxy groups: adhesiveness, moisture-cure properties
  - Amino groups: reactive with epoxies and other resins
  - (Meth)acrylic groups: radical polymerization

## Three Types of Modified Silicone Fluid for Resin Modification



Dual-end type

**● Structure model**

**● Model of modification**

Block copolymerization

Untreated

Side-chain type

**● Structure model**

**● Model of modification**

Random copolymerization

Single-end type

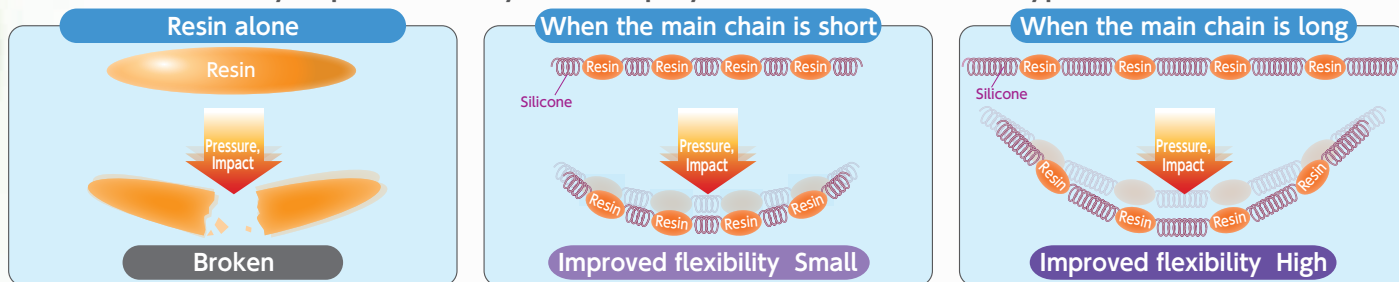
**● Structure model**

**● Model of modification**

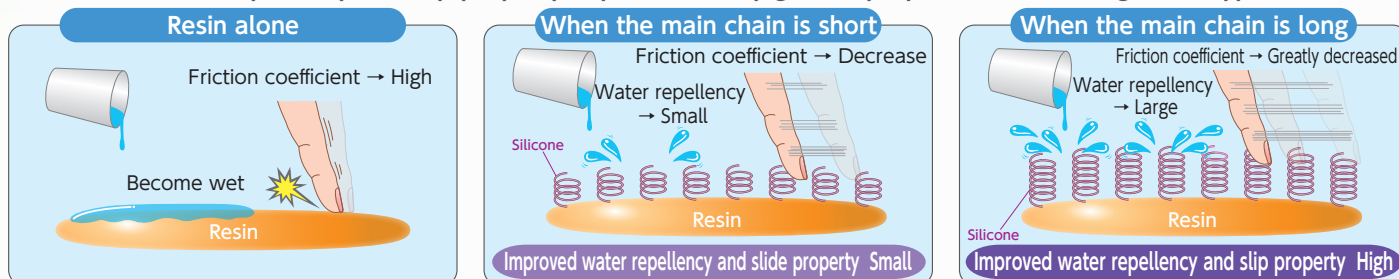
Graft copolymerization

## Example of characteristic improvement with length of siloxane main chain

### ●Model of flexibility improvement by block copolymerization of dual-end type

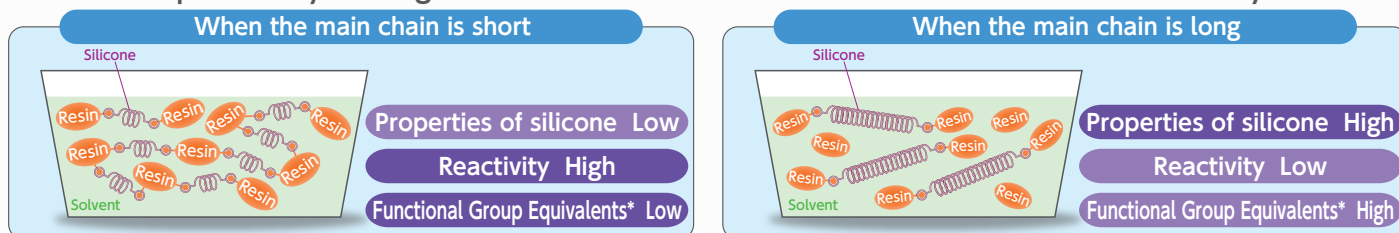


### ●Model of water repellency and slip property improvement by graft copolymerization of single-end type



## Relationship between siloxane main chain length and reactivity

### ●Select the product by looking at the balance between the siloxane backbone and reactivity.



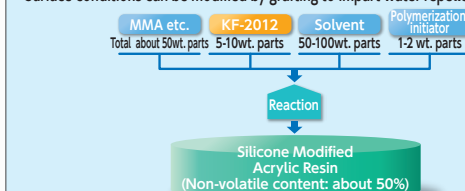
\*Functional group equivalents are the number of functional groups relative to the length of the siloxane main chain. Products with a short main chain have a relatively high proportion of functional groups in the molecule.

## Example of application

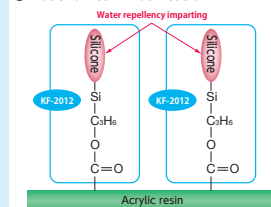
### ●Imparting water repellency to acrylic paint



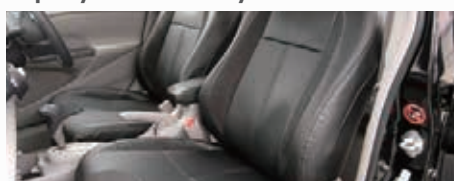
#### ●An example of modification by radical polymerization using a single-end silicone fluid (KF-2012). Surface conditions can be modified by grafting to impart water repellency.



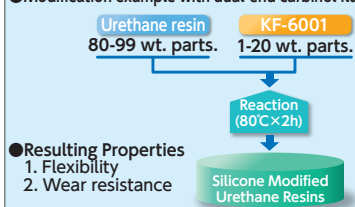
#### ●Model of resin modification



### ●Improved tactile quality of polyurethane synthetic leather



#### ●Modification example with dual-end carbinol fluids

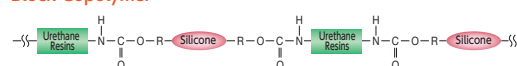


#### ●Model of Block Copolymer

##### Structure of KF-6001





##### Block Copolymer



## Organic functional groups and applicable resins

Types of resins		Thermoset resin		Thermoplastic resin		
Reactive groups		Polyurethane	Epoxy	Acrylic	Polyimide	Polyester
Amino groups			●		●	
Epoxy groups			●			
Hydroxyl groups	Carbinol type	●				●
	Diol type	●				●
	Polyether type	●				●
Methacrylic groups				●		
Carboxyl groups			●			●
Mercapto groups				●		
Acid anhydride groups			●		●	●

●Side chain type

Modification type	Organic functional group	Product name	Viscosity at 25°C mm <sup>2</sup> /s	Specific gravity at 25°C	Refractive index at 25°C	Functional group equivalent weight(FGEW) g/mol	Packaging	UN hazard classification
Mono amino	— RNH <sub>2</sub>	KF-868	90	0.95	1.403	8,800	1kg, 16kg, 180kg	Not applicable
		KF-865	110	0.97	1.405	5,000	1kg, 16kg, 180kg	Not applicable
		KF-864	1,700	0.98	1.406	3,800	1kg, 16kg, 180kg	Not applicable
Diamino	<div>— RNR'NH<sub>2</sub> H</div>	KF-859	60	0.96	1.403	6,000	1kg, 16kg, 180kg	Not applicable
		KF-393	70	0.98	1.422	350	1kg, 16kg	Not applicable
		KF-860	250	0.97	1.404	7,600	1kg, 16kg, 180kg	Not applicable
		KF-880	650	0.98	1.407	1,800	1kg, 18kg, 180kg	Not applicable
		KF-8004	800	0.98	1.408	1,500	1kg, 18kg, 180kg	Not applicable
		KF-8002	1,100	0.98	1.408	1,700	1kg, 18kg, 200kg	Not applicable
		KF-8005	1,200	0.97	1.403	11,000	1kg, 16kg, 180kg	Not applicable
		KF-867	1,300	0.98	1.407	1,700	1kg, 18kg, 180kg	Not applicable
		KF-8021	15,000	0.97	1.403	55,000	1kg, 16kg	Not applicable
		KF-869	1,500	0.97	1.405	3,800	1kg, 16kg	Not applicable
		KF-861	3,500	0.98	1.408	2,000	1kg, 16kg	Not applicable
Amino - Polyether	<div>— RNH<sub>2</sub> — R(C<sub>2</sub>H<sub>4</sub>O)<sub>a</sub>(C<sub>3</sub>H<sub>6</sub>O)<sub>b</sub>R'</div>	X-22-3939A	3,300	1.03	1.448	1,800	1kg, 16kg	Not applicable
Special amino	— ★	KF-877	5,700	0.98	1.406	5,200	1kg, 16kg,200kg	UN-3082
		KF-889	500	1.00	1.429	3,000	1kg, 16kg,180kg	UN-3082
Epoxy	<div>— RCH—CH<sub>2</sub> O</div>	X-22-343	25	1.01	1.423	525	1kg, 16kg	Not applicable
KF-101		1,500	1.01	1.437	350	1kg, 16kg	Not applicable	
Epoxy (side-chain phenyl type)		X-22-2000	190	1.04	1.443	620	1kg, 16kg	Not applicable
Alicyclic epoxy	<div>— R</div>	X-22-2046 <sup>*</sup>	45	0.96	1.474	600	1kg, 15kg	UN-1866
		KF-102	3,500	0.97	1.408	3,600	1kg, 16kg,180kg	Not applicable
Epoxy - Polyether	<div>— R—CH—CH<sub>2</sub> O — R(C<sub>2</sub>H<sub>4</sub>O)<sub>a</sub>(C<sub>3</sub>H<sub>6</sub>O)<sub>b</sub>R'</div>	X-22-4741	350	1.06	1.448	2,500	1kg, 16kg	Not applicable
		KF-1002	4,500	1.00	1.426	4,300	1kg, 16kg	Not applicable
Epoxy-Aralkyl	<div>— RCH—CH<sub>2</sub> O — CH<sub>2</sub>—CH CH<sub>3</sub></div>	KF-1005	2,500	1.10	1.484	250	1kg,18kg	Not applicable
Carbinol	— ROH	X-22-4039	90	0.99	1.413	58* <sup>1</sup>	1kg, 16kg	Not applicable
		X-22-4015	130	0.98	1.408	30* <sup>1</sup>	1kg, 16kg	Not applicable
Mercapto	— RSH	KF-2001	200	0.98	1.410	1,900	1kg, 16kg	Not applicable
Carboxyl	— RCOOH	X-22-3701E	2,000	0.98	1.409	4,000	1kg, 16kg	Not applicable
Hydrogen	— H	KF-99	20	1.00	1.396	60	1kg,18kg,200kg	Not applicable
		KF-9901	20	0.97	1.399	140	1kg,18kg,200kg	Not applicable


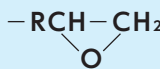
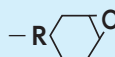

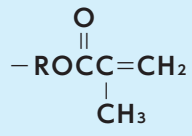
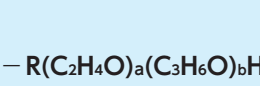



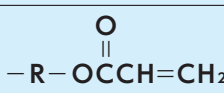
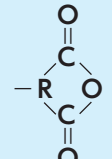
★Please contact our Sales Department for further information.

(Not specified values)

※ Active ingredient 50% (toluene dilution)

\*1 Hydroxyl group value [mgKOH/g], Functional group equivalent weight [g/mol] = 56,000/Hydroxyl group value [mgKOH/g]

## ●Dual-end type

Modification type	Organic functional group	Product name	Length of siloxane main chain	Viscosity at 25℃ mm²/s	Specific gravity at 25℃	Refractive index at 25℃	Functional group equivalent weight(FGEW) g/mol	Packaging	UN hazard classification
Amino		PAM-E	Short	4	0.90	1.448	130	1kg, 15kg	Not applicable
		KF-8010	Short	12	1.00	1.418	430	1kg, 16kg	Not applicable
		X-22-161A	Medium	25	0.97	1.411	800	1kg, 16kg	Not applicable
		X-22-161B	Medium	55	0.97	1.408	1,500	1kg, 16kg,180kg	Not applicable
		KF-8012	Long	90	0.97	1.407	2,200	1kg, 16kg,180kg	Not applicable
		KF-8008	Long	450	0.97	1.405	5,700	1kg, 16kg,180kg	Not applicable
Amino (side-chain phenyl type)		X-22-1660B-3	Medium	550	1.07	1.497	2,200	1kg, 16kg	Not applicable
X-22-9409		Long	105	1.05	1.500	670	1kg, 16kg	Not applicable	
Epoxy		X-22-163	Short	15	1.00	1.450	200	1kg, 16kg	Not applicable
		KF-105	Short	15	0.99	1.422	490	1kg, 16kg	Not applicable
		X-22-163A	Medium	30	0.98	1.413	1,000	1kg, 16kg	Not applicable
		X-22-163B	Medium	60	0.98	1.409	1,800	1kg, 16kg	Not applicable
		X-22-163C	Long	120	0.98	1.408	2,700	1kg, 16kg	Not applicable
Alicyclic epoxy		X-22-169AS	Short	30	0.99	1.433	500	1kg, 16kg	Not applicable
		X-22-169B	Medium	70	0.98	1.412	1,700	1kg, 16kg	Not applicable
Carbinol		KF-6000	Short	35	0.98	1.422	120* <sup>1</sup>	1kg, 16kg,180kg	Not applicable
		KF-6001	Medium	45	0.98	1.413	62* <sup>1</sup>	1kg, 16kg,180kg	Not applicable
		KF-6002	Medium	70	0.98	1.409	35* <sup>1</sup>	1kg, 16kg,160kg	Not applicable
		KF-6003	Long	110	0.98	1.407	22* <sup>1</sup>	1kg, 16kg,160kg	Not applicable
Methacryl		X-22-164	Short	10	0.97	1.450	190	1kg, 16kg	Not applicable
		X-22-164AS	Short	12	0.97	1.425	450	1kg, 16kg	Not applicable
		X-22-164A	Medium	25	0.98	1.415	860	1kg, 16kg	Not applicable
		X-22-164B	Medium	55	0.98	1.410	1,600	1kg, 16kg	Not applicable
		X-22-164C	Medium	90	0.98	1.408	2,400	1kg, 16kg	Not applicable
		X-22-164E	Long	190	0.97	1.406	3,900	1kg, 16kg	Not applicable
Polyether		X-22-4952	Medium	100	0.99	1.428	50* <sup>1</sup>	1kg, 16kg	Not applicable
		X-22-4272	Medium	270	1.02	1.430	50* <sup>1</sup>	1kg, 16kg	Not applicable
		KF-6123	Medium	420	1.03	1.434	50* <sup>1</sup>	1kg, 18kg	Not applicable
Mercapto		X-22-167B	Medium	55	0.97	1.411	1,700	1kg, 16kg	Not applicable
		X-22-167C	Medium	90	0.97	1.408	2,300	1kg, 16kg	Not applicable
Carboxyl		X-22-162C	Long	220	0.98	1.406	2,300	1kg, 16kg	Not applicable
Silanol		X-21-5841	Short	30	0.97	1.404	500	1kg, 16kg,180kg	Not applicable
		KF-9701	Medium	60	0.98	1.404	1,500	1kg, 16kg, 200kg	Not applicable
Acrylic		X-22-2445	Medium	55	0.98	1.407	1,600	1kg, 16kg	Not applicable
Carboxylic acid anhydride		X-22-168AS	Short	160	1.03	1.432	500	1kg	Not applicable
		X-22-168A	Medium	140	1.01	1.418	1,000	1kg	Not applicable
		X-22-168B	Medium	180	1.00	1.412	1,600	1kg	Not applicable
Carboxylic acid anhydride (side-chain phenyl type)		X-22-168-P5-B	Medium	1,300	1.09	1.498	2,100	1kg	Not applicable

\*1 Hydroxyl group value [mgKOH/g], Functional group equivalent weight [g/mol] = 56,000/Hydroxyl group value [mgKOH/g] (Not specified values)

**●Single-end type**

Modification type	Organic functional group	Product name	Length of siloxane main chain	Viscosity at 25°C mm <sup>2</sup> /s	Specific gravity at 25°C	Refractive index at 25°C	Functional group equivalent weight(FGEW) g/mol	Packaging	UN hazard classification
Epoxy	$\begin{array}{c} \text{—RCH—CH}_2 \\ \diagdown \quad \diagup \\ \text{O} \end{array}$	X-22-173BX	Medium	30	0.97	1.408	2,500	1kg, 16kg	Not applicable
		X-22-173DX	Long	60	0.97	1.406	4,600	1kg, 16kg	Not applicable
Carbinol	—ROH	X-22-170BX	Medium	40	0.97	1.407	20 * <sup>1</sup>	1kg, 16kg	Not applicable
		X-22-170DX	Long	65	0.97	1.406	12 * <sup>1</sup>	1kg, 16kg	Not applicable
Diol	$\begin{array}{c} \text{ROH} \\   \\ \text{—R'—C—R''} \\   \\ \text{ROH} \end{array}$	X-22-176F	Long	500	0.98	1.405	9 * <sup>1</sup>	1kg, 16kg, 180kg	Not applicable
		X-22-176DX	Medium	130	0.97	1.409	35 * <sup>1</sup>	1kg, 16kg, 180kg	Not applicable
		X-22-176GX-A	Long	400	0.97	1.405	8 * <sup>1</sup>	1kg, 16kg, 180kg	Not applicable
Methacryl	$\begin{array}{c} \text{O} \\    \\ \text{—ROCC=CH}_2 \\   \\ \text{CH}_3 \end{array}$	X-22-174ASX	Short	9	0.95	1.415	900	1kg, 16kg	Not applicable
		X-22-174BX	Medium	27	0.96	1.409	2,300	1kg, 16kg	Not applicable
		KF-2012	Medium	60	0.97	1.407	4,600	1kg, 16kg, 180kg	Not applicable
		X-22-2426	Long	200	0.97	1.405	12,000	1kg, 16kg	Not applicable
		X-22-2404	Short	5	0.93	1.418	420	1kg, 16kg	Not applicable
Carboxyl	—RCOOH	X-22-3710 * <sup>2</sup>	Medium	60	0.97	1.412	1,450	1kg, 16kg	Not applicable

(Not specified values)

**●Side-chain, dual-end type**

Modification type	Organic functional group	Product name	Viscosity at 25°C mm <sup>2</sup> /s	Specific gravity at 25°C	Refractive index at 25°C	Functional group equivalent weight(FGEW) g/mol	Packaging	UN hazard classification
Side-chain amino, dual-end methoxy	—RNH <sub>2</sub> , —OR'	KF-857	65	0.98	1.411	790	1kg, 15kg	Not applicable
		KF-862	650	0.98	1.407	1,900	1kg, 16kg, 180kg	Not applicable
		KF-858 * <sup>3</sup>	23	0.88	1.394	-	1kg, 15kg	UN-1866
Epoxy	$\begin{array}{c} \text{—RCH—CH}_2 \\ \diagdown \quad \diagup \\ \text{O} \end{array}$	X-22-9002	900	0.98	1.406	5,000	1kg, 16kg	Not applicable

 \*<sup>1</sup> Hydroxyl group value [mgKOH/g], Functional group equivalent weight [g/mol] = 56,000/Hydroxyl group value [mgKOH/g] (Not specified values)

 \*<sup>2</sup> Including non-reactive & dual-end type carboxyl-modified silicone fluid

 \*<sup>3</sup> Active ingredient 50% (acetate IPA dilution)

## **Storage & Handling Precautions**

1. Many modified silicone fluids contain organic functional groups or hydrolyzable groups, and their reactivity varies. Before using these products, carefully consider their respective characteristics.
2. Heat, light, acids and bases may cause deterioration of modified silicone fluids. Take care to prevent contamination, and seal tightly and store in a cool, dark place.
3. Our modified silicone fluids are not produced specifically for medical use. Accordingly, they should not be used as is for orthopedic or cosmetic surgery or other medical applications.
4. If amino-modified silicone fluid is being used as an aerosol and the particles are inhaled, there is a possibility of acute inhalation toxicity. Average consumers should not use amino-modified silicone fluid in spray applications.
5. Some silicone products described herein are classified as hazardous materials under the laws of certain countries. In such cases, the laws must be followed regarding storage, labeling, and handling.

### ◆ **Safety & Hygiene**

1. Some modified silicone fluids may cause skin irritation. If contact occurs, they are difficult to remove from the skin, so always wear rubber gloves (etc.) and avoid contact with the skin and mucous membranes. In case of contact, wipe with a rag, then wash with soap and water or flush thoroughly with water. In case of accidental eye contact, immediately flush with water for at least 15 minutes and then seek medical attention.
2. Be sure there is adequate ventilation when handling these products. If you feel ill after breathing in the vapors, move immediately to an area with fresh air.
3. Keep out of reach of children.
4. Be sure to read the Safety Data Sheets (SDS) for these products before use. SDS are available from the Shin-Etsu Silicone 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/>

### ◆ **Other**

1. Some of the products (product name starting with X) featured in this catalog are preproduction prototypes. Please contact Shin-Etsu to confirm the availability of all products.
2. For cosmetics, "A Grade" products are available, but in some cases a separate application is required if modified silicone fluids are to be used as a cosmetic ingredient. Please contact Shin-Etsu regarding required documents.

## Silicone Division Sales and Marketing Department I

Marunouchi Eiraku Bldg., 4-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo 100-0005, Japan

Phone : +81-(0)3-6812-2406 Fax : +81-(0)3-6812-2414

### 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 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 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 Taiwan Co., Ltd.

Rm. D, 11F., No. 167, Dunhua N. Rd., Songshan Dist.,

Taipei City 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

#### Hanoi Branch

Unit 32, 29th Floor, Lotte Center Hanoi East Tower,

54 Lieu Giai Street, Ba Dinh District, Hanoi City, Vietnam

Phone : +84-(0)24-3267-3868

### 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 Road, Silom, Bangrak,

Bangkok 10500, Thailand

Phone : +66-(0)2-632-2941 Fax : +66-(0)2-632-2945

- The data and information presented in this catalog may not be relied upon to represent standard values. Shin-Etsu reserves the right to change such data and information, in whole or in part, in this catalog, including product performance standards and specifications without notice.
- 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>
- 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.
- Please contact Shin-Etsu before reproducing any part of this catalog. Copyright belongs to Shin-Etsu Chemical Co., Ltd.



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

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

"Shin-Etsu Silicone" is a registered trademark of Shin-Etsu Chemical Co., Ltd. <https://www.shinetsusilicone-global.com/>

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

©Shin-Etsu 2018.12/2025.6 ©M.G. Web in Japan.