Liquid Silicone Rubber for Moldmaking

Shin-Etsu Silicone

Hassle-free processing with Shin-Etsu Easy Transfer and Releasable Molds

Shin-Etsu's liquid silicone rubber for moldmaking is an excellent material that can be used to make replicas with a wide variety of different materials including polyester and epoxy resins, urethane foam, wax, gypsum and low-temperature composite. This moldmaking liquid silicone rubber can be counted on to precisely reproduce the shape of the original model.

Due to the ease of casting with liquid silicone rubber, it is used widely for producing replicas in industrial applications or even just for fun.

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Shin-Etsu moldmaking liquid silicone rubber products have the following overall characteristics.

1 Workability

Make silicone rubber molds easily and quickly by mixing the base compound with a curing agent and then pouring it into a mold. The workable time and the cure time can both be adjusted as necessary.

2 Ease of mold release

Mold releasing agents such as soapy water or wax are unnecessary because molds made of liquid silicone rubber release easily from the master or cast parts on their own.

3 Dimensional stability

Molds made with liquid silicone rubber exhibit very little shrinkage and superior dimensional stability.

4 Flowability

Liquid silicone rubber can faithfully reproduce the tiniest of details in the master such as fingerprints and wood grain because of its superior flowability.

5 Heat and chemical resistance

Moldmaking liquid silicone rubber exhibits excellent resistance to both heat and chemicals.

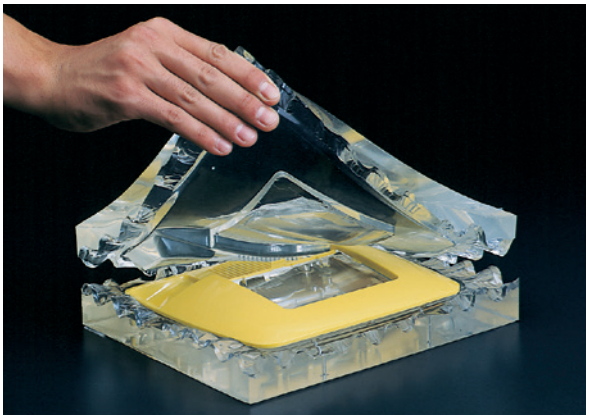
6 Deep section curability

Moldmaking liquid silicone rubber cures uniformly throughout the mold, irrespective of thickness.

7 Non-exothermic

Moldmaking liquid silicone rubber cures at room temperature. In addition, since no heat is generated during the curing process, the liquid silicone rubber does not adversely affect the master.

Liquid silicone rubber flows easily into the tiniest of recesses.



Smooth release is a guarantee.

Brush strokes on oil paintings and the contours of leather surfaces are all faithfully reproduced.

Moldmaking Methods

Typical examples of moldmaking

Methods		Processes	Applications
General molds	A silicone rubber mold is created from a master and then material such as liquid resin or gypsum is poured into the cured mold to make a replica.	●Pouring process A mold is made by pouring the liquid silicone rubber directly onto the master. This process offers the advantages of having few steps and requiring a minimal amount of time.	Fine handicrafts, furniture parts, ornaments and welder moldings
		●Lamination process (skin molding method) A mold is made by laminating the silicone rubber onto the master to create a skin of an even thickness and then it is reinforced with a material such as gypsum or resin. The process offers the advantages of requiring a minimal amount of silicone rubber and yielding a lightweight mold.	Reproduction of art works, creating molds of large items and molds of three-dimensional figures
Inverted molds	A silicone rubber mold is created from a master into which liquid resin, paraffin or gypsum is poured to make a replica of the master. This method is used to create molds which are then used to create subsequent molds as part of the inversion process. These subsequent molds are used to create simple metal molds and sand molds.	●Inverted molds used in electroforming Master → silicone rubber mold → resin mold → electroforming → electrocasting mold	Automotive parts and toys
		●Lost wax mold Master → silicone rubber mold → wax mold → sand mold → casting.	Precision cast parts and cast ornaments such as golf club heads
		●Inverted molds made from low-temperature composite Master → silicone rubber mold → heat-resistant gypsum mold → injection mold.	Food samples and toys
High precision molds	A high-precision silicone rubber mold is created using a vacuum casting device. The mold is placed into a vacuum tank and a liquid resin such as urethane or epoxy is poured into the crevices of the mold under a vacuum to create a precise resin mold that produces defect-free parts.	●Vacuum pouring process Master → pour liquid silicone rubber inside a vacuum tank → after the curing is finished, the rubber is cut open using a surgical scalpel to create a split mold → the split mold is placed again in the vacuum tank and a liquid resin is poured into the mold under a vacuum →the resin is cured in a thermostatic tank →the cast part is removed. The vacuum casting process is the optimal method to use when high-precision replicas are required. It offers the advantage of cutting the number of days and the cost involved in creating small lot prototypes.	Prototype models of small-lot resin moldings, automotive parts, household electrical appliances and office equipment

Types and Selection Standards

Shin-Etsu liquid silicone rubber can be divided into two curing types based on the reaction used to cure the silicone. Condensation-cure materials utilize atmospheric moisture and release alcohol during vulcanization. Addition-cure materials rely on heat to cure and produce no byproducts. These two types of materials have different characteristics and should be selected depending on the requirements of the application.

1 General molds (Condensation-cure porudts)

●KE-12, KE-14 and KE-17

These products meet general use mold making requirements. All are characterized by low viscosity and superior workability. CAT-RM is a fast curing agent that can be used for making thick molds under room temperature curing conditions. CAT-RT is a slow curing agent that cures from the surface and cannot be used in deep section or thick molds. However, KE-17 cured with CAT-RT prevents uneven coloration of dye-coated replicas. Polyester, urethane and epoxy resins are poured into molds made with these products to make buttons, accessories, dolls and art objects. Polyvinyl chloride sol is used to make food samples, while wax is used in the making of ornamental candles or lost-wax molds. These products can be used in a wide range of applications incorporating low-temperature composite inverted molds using gypsum.

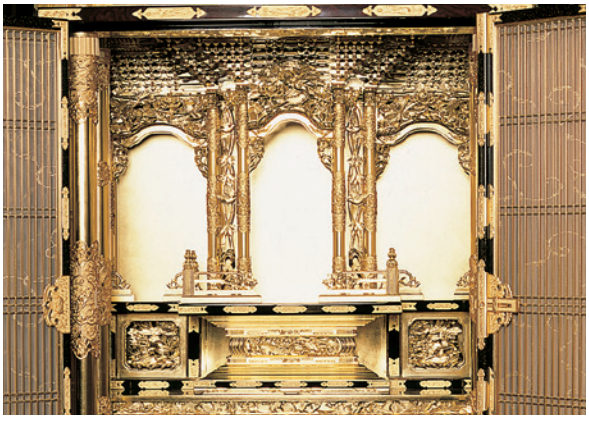
Making a mold of a sculpture using the lamination method

Molds of food samples (replicas made of polyvinyl chloride sol)

2 Putty-like molds (Addition-cure products)

●KE-1222-A/B

KE-1222-A/B is a putty-like addition-cure silicone rubber. You can achieve curing in a short period of time (5 to 10 minutes) by mixing equal amounts of A and B. The two components should be quickly mixed together by hand and pressed against the master to make the mold.

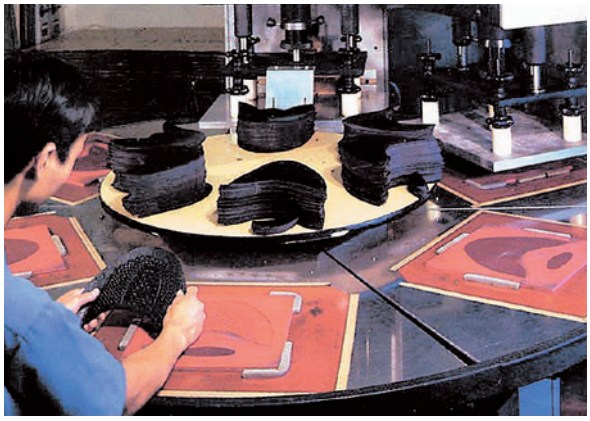


Molds of Buddhist altar ornamentation

3 Welder molds (Condensation-cure products)

●KE-24 and KE-26

These products are used as moldmaking molds in welder molding of synthetic leathers using polyvinyl chloride sheeting or urethane sheeting. KE-24 and KE-26 are high viscosity liquids that cure into a light blue silicone rubber. These three-component products cure with the addition of curing agent CAT-24 and CAT-RM in combination. All of these products can be used to create a mold which is hard enough to maintain its shape when pressure and heat are applied to the mold.



Welder molding of synthetic leather

4 High strength molds (Condensation-cure products)

●KE-1414, KE-1415, KE-1416 and KE-1417

These products all have the high tensile strength, high tear strength and elongation characteristics of silicone rubber. KE-1414, KE-1415 and KE-1416 cure with the addition of 5% of the CX-32-1714 curing agent, and KE-1417 with the addition of 5% of the CAT-1417-30 or CAT-1417-40 curing agents. Curing time can be reduced by increasing the curing agent to 7%.

These condensation-cure products are highly durable in regards to polyester and foamed/non-foamed rigid urethane resins. They are appropriate for use in the moldmaking of intricate and detailed objects such as furniture, large handicrafts and fiber reinforced plastic (FRP) items. KE-1417 has enhanced durability to resist urethane resins. Due to the high viscosity of these materials, de-air process is necessary to ensure defect-free parts.

Casting of low-melting-point alloy

Molds for garage kits

For complex castings (High strength, addition-cure products)

●KE-1310ST, KE-1314-2 and KE-1310T

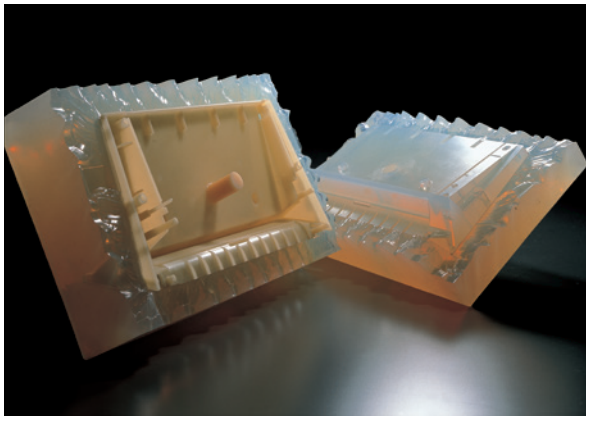
All three are addition-cure products that form translucent rubbers with high strength, high tear strength and high elongation.
Add curing agents and mix to cure: KE-1310ST cures with addition of 10% CAT-1310S or CAT-1310L; KE-1314-2 cures with addition of CAT-1314S or CAT-1314L.*
KE-1314-2 is an oil-bleed type, which facilitates easier ejection of castings and greater mold durability.
Like KE-1310ST, KE-1310T is an addition-cure product which cures to form translucent rubber with high strength, high tear strength and high elongation. Use curing agent CX-32-1649 for enhanced durability, especially when working with epoxy resin castings.

*For these two products, other curing agents are available in addition to the standard curing agents listed. Please contact our Sales Department for details.

KE-1310ST, KE-1314-2 and KE-1310T are all translucent, so they can be used to create split molds that allow you to see the master through the mold.
In their uncured state, all three are high viscosity, and should be deaerated using a vacuum deaerator before pouring the liquid silicone rubber over the master.
Addition-cure liquid silicone rubbers may not cure properly if they come in contact with certain substances that may be present in masters or mold frames, or with certain substances in the air. (For details, see “Curing inhibition with addition-cure products” on p.20.)
Shin-Etsu offers curing agents designed to combat faulty curing. Contact our Sales Department for details.

●KE-1603-A/B and KE-1606

KE-1603-A/B and KE-1606 are high transparency products for moldmaking.



A precision model mold and split mold made using the vacuum casting method

Casting of automotive headlight parts

Transparent and translucent liquid silicone rubber moldmaking

General Characteristics

Condensation-cure type		General moldmaking			Welder molding	
Parameter \ Product name		KE-12	KE-14	KE-17	KE-24	KE-26
Before curing	Appearance	White	Grayish white	Grayish white	Grayish white	Grayish white
	Viscosity Pa·s	10	15	13	75	60
	Curing agent Standard added amount	CAT-RM 0.5%	CLC-229 5.0%	CAT-RM 0.5%	CAT-RM 0.5% and CAT-24 4.5%	CAT-RM 1.0% and CAT-24 4.5%
	Pot life workable time at 23°C min*1	30	30	60	180	120
	Standard curing time °C×h*2	23×8	23×24	23×24	23×24	23×24
	Curing inhibition	No	No	No	No	No
After curing	Time to make test piece °C×h	23×72	23×72	23×72	23×72	23×72
	Appearance	White	Grayish white	Grayish white	Grayish white	Grayish white
	Density 23°C g/cm³	1.28	1.16	1.17	1.32	1.40
	Hardness Durometer A	40	30	50	83	88
	Tensile strength MPa	2.5	3.5	2.0	6.0	7.5
	Elongation at break %	170	280	140	65	70
	Tear strength kN/m	3	3	3	3	3
	Linear shrinkage %*4	0.5	0.5	0.3	1.0	1.0
	Special characteristics	Easy to work with	Easy to work with	Easy to work with	High hardness	High hardness

Measurement conditions (JIS K 6249) (Not specified values)

*1 The workable time of liquid silicone rubbers indicates how long the material will remain fluid at 23 °C. However, work should be carried out in the shortest possible time because viscosity increases with time.
*2 The curing time of condensation-cure type liquid silicone rubbers will vary depending on temperature and humidity. It also varies depending on the size of the cured item.

Condensation-cure type		Medium and high strength condensation-cure type							other
Parameter \ Product name		X-32-2256	X-32-2100-T	KE-1414	KE-1415	KE-1416	KE-1417		X-32-2428-4
Before curing	Appearance	Grayish white	Translucent	Grayish white	Grayish white	Grayish white	Grayish white		Translucent
	Viscosity Pa·s	52	25	25	45	35	45		20
	Curing agent Standard added amount	CX-32-2256 10.0%	CX-2100T 10.0%	CX-32-1714 5.0%	CX-32-1714 5.0%	CX-32-1714 5.0%	CAT-1417-30 5.0%	CAT-1417-40 5.0%	CX-32-2428-4 5.0%
	Pot life workable time at 23°C min*1	35	90	40	40	40	90	90	90
	Standard curing time °C×h*2	23×24	23×24	23×24	23×24	23×24	23×24	23×24	23×24
	Curing inhibition	No	No	No	No	No	No	No	No
After curing	Time to make test piece °C×h	23×72	23×72	23×72	23×72	23×72	23×72	23×72	23×72
	Appearance	Grayish white	Translucent	Grayish white	Grayish white	Grayish white	Light blue	Reddish brown	Translucent
	Density 23°C g/cm³	1.16	1.07	1.14	1.19	1.19	1.13	1.13	1.10
	Hardness Durometer A	36	35	30	20	15	30	40	12
	Tensile strength MPa	4.3	4.8	4.3	4.2	3.0	3.6	5.0	2.9
	Elongation at break %	260	230	300	400	450	300	260	540
	Tear strength kN/m	13	17	15	18	16	23	25	15
	Linear shrinkage %*4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Special characteristics	Viscosity and cure speed can be adjusted with curing agent.*3	Translucent	Curing agent for skin-molding is available.*4	Hardness 20	Hardness 15	Improved urethane resistance Hardness 30	Improved urethane resistance Hardness 40	For modeling Low hardness & high hardness types

Measurement conditions (JIS K 6249) (Not specified values)

*1 The workable time of liquid silicone rubbers indicates how long the material will remain fluid at 23°C. However, work should be carried out in the shortest possible time because viscosity increases with time.
*2 The curing time of condensation-cure type liquid silicone rubbers will vary depending on temperatur and humidity. It also varies depending on the size of the cured item.
*3 For X-32-2256, we offer a special curing agent used to adjust viscosity and cure speed.
*4 For skin-molding with KE-1414, please use curing agent CX-32-2077 (Standard added amount : 5%).

General Characteristics

Addition-cure type		High strength addition-cure type						
Parameter \ Product name		KE-1300T	KE-1310ST		KE-1310T	KE-1314-2		KE-1316
Before curing	Appearance	Translucent	Translucent		Translucent	Translucent		Translucent
	Viscosity Pa·s	95	75		70	75		35
	Curing agent Standard added amount	CAT-1300 10.0%	CAT-1310S 10.0%*3	CAT-1310L 10.0%	CX-32-1649 10.0%	CAT-1314S 10.0%*3	CAT-1314L 10.0%	CAT-1316 10.0%*4
	Pot life workable time Finger touch method at 23°C min*1	90	80	330	480	90	570	60
	Standard curing time °C×h*2	23×24	23×24	–	23×24	23×24	–	23×24
	Curing inhibition	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After curing	Time to make test piece °C×h	60×2	60×2	60×4	60×2	60×2	60×4	60×2
	Appearance	Translucent	Translucent	Translucent	Translucent	Translucent	Translucent	Translucent
	Density 23°C g/cm³	1.09	1.08	1.08	1.08	1.08	1.08	1.13
	Hardness Durometer A	40	40	40	40	40	40	23
	Tensile strength MPa	5.0	5.5	5.7	5.5	5.0	5.9	6.5
	Elongation at break %	400	350	320	350	350	350	700
	Tear strength kN/m	17	25	26	21	25	25	33
	Linear shrinkage %	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Special characteristics		Improved urethane resistance		Improved epoxy resistance	Oil bleed		Low viscosity, low hardness

Measurement conditions (JIS K 6249) (Not specified values)

*1 The workable time of liquid silicone rubbers indicates how long the material will remain fluid at 23 °C. However, work should be carried out in the shortest possible time because viscosity increases with time.
*2 Standard curing time will vary depending on the size of the cured item.
*3 For KE-1310ST and KE-1314-2, we offer a special curing agent used to adjust cure speed and hardness. Please contact to our sales department.
*4 For KE-1316, we offer a special curing agent used to adjust hardness and cure speed and impart adhesiveness. Please contact to our sales department.

Addition-cure type		High strength addition-cure type			other		
Parameter \ Product name		KE-1600	KE-1603-A/B	KE-1606	KE-1222-A/B	KE-1241	KE-1308
Before curing	Appearance	Grayish white	Colorless transparent	Colorless transparent	A:Blue B:Deep flesh tone	Grayish white	Translucent
	Viscosity Pa・s	170	A:85/B:50	60	Putty	35	4
	Curing agent Standard added amount	CAT-1600 10.0%	A:B=1:1	CAT-RG 10.0%	A:B=1:1	CLA-9 10.0%	CAT-1300L-4 6.0%*5
	Pot life workable time Finger touch method at 23°C min	150	90	200	5	150	240
	Standard curing time °C×h*2	23×24	23×24	23×24	–	23×24	–*6
	Curing inhibition	Yes	Yes	Yes	Yes	Yes	Yes
After curing	Time to make test piece °C×h	23×24	23×24	23×24	23×0.5	60×2	120×0.5
	Appearance	Blue	Colorless transparent	Colorless transparent	Dark brown	Grayish white	Translucent
	Density 23°C g/cm³	1.27	1.03	1.03	1.72	1.20	1.04
	Hardness Durometer A	45	28	28	80	30*4 (Asker C)	8*4 (Asker C)
	Tensile strength MPa	6.5	3.5	4.3	–	3.4	1.1
	Elongation at break %	200	450	350	–	750	800
	Tear strength kN/m	15	12	12	–	–	10
	Linear shrinkage %	0.1	0.1	0.1	0.1	0.1	0.1
	Special characteristics	High hardness*3	High transparency Mix ratio 1:1	High transparency Mix ratio 10:1	Rapid cure Putty type	For printing on curved surfaces	For molding Low hardness

Measurement conditions (JIS K 6249) (Not specified values)

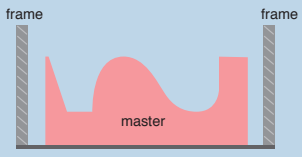
*1 The workable time of liquid silicone rubbers indicates how long the material will remain fluid at 23 °C. However, work should be carried out in the shortest possible time because viscosity increases with time.
*2 Standard curing time will vary depending on the size of the cured item.
*3 KE-1600: Hardness can be increased to 70 by performing an aging process (150 °C×30 min) after the standard cure time elapses.
*4 Hardness measured by Asker C hardness tester.
*5 For KE-1308, we offer a special curing agent used to adjust hardness. Please contact to our sales department.
*6 The hardness of KE-1308 is affected by cure temperature. To achieve the prescribed hardness, we recommend 120 °C×30 min.

Making a Silicone Rubber Mold

1 Making a single side silicone rubber mold using the pouring process

More liquid silicone rubber is used with the pouring process in comparison with the lamination process, but it is less involved and simplifies the moldmaking process. This process can be used to make a wide range of items such as buttons, broaches, handrails and ornamentation.

1



Place the master within a frame and secure it to the bottom.

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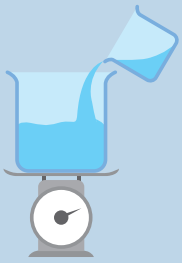

Weigh out the required amounts of base compound and curing agent.

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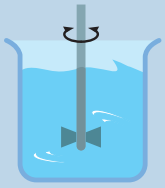

Mix the base compound and curing agent together.

4

Extract remaining trapped air with a vacuum chamber.

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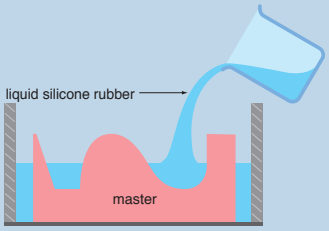

Pour in the liquid silicone rubber until the master is completely covered and carry out secondary de-airing to eliminate all bubbles from the liquid silicone rubber. If you do not have a vacuum chamber, use a brush to spread the liquid silicone rubber uniformly over the surface of the master first until all air pockets on the surface have been removed and then pour in the rest of the liquid silicone rubber.

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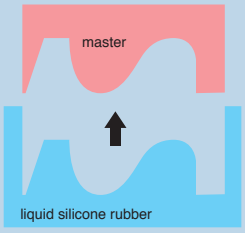

Once the rubber cures completely, pull the master from the frame. The silicone mold is now complete

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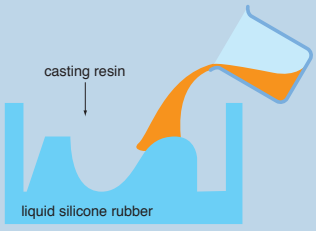
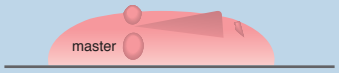


Pour the casting resin into the silicone rubber mold and let it cure. You can lengthen the life of the silicone rubber mold if you apply a releasing agent as necessary.

2 Making a split mold using the lamination process

This method is more labor intensive than the pouring method, but it requires less liquid silicone rubber. In addition, you can make lightweight silicone rubber molds containing a reinforcing material. This moldmaking method can be used when you want to make large three-dimensional objects or objects with intricate shapes. Exactly how many pieces the mold should be split into depends on the shape of the master.

1



Secure the master. Mix the base compound and curing agent together. Depressurize and carry out de-airing as necessary.

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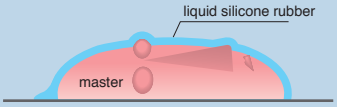
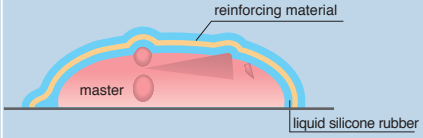


Use a brush to apply two to three layers of liquid silicone rubber. Since the liquid silicone rubber tends to collect in recesses and thin out over protrusions, the work should be performed so that the curing time is set at 10 to 20 minutes from the time of application. It is also best to wait until the applied liquid silicone rubber has hardened enough so that it has lost its flowability before applying another coat.

3



Once the liquid silicone rubber has hardened but is still slightly sticky, apply reinforcing material such as glass cloth or gauze, and then apply an additional two to three coats of liquid silicone rubber.

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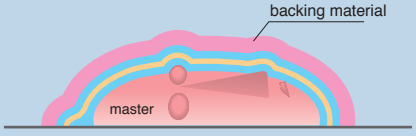

Once the liquid silicone rubber has completely hardened, apply a backing material such as gypsum or polyester to enhance the strength of the mold.

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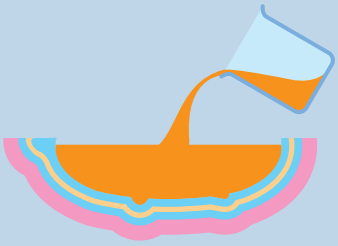

Once the backing material has completely cured, remove the master. Pour a casting resin into the silicone rubber mold and allow it to cure.

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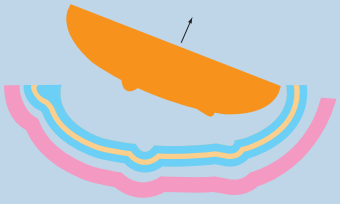
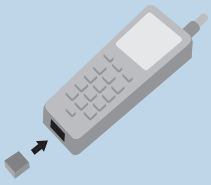


Once the replica resin has been completely cured, remove it from the mold and the replica is finished.

3 Making a silicone rubber mold using the vacuum pouring method

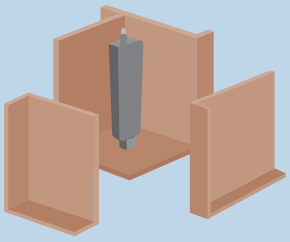
This method can be used to make highly precise molds because work is performed in a vacuum. The vacuum casting method is a good choice when you are making anything from detailed and intricately shaped objects to large parts and challenging split molds.

1



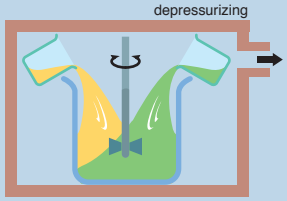
Affix the gate, which serves as the opening for pouring in the casting resin, to the master.

2



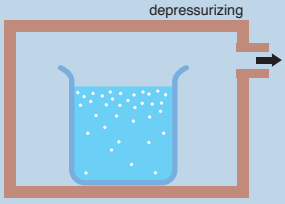
Build a frame with the gate oriented downward.

3



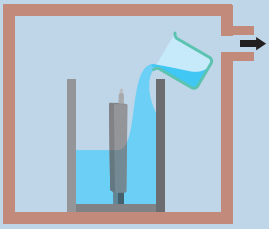
Thoroughly mix the base compound with a curing agent while depressurizing and de-airing.

4



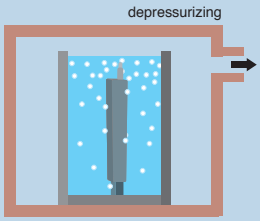
Continue de-airing under the depressurized conditions.

5



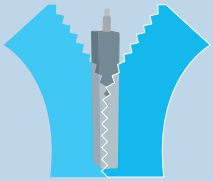
Under depressurized conditions, pour in liquid silicone rubber until the master is completely covered.

6



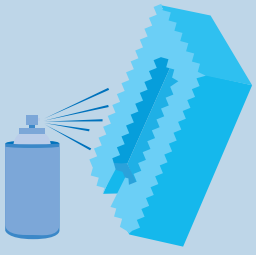
Depressurize and defoam, and then allow the mold to stand for the specified time. If you are using an addition-cure material, then the curing time can be shortened by applying heat.

7



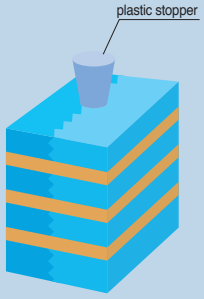
Once the curing is finished, remove the frame. Cut open the silicone rubber mold and remove the master.

8



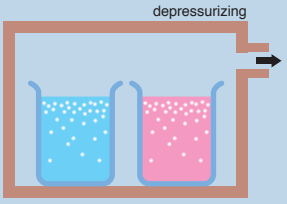
Spray the silicone rubber mold with a releasing agent as necessary.

9



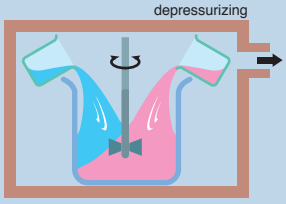
Assemble the mold, place boards on both sides and fix them securely into place using rubber rings and clamps and place a plastic stopper in the gate.

10



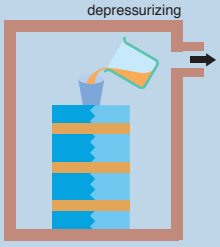
Depressurize and defoam the specified amount of casting resin.

11



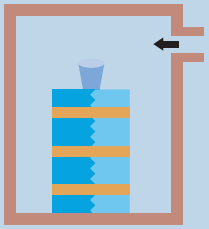
Mix the defoamed casting resin.

12



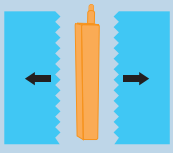
Pour in the casting resin which has been mixed via the plastic stopper under a depressurized state.

13



Once atmospheric pressure has been restored, the resin will flow into the mold. Cure the resin under the specified conditions (temperature and humidity).

14



Split the cured mold, and remove the poured item. Cut off the gate and file down the area.

Curing Method

Moldmaking liquid silicone rubber can be classified according to its curing method as either a condensation-cure product or an addition-cure product. Condensation-cure products and the addition-cure products differ in many ways. (Refer to Table 1 for information on how to correctly handle each type.)

■Table 1

Parameter \ Curing method	Condensation-cure type	Addition-cure type
Curing speed	Increasing the amount of the curing agent will accelerate curing, while decreasing the amount will slow it down. Since condensation-cure products are used at room temperature, results can be affected by atmospheric temperature and humidity.	The specific amount of a curing agent cannot be changed. Curing starts at room temperature, but the curing can be accelerated by heating to a temperature between 40°C to 150°C.
Shrinkage	Slightly higher than addition-cure products	Minimal
Curing inhibition	No	Yes
Primer	PRIMER-S or PRIMER-T	PRIMER-NO.4
Diluent	RTV-THINNER	RTV-THINNER
Cure accelerator	CAT-RS	X-93-405
Cure retardant	WETTER-NO.5	SEIGYOZAI-NO.6-10

KE-1310ST: effects of the addition of a curing accelerator or curing retardant

Composition	KE-1310ST (CAT-1310S)	100(10)	100(10)
	X-93-405 (accelerator)	1.0	–
	SEIGYOZAI-NO.6-10	–	1.0
Pot life workable time and curing time	Workable time at 23°C min	50	130
	Time until set hardness is achieved: measured at a thickness of 10 mm		
	Curing time at 60°C h	2	2
Post-curing properties	Curing conditions: 60°C×4h		
	Hardness Durometer A	40	40
	Elongation at break %	350	350
	Tensile strength MPa	6.0	6.0
	Tear strength kN/m	25	25

(Not specified values)

Composition	KE-1310ST (CAT-1310L)	100(10)	100(10)	100(10)
	X-93-405 (accelerator)	1.0	–	–
	SEIGYOZAI-NO.6-10	–	–	1.0
Pot life workable time and curing time	Workable time at 23°C min	140	300	23h
	Time until set hardness is achieved: measured at a thickness of 10 mm			
	Curing time at 60°C h	3	4	5
Post-curing properties	Curing conditions: 60°C×6h			
	Hardness Durometer A	41	41	41
	Elongation at break %	350	350	350
	Tensile strength MPa	6.0	6.0	6.0
	Tear strength kN/m	25	25	25

(Not specified values)

1 Curing speed

Condensation-cure products

Condensation-cure products cure at room temperature and become an elastomer in 8 to 24 hours. You can accelerate curing by increasing the amount of curing agent. However, there is a limit to how much the curing agent can be increased or decreased (see Figures 1 and 2). The curing speed is faster at higher temperatures and higher humidity, while it is slower at lower temperatures and lower humidity (see Figure 3). If you want to accelerate curing by heating, do it at temperatures of 50°C or lower.

Addition-cure products

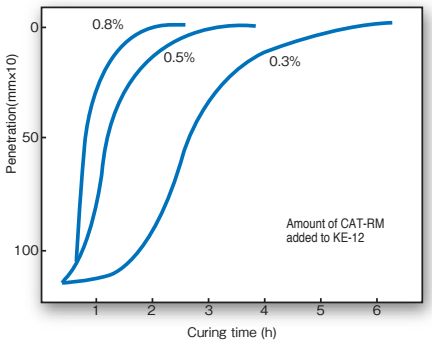
Addition-cure products can also cure at room temperature in the same way as condensation-cure products, but curing will proceed quickly if the material is heated to between 40°C to 150°C (see Table 2). However, silicone rubber molds expand when heated and contract when cooled. To enhance the accuracy of the dimensions, make sure to warm the rubber mold to the same temperature used during curing before you pour the resin into the silicone rubber mold. In addition, changing the amount of curing agent will not change the curing speed but it will adversely affect physical properties after curing is finished. Thus the measurement of the curing agent must be done as accurately as possible.

■Table 2 Curing temperature and curing time of KE1300 (addition-cure type)

Curing temperature °C	Curing time
25	Within 24 h
50	2 h
70	1 h
100	30 min
150	10 min

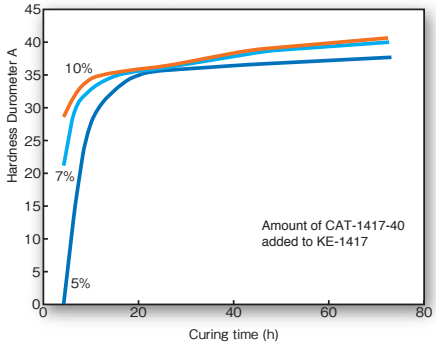
■Figure 1

Amount of curing agent added and curing speed with KE-12 (condensation-cure type) at 20°C.



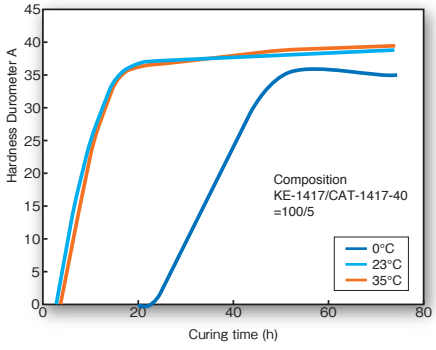
■Figure 2

Amount of curing agent added and curing speed with KE-1417 (condensation-cure type) at 23°C.



■Figure 3

Temperature and curing speed of KE-1417



2 Additives used to control curing speed

Cure accelerators and retardants are available that control the workable time or curing time depending on the needs of your specific project. The characteristics of different accelerators and retardants are shown in Table 3. Use these agents only afcare-fully checking their handling precautions.

■Table 3

	Additives	Characteristics	Applicable products
Curing accelerators	CAT-RS	Curing accelerator for use only with condensation-cure products By adding the designated curing agent and 0.1% to 0.5% CAT-RS you can greatly shorten the curing time. However, the workable time also becomes proportionately shorter.	KE-12,KE-17,KE-24, KE-1414,KE-1415, KE-1416
Curing accelerators	X-93-405	Curing accelerator for use only with addition-cure products For example, if this accelerator is added at an amount of 1% to the base compound, you can reduce the curing time by half. However, the workable time also is reduced by half.	All addition-cure products
Curing retardants	WETTER-NO.5	Curing retardant for use only with condensation-cure products For example, if this retardant is added at an amount of 1% to the base compound, you can approximately double the workable time and the curing time.	All condensation-cure products
Curing retardants	SEIGYOZAI-NO.6-10	Curing retardant for use only with addition-cure products For example, if this retardant is added at an amount of 1% to the base compound, you can increase the workable time and the curing time by approximately 2.5 times.	All addition-cure products

Handling precautions

1. The additives which are used with the condensation-cure products and the addition-cure products differ and cannot be used interchangeably. For example, if you mistakenly use a condensation-cure additive with an addition-cure product, then curing will be inhibited.
2. When you use a curing accelerator or curing retardant, make sure you add the standard amount to the designated curing agent. If you only use a curing accelerator or curing retardant without a curing agent, no curing will occur.
3. Substantial effects are obtained with the addition of minute amounts of accelerator or retardant. Thus these agents must be carefully and accurately measured. If you add too much curing accelerator, the mixture may cure during mixing. Conversely if you add too much curing retardant, the curing speed will slow down drastically and complete curing may not be achieved even after several days.

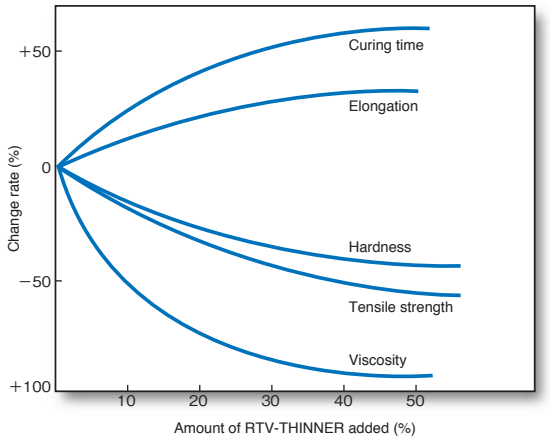
3 Diluent RTV-THINNER

It may be desirable, depending on the working conditions, to lower the viscosity of the liquid silicone rubber without appreciably changing the physical properties of the rubber after curing is finished. In such cases, an RTV-THINNER can be used as a diluent. For example, you can halve the viscosity by adding 10% RTV-THINNER, (the RTV-THINNER is a silicone containing no volatile substances). However, refer to Figure 4 for the proper amount to add because an excess amount of the diluent will adversely affect the physical properties of the rubber. It is recommended that no more than 10% diluent be added to avoid deterioration in physical properties.

■Changes in properties with the addition of diluent

Viscosity of the base compound ⟶ decreased (considerable effect)
Workable time (curing time) ⟶ prolonged (minimal effect)
Hardness and tensile strength ⟶ decreased (considerable effect)
Elongation ⟶ increased (minimal effect)

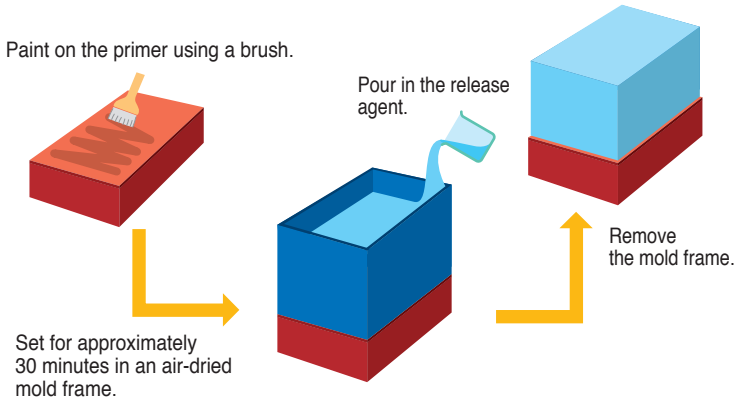
■Figure 4
Amount of RTV-THINNER added and changes in physical properties



Bonding

Moldmaking liquid silicone rubber bonds to few materials because of its superior releasability. Thus the surface of a material must be pretreated with a primer in order to bond liquid silicone rubber to a mold frame or backing material. The primer, which is a liquid, can be applied with a brush. However keep in mind that different primers are used with condensation-cure products versus addition-cure products (see Table 5). If you want to bond a cured silicone rubber mold to a part of another material, bond pieces of silicone rubber together or repair a torn piece of rubber, use one of the silicone rubber bonding agents shown in Table 6.

■Method of use



■Table 5 Primer for two-component liquid silicone rubber

Primer	Appearance	Specific gravity at 25°C	Viscosity at 25°C mm2/s	liquid silicone rubber to use with	Bonding material
PRIMER-NO.4	Colorless transparent	0.78	0.6	Addition-cure type	Metals & plastics
PRIMER-S	Colorless transparent	0.84	15	Condensation-cure type	Metals
PRIMER-T	Colorless transparent	0.86	10	Condensation-cure type	Plastics

■Table 6 Typical silicone rubber bonding agents

Pruduct name	Characteristics
KE-42·KE-45	Condensation-cure one-component bonding agents: Bonding agents of this type can be used as they are when squeezed out of the tube. Time is required for inner areas to cure, because these agents cure from the surface down to the inner areas.
KE-66·KE-67·KE-68	Condensation-cure two-component bonding agents: These bonding agents cure within 24 hours when the curing agent CAT-RC(2%) is added. KE-66 has low viscosity, KE-67 has medium viscosity and KE-68 is a non-liquid paste.
KE-1800-TA/TB	Bonding agents for use exclusively with addition-cure materials such as KE-1310ST and KE1600: KE-1800-TA/TB is a translucent bonding agent and the TA and TB components are mixed in a 1:1 ratio. This agent cures within 24 hours at room temperature and in approximately 10 minutes when heated to 150°C

5 Curing inhibition with addition-cure products

(1) What is curing inhibition?

An liquid silicone rubber addition-cure product may not cure on surfaces where it comes into contact with certain types of substances. It may fail to cure entirely if certain types of substances have been mixed into the rubber. This phenomenon, which is known as "curing inhibition," occurs because the substance inhibits the catalytic function of the liquid silicone rubber.

(2) Cure inhibiting substances

Possible cure inhibitors are substances which contain sulfur, phosphorus, nitrogen compounds, water and organometallic salts.
Specific examples of cure-inhibiting substances

- Organic rubber (natural rubber and synthetic rubbers such as chloroprene rubber, nitrile rubber and EPDM).
- Soft polyvinyl chloride resin
- Amine-hardening epoxy resin ●Isocyanates of urethane resin ●Rubber clay and oil clay
- Liquid silicone rubber condensation-cure products Examples : (KE-42, KE-45, KE-66, KE-12, KE-17 and KE-1414)
- Some adhesive tape bonding agents, adhesives, paints (such as polyester paints), waxes, solder fluxes and pine resin

(3) Preliminary cure check and countermeasures

If there is any possibility of cure inhibition, apply a small amount of liquid silicone rubber to the master to perform a preliminary check. Also do not use the mixing vessels or any other tools or equipment before thoroughly washing them with a solvent and thoroughly drying them. If curing is definitely inhibited, it may be possible to stop it by treating the master with a coat of acrylic paint or a coat of BARRIER-COAT NO.7. If that does not stop the inhibition, then use an liquid silicone rubber condensation-cure product.

6 BARRIER-COAT NO.7

BARRIER-COAT NO.7 is a low viscosity liquid which can be applied with a brush or sprayed on. Applying it to the master will prevent curing inhibition and it can also be used to prevent bonding between different pieces of liquid silicone rubber. However, BARRIER-COAT NO.7 cannot be used as a bonding primer because it has no bonding properties.

■Properties of BARRIER-COAT NO.7

Appearance	Specific gravity at 25°C	Viscosity at 25°C mPa•s	Component
Colorless transparent liquid	0.88	11	Acrylic resin:10% + Toluene:90%=100%

7 Thixotropic agent X-93-702

X-93-702 can increase a viscosity and stop the flowability of addition- or condensation-cure liquid silicone rubbers for use with mold frames. When thixotropy is required due to manufacturing process, for example with imitation stone or wood, or with skin molds, add 0.5 parts X-93-702 to 100 parts main agent.

■Applicable liquid silicone rubber for moldmaking

Addition-cure type: KE-1300T, KE-1310ST, KE-1314-2
Condensation-cure type: KE-1414, KE-1415, KE-1416, KE-1417

■Properties of X-93-702

Appearance	Specific gravity at 25°C	Viscosity at 25°C mm^2/s
Colorless transparent liquid	1.05	270

Causes of poor moldmaking and solutions

Problem	Causes	Solutions
The liquid silicone rubber does not cure	(1) Too much or too little curing agent has been added.	Add the specified amount of curing agent.
	(2) Curing agent is not suitable.	Use the correct curing agent.
	(3) Inadequate mixing.	Mix thoroughly.
	(4) Curing inhibition for addition-cure products (a) Inhibition only where the liquid silicone rubber is in contact with the master. (b) Liquid silicone rubber fails to completely cure.	(a) Treat the surface of the master with BARRIER-COAT NO.7. (b) Use a special mixing spatula and container. Work in an environment free from any cure inhibiting substances.
	(5) The room temperature is too low for the liquid silicone rubber to cure.	Raise the room temperature to between 20°C and 30°C.
	(6) The liquid silicone rubber has been stored for too long or is from an old production lot.	Do not store liquid silicone rubber for periods of longer than 3 months. Use the liquid silicone rubber within 1 month after opening.
	(7) The liquid silicone rubber has been improperly stored and deteriorated over time.	Keep liquid silicone rubber in a cold, dark location and avoid storage under high temperatures and high humidity or where it can be exposed to direct sunlight.
Cannot increase the number of moldmaking cycles	(1) Rubber mold has been insufficiently aged.	Pour in the resin only after the rubber has cured completely. Post-cure the rubber mold by heating it at 50°C×1~4h.
	(2) Resin poured is not suitable for use with the liquid silicone rubber.	Switch to the optimal liquid silicone rubber.
	(3) The resin is inadequately mixed or mixed at an incorrect compounding ratio causing problems such as abnormal heat release.	Eliminate the causes related to the resin.
	(4) The rubber mold service cycles are too frequent.	The durability of the rubber mold will be improved if it is not used too often and is allowed to stand unused.
	(5) The barrier coat agent is inappropriate.	Examine the barrier coat agent which is used.
The liquid silicone rubber bonds to the master	The liquid silicone rubber may adhere to the master if it is made of glass, ceramic or stone.	Treat the surface with liquid soap, a synthetic detergent water solution or BARRIER-COAT NO.7.
Air bubbles remain present in the rubber mold.	(1) The rubber mold has not been properly defoamed.	Completely defoam the mold. Use a vacuum defoamer.
	(2) Air bubbles are released by a wooden master into the mold.	Treat the wooden master with a filler.
	(3) Condensation is present on the master.	Dry the master.
The silicone rubber mold is deformed.	(1) The rubber mold has been insufficiently aged.	After the liquid silicone rubber has cured, thoroughly age the mold.
	(2) The rubber mold has been improperly stored.	Reset the master and store the resulting mold properly.

Packaging

Product name		1kg	10kg	20kg
Condensation cure	KE-12	●		●
	KE-14	●		●
	KE-17	●		●
	KE-24	●		●
	KE-26	●		●
	X-32-2256	●		●
	X-32-2100-T	●		●
	KE-1414	●		●
	KE-1415	●		●
	KE-1416	●		●
	KE-1417	●		●
	X-32-2428-4	●		●
Addition cure	KE-1300T	●	●	●
	KE-1310ST	●	●	●
	KE-1310T	●	●	
	KE-1314-2	●	●	●
	KE-1316	●	●	●
	KE-1600	●		●
	KE-1603-A/B	●		● (18kg)
	KE-1606	●		● (18kg)
	KE-1222-A/B	●		● (30kg)
	KE-1241	●		●
	KE-1308	●		●

Storage and Handling Precautions

Strage and Handling precautions

1. Store in a dry and cool place (1°C to 30°C, out of direct sunlight) with good ventilation. Keep away from heat and flame.
   If products are stored too long priod, it could be out of order due to settle or cohesion of the filler. It is the best to use up the products shortly after purchasing.
   If store any remains, be sure to seal the container completely. Note that certain products must be kept at 1°C to 25°C. If the product label says “keep refrigerated”, it should be kept at temperatures of 10°C or below.

2. Liquid silicone rubber for mold making base compound contains fillers which may settle to the bottom of the container. Thus make sure to mix, stir and defoam thoroughly with a spatula and a vacuum defoamer to ensure uniformity before use.
   If the product is not dispersed enough, it may adversely affect the properties of the rubber.

3. Use the curing agent recommended by us. You may have some troubles when using other curing agents.

4. Addition-cure liquid silicone rubber products may not cure properly if they are contaminated with or come in contact with certain cure-inhibiting substances (e.g. sulfur, phosphorus, nitrogen compounds, water, organometallic salts).

5. Be sure to clean the substrate to remove dirt, grime, moisture and oil from the surface.

6. Please use appropriate primers for substrates.

Safety and hygiene

1. When handling the products, take care to avoid contact with the skin and musous membranes by wearing protective glasses and protective gloves.
   In case of skin contact, immediately wipe off with dry cloth and then flush thoroughly with soap and water.

2. Uncured liquid silicone rubber may irritate skin and mucous membranes. Take care to avoid eye contact or prolonged contact with the skin. In case of accidental eye contact, immediately flush with water for at least 15 minutes and then seek medical attention.
   Contact lens wearers must take special care when using liquid silicone rubber: if uncured liquid silicone rubber enters the eye, the contact lens may become stuck to the eye.

3. When handling the products, make sure that the work area is well ventilated and avoid inhaling the vapers. Please avoid using in a place with poor ventilation or possibility of inhaling vapers.
   If you become uncomfortable by inhaling the vapors, move to an area with fresh air immediaterly.
   Contents of vapers are solvents of primers or gasses (mainly alcohol) generated from condensation cure liquid silicone rubbers. If necessary, please wear a protective mask.

4. Keep out of reach of children.

5. Be sure to read the Safety Data Sheets (SDS) for these products before use. SDS are available from the Shin-Etsu Sales Department.

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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)

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This is an edited version of the product data released on Oct. 2021.