



Shin-Etsu Silicone

**LIMS**<sup>™</sup> Liquid Injection Molding System





# A molding system for the modern age.



# LIMS

Liquid Injection Molding System

With LIMS, users can achieve significant cost reductions thanks to reduced molding time, improved yield and greater production efficiency.

LIMS (Liquid Injection Molding System) is a new type of molding system. Fine liquid silicone rubber is metered precisely and consistently by special molding equipment. After loading the two liquid components (A & B) into the molding machine, all steps proceed automatically, from mixing to molding. The molding process is simpler and takes less time, making it easy to produce high quality molded products. And the many fine properties of liquid silicone rubbers make this system ideal for electronic, automotive and food product applications, to name but a few. LIMS is highly economical, because it helps improve productivity and reduce labor costs.

## Excellent material properties

These silicones have excellent heat resistance, high strength and flame retardancy. Some are electrical insulators, while others are conductors. Our transparent products can be used as is, or can be colored easily. Our silicone materials are ideal for a wide range of applications.

## Reduced molding time

Addition-cure liquid silicone is used, so cure time is short. The molding process takes less time.

## Improved productivity

The system uses liquid materials, so molding can be done at low injection pressures and it is suitable for molding high-precision components. The two liquid components are mixed precisely and contaminants are kept out, resulting in high quality molds and greater efficiency.

## Automated molding

Can be used for flashless, runnerless molding. After curing, molded items eject easily, so the molding process can be automated. Continuous automated molding with short cycle times is also possible.

## More eco-friendly molding

No by-products are produced in the curing reaction. Flashless, runnerless molding eliminates the need for disposal of waste material, so the manufacturing process is gentler to the environment.

### Liquid silicone rubber

- Rapid curing
- Long pot life
- Good releasability, high tear strength
- Flowability

### Molds

- Cold runners
- Flashless
- Runnerless

### Injection molding machines

- Precise injection metering
- Consistent shots

### Pumps

- Precise measurement

Automated molding

Reduced costs

## Overview

Series	Features	Description (Hardness)	Note (Regulatory)
<b>KEG-2000 Series</b>	Standard For General Purpose	20 to 80 Shore	FDA, BfR; 30 to 80 Shore USP Class VI; 40 to 75 Shore ISO 10993; 20 to 80 Shore KTW; 20 to 70 Shore WRAS; 20 to 70 Shore W270; 20 to 70 Shore UL94HB listed; 20 to 75 Shore
<b>KEG-2001 Series</b>	Very Fast Curing	40 to 70 Shore	FDA, BfR; 40 to 70 Shore USP Class VI; 40 to 70 Shore ISO 10993; 50 to 70 Shore
<b>KEG-2002 Series</b>	Low Viscosity	50 and 60 Shore	FDA, BfR; 50 and 60 Shore
<b>KEG-2003 Series</b>	Low Volatile	40 and 50 Shore	FDA, BfR; 40 and 50 Shore
<b>KE-2004 Series</b>	Low Hardness Version	1, 3, 5, 10, 20 Shore	New Development
<b>KE-2014 Series</b>	Non Post Cure Oil Bleeding	30 to 60 Shore	Especially for Automotive
<b>KE-2015 Series</b>	Non Post Cure Non Oil Bleeding	30 to 70 Shore	Especially for Automotive
<b>KE-2017 Series</b>	Non Post Cure Oil Bleed, Low Volatile	10 to 60 Shore	Especially for Automotive
<b>KE-2018 Series</b>	Non Post Cure Oil Bleed, Low Volatile Selective Self-Adhesive	30 to 60 Shore	Especially for Automotive
<b>KE-2019 Series</b>	Non Post Cure Low Volatile Low Compression Set	30 to 50 Shore	Especially for Automotive
<b>KE-2090 Series</b>	Selective Self-Adhesive For General Purpose	10 to 70 Shore	USP Class VI : 30 to 70 Shore ISO 10993 : 20 and 40
<b>KE-2091 Series</b>	Selective Self-Adhesive For General Purpose Low Volatile	30 to 60 Shore	
<b>KE-2096 Series</b>	Selective Self-Adhesive For PA, Universal	40 to 50 Shore	Universal for Plastic And Metal
<b>KE-1955</b>	Flame Retardant	55 Shore	UL94V-0 Listed
<b>KET-1001-80</b>	High Hardness	80 Shore	
<b>X-34-1920</b>	Oil Resistant	70 Shore	New Development

Product	Appearance	Hardness ShoreA	Density g/cm <sup>3</sup>	Viscosity (A/B) Pa·s	
<b>KEG-2000 Series, Standard</b>					
KEG-2000-20A/B	Translucent	23	1.08	700/700	
KEG-2000-30A/B	Translucent	32	1.12	1,200/1,200	
KEG-2000-40A/B	Translucent	43	1.12	1,300/1,300	
KEG-2000-50A/B	Translucent	51	1.14	1,400/1,400	
KEG-2000-60A/B	Translucent	60	1.14	1,600/1,600	
KEG-2000-70A/B	Translucent	70	1.14	1,400/1,400	
KEG-2000-75A/B	Translucent	77	1.15	1,400/1,400	
KEG-2000-80A/B	Translucent	81	1.13	1,120/1,080	
<b>Very Fast Curing version of KEG-2000 Series</b>					
KEG-2001-40A/B	Translucent	42	1.12	1,000/1,000	
KEG-2001-50A/B	Translucent	52	1.13	1,000/1,000	
KEG-2001-60A/B	Translucent	60	1.13	1,320/1,280	
KEG-2001-70A/B	Translucent	70	1.14	1,200/1,200	
<b>Low Viscosity version of KEG-2000 Series</b>					
KEG-2002-50A/B	Translucent	51	1.13	700/700	
KEG-2002-60A/B	Translucent	59	1.13	500/500	
<b>Low Volatile</b>					
KEG-2003-40A/B	Translucent	40	1.13	650/700	
KEG-2003-50A/B	Translucent	50	1.13	720/800	
<b>Low Hardness version</b>					
KE-2004-1A/B	Translucent	1	1.02	300/300	
KE-2004-3A/B	Translucent	3	1.02	320/320	
KE-2004-5A/B	Translucent	5	1.03	164/128	
KE-2004-10A/B	Translucent	9	1.07	100/54	
KE-2004-20A/B	Translucent	20	1.08	680/620	
<b>KE-2014 Series, Non Post Cure, Oil Bleeding*<sup>1</sup></b>					
KE-2014-30A/B	Translucent	30	1.12	600/550	
KE-2014-40A/B	Translucent	40	1.12	1,500/1,400	
KE-2014-50A/B	Translucent	50	1.14	2,000/1,800	
KE-2014-60A/B	Translucent	60	1.14	2,400/2,300	
<b>KE-2015 Series, Non Post Cure, Non Oil Bleeding*<sup>1</sup></b>					
KE-2015-30A/B	Translucent	33	1.12	1,200/1,160	
KE-2015-40A/B	Translucent	43	1.12	980/850	
KE-2015-50A/B	Translucent	51	1.12	2,400/2,230	
KE-2015-60A/B	Translucent	59	1.14	1,920/1,780	
KE-2015-70A/B	Translucent	70	1.13	1,820/1,770	

Curing condition: 5min/150°C + 4h/200°C  
Standard; JIS K 6249

\*1: Curing condition (Not post cure) : 10min/150°C

\*2: Curing Speed at 150°C

\*3: Compression Set ; 22h/175°C

	Curing Speed at 130°C (MDR), sec		Tensile Strength		Elongation %	Tear Strength		Compression Set % *3
	T10	T90	MPa	psi		kN/m	ppi	
	26	42	6.2	900	880	15	87	28
	31	53	9.2	1,330	830	28	162	14
	25	45	9.9	1,440	630	34	197	17
	31	64	12.7	1,840	670	38	220	11
	35	76	11.5	1,670	550	48	220	20
	29	61	10.8	1,570	470	34	197	18
	31	66	8.6	1,250	220	5.5	32	25
	27 *2	40 *2	8.0	1,160	200	5	29	—
	22	38	11.0	1,600	630	33	191	—
	18	35	11.8	1,710	530	40	232	—
	21	39	9.2	1,330	550	44	255	—
	22 *2	40 *2	9.5	1,380	420	40	232	—
	27	41	10.0	1,450	520	35	203	—
	27	40	9.5	1,380	460	43	249	—
	24	38	9.5	1,380	700	32	186	—
	25	41	9.5	1,380	520	42	244	—
	24 *2	87 *2	1.0	150	890	1.8	10	—
	29 *2	64 *2	1.1	160	890	3.3	19	—
	30 *2	53 *2	2.2	320	860	5	29	—
	36 *2	56 *2	2.8	410	580	10	58	—
	30 *2	48 *2	5.2	750	820	20	116	—
	10 *2	20 *2	8.4	1,220	750	22	128	16
	10 *2	17 *2	8.3	1,200	550	34	197	14
	11 *2	20 *2	10.2	1,480	560	31	180	13
	12 *2	25 *2	9.7	1,410	450	39	226	35
	26 *2	45 *2	9.5	1,380	860	22	128	16
	23 *2	52 *2	11.1	1,610	680	30	174	10
	24 *2	55 *2	9.6	1,390	580	36	209	12
	29 *2	40 *2	9.4	1,360	490	42	244	31
	26 *2	54 *2	10.0	1,450	360	52	302	29

(Not specified values)

Product	Appearance	Hardness ShoreA	Density g/cm <sup>3</sup>	Viscosity (A/B) Pa·s	
<b>KE-2017 Series, Non Post Cure, Oil Bleeding, Low Volatile*<sup>1</sup></b>					
KE-2017-10A/B	Translucent	15	1.10	530/410	
KE-2017-20A/B	Translucent	21	1.09	500/380	
KE-2017-30A/B	Translucent	33	1.13	1,840/1,450	
KE-2017-40A/B	Translucent	42	1.13	1,800/1,700	
KE-2017-50A/B	Translucent	52	1.13	1,700/1,500	
KE-2017-60A/B	Translucent	61	1.15	2,540/1,800	
<b>KE-2018 Series, Non Post Cure, Oil Bleeding, Low Volatile, Selective Self-Adhesive*<sup>1</sup></b>					
KE-2018-30A/B	Translucent	33	1.12	1,200/700	
KE-2018-40A/B	Translucent	42	1.13	1,600/1,200	
KE-2018-50A/B	Translucent	51	1.13	1,400/1,110	
KE-2018-60A/B	Translucent	60	1.12	1,000/1,170	
<b>KE-2019 Series, Non Post Cure, Low Volatile, Low Compression Set*<sup>1</sup></b>					
KE-2019-30A/B	Translucent	33	1.10	310/300	
KE-2019-40A/B	Translucent	43	1.11	300/330	
KE-2019-50A/B	Translucent	51	1.13	780/840	
<b>KE-2090 Series, Selective Self-Adhesive, For General Purpose*<sup>2</sup></b>					
KE-2090-10A/B	Translucent	9	1.06	90/85	
KE-2090-20A/B	Translucent	21	1.07	250/250	
KE-2090-30A/B	Translucent	30	1.11	400/700	
KE-2090-40A/B	Translucent	40	1.11	300/700	
KE-2090-50A/B	Translucent	52	1.12	300/700	
KE-2090-60A/B	Translucent	59	1.12	400/700	
KE-2090-70A/B	Translucent	69	1.13	500/600	
<b>KE-2091 Series, Selective Self-Adhesive, For General Purpose, Low Volatile</b>					
KE-2091-30A/B	Translucent	40	1.11	400/700	
KE-2091-40A/B	Translucent	52	1.12	340/800	
KE-2091-50A/B	Translucent	60	1.12	450/700	
KE-2091-60A/B	Translucent	68	1.13	600/600	
<b>KE-2096 Series, Selective Self-Adhesive, For PA, Universal*<sup>2</sup></b>					
KE-2096-40A/B	Translucent	36	1.12	540/620	
KE-2096-50A/B	Translucent	50	1.13	610/650	
<b>Flame Retardant</b>					
KE-1955A/B	Black	56	1.24	650/600	
<b>High Hardness*<sup>1</sup></b>					
KET-1001-80A/B	Translucent	80	1.17	2,400/2,200	
<b>Oil Resistant</b>					
X-34-1920A/B	Translucent	70	1.38	500/500	

Curing condition; 5min/150°C + 4h/200°C  
Standard; JIS K 6249

\*1: Curing condition (Not post cure) : 10min/150°C \*4: Curing Speed at 120°C  
\*2: Curing condition (Not post cure) : 10min/120°C \*5: Compression Set ; 22h/175°C  
\*3: Curing Speed at 150°C \*6: Compression Set ; 70h/150°C

	Curing Speed at 130°C (MDR), sec		Tensile Strength		Elongation %	Tear Strength		Compression Set % *5
	T10	T90	MPa	psi		kN/m	ppi	
	36	87	5.8	840	900	20	116	37 *6
	31	83	7.9	1,150	860	10	58	14 *6
	41	77	9.9	1,440	740	20	116	16 *6
	36	76	10.2	1,480	650	33	191	18 *6
	32	75	9.4	1,360	490	38	220	18 *6
	38	75	9.3	1,350	300	33	191	22 *6
	17	35	11.7	1,700	770	32	186	24 *6
	17	40	11.5	1,670	680	36	209	26 *6
	19	31	10.0	1,450	590	35	203	16 *6
	19	29	9.2	1,330	480	45	261	42 *6
	22	43	9.3	1,350	760	23	133	22 *6
	23	52	10.3	1,490	630	27	157	16 *6
	27	69	11.4	1,650	550	41	238	27 *6
	26 *3	50 *3	3.4	490	870	11	64	—
	26 *3	95 *3	7.3	1,060	970	18	104	—
	62 *4	80 *4	9.5	1,380	800	20	116	—
	85 *4	105 *4	9.0	1,310	650	30	174	—
	70 *4	100 *4	8.3	1,200	450	29	168	—
	94 *4	154 *4	7.5	1,090	320	30	174	—
	72 *4	110 *4	7.8	1,130	250	8	46	—
	82 *5	105 *5	9.0	1,300	630	18	104	29 *4
	66	102	8.3	1,200	420	25	145	19 *4
	94	154	7.3	1,060	240	42	244	35 *4
	69	98	7.7	1,120	230	31	180	40 *4
	26	38 *6	8.2	1,190	670	35	203	—
	32	43 *6	8.5	1,070	470	43	197	—
	17	36	9.9	1,440	550	33	191	7
	19	97	8.0	1,160	300	32	186	—
	26 *3	40 *3	5.9	860	270	—	—	—

(Not specified values)

## ■ Cure temperature

The standard temperature range for curing is between 130°C and 200°C, although the ideal temperature varies depending on the thickness and shape of the molded item. Generally speaking, molding can be done at temperatures from 90°C to 210°C.

## ■ Injection pressure

Best results are achieved at cure temperatures from 130°C to 200°C and pressures from 40 kg/cm<sup>2</sup> to 120 kg/cm<sup>2</sup>.

## ■ Cure time

At 150°C, cure time is under 10 seconds per 1-mm of thickness. This enables molding with very short cycle times.

## ■ Linear shrinkage

At temperatures between 100°C and 150°C, linear shrinkage is about 2%-3%.

## ■ Pot life

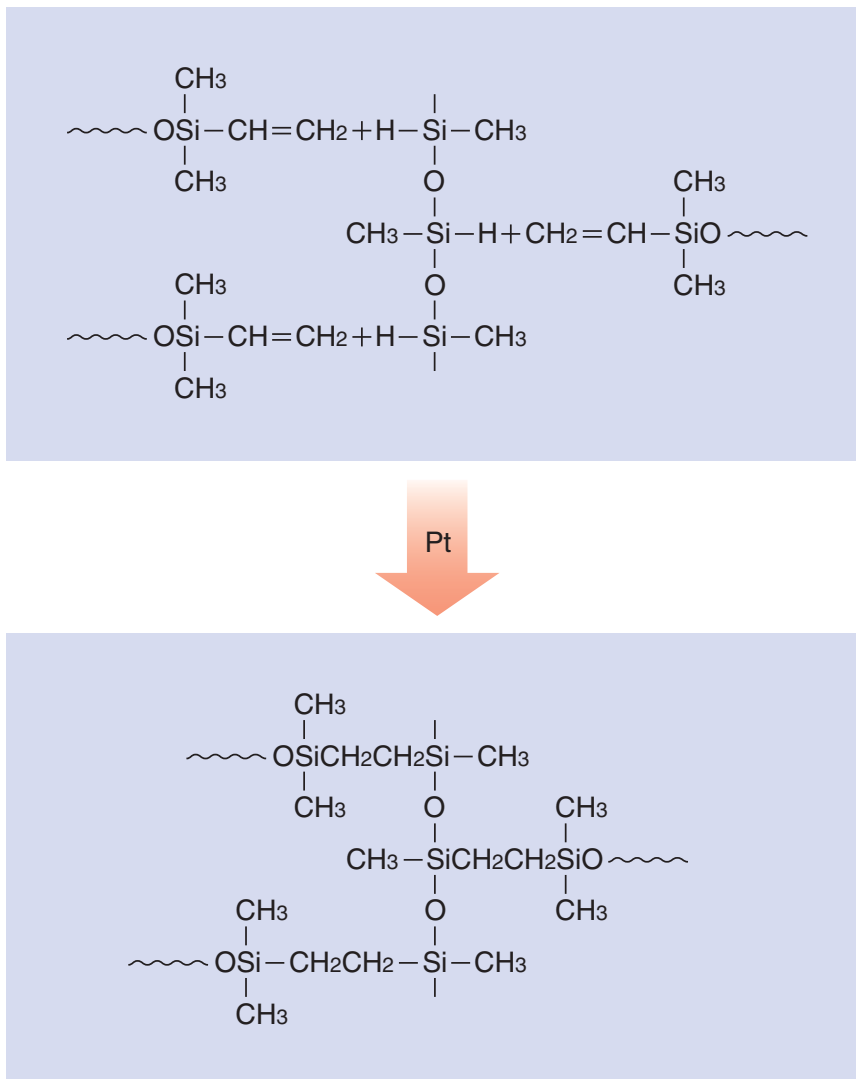
The pot life of a given product after mixing components A and B is dependent on temperature. Ordinary products will retain a suitable viscosity (one that will not cause problems for molding) for 72 hours at room temperature (25°C). To extend the pot life, install a chiller to cool the mixing section.



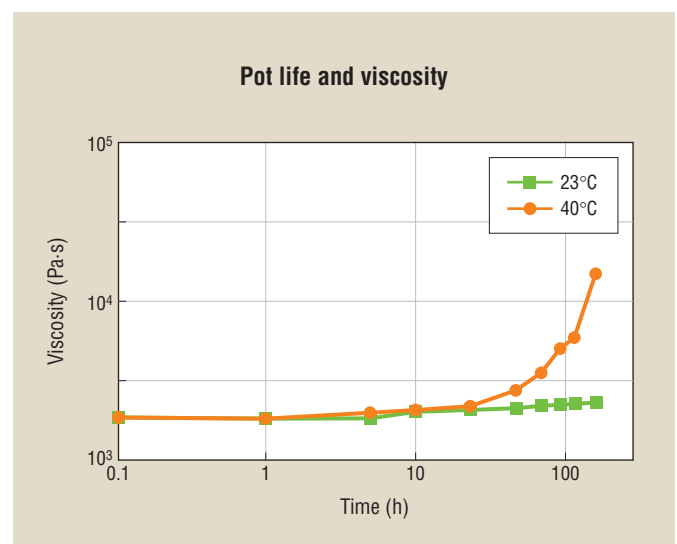
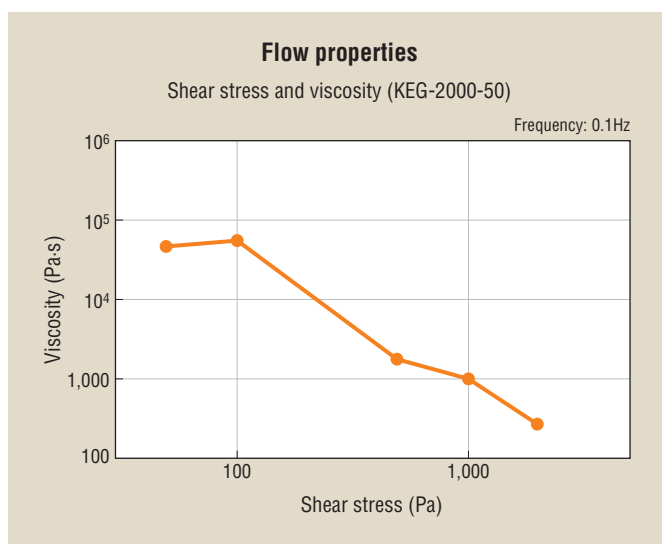
## ■ Curing mechanism

LIMS liquid silicone rubbers normally cure by addition reaction as shown below.

Heating accelerates the reaction, and cure time decreases as the temperature increases.



## ■ Flow properties and Pot life of KEG-2000-50A/B



## Curing profile of KEG-2000-50A/B and KEG-2001-50A/B by means of MDR (Moving Die Rheometer)

KEG-2001-50A/B is the fast curing version of KEG-2000-50A/B.

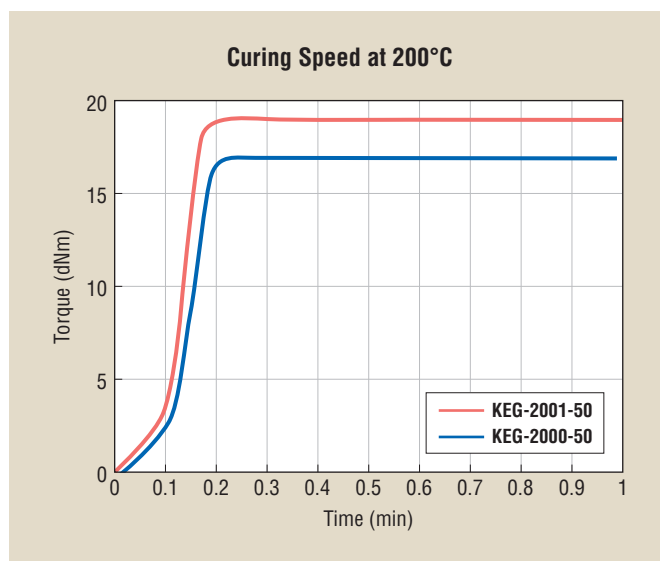
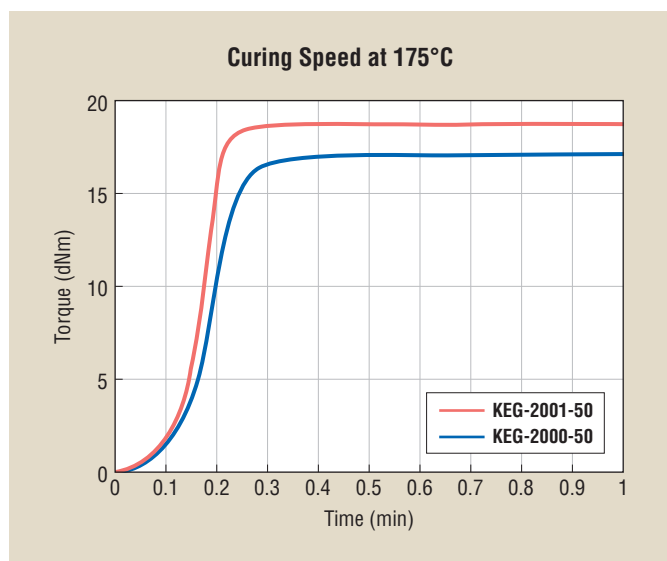
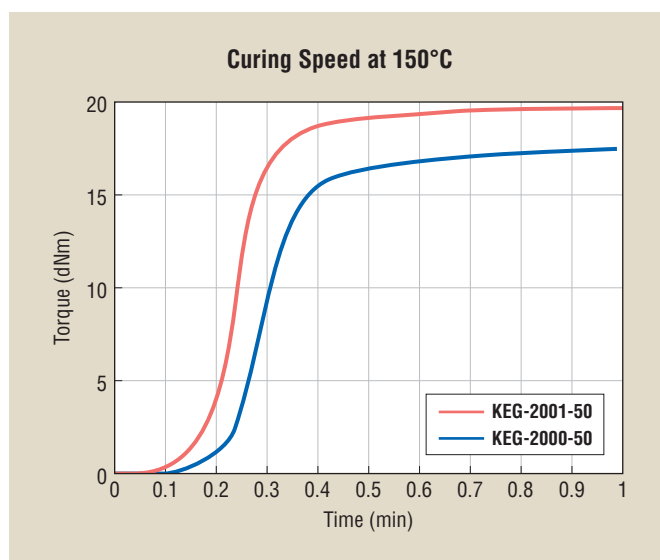
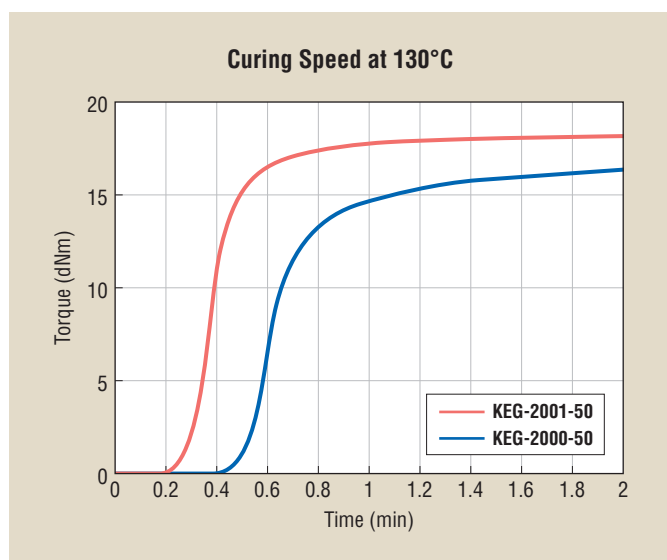
(Unit: sec)

Curing speed Temperature	KEG-2000-50A/B (Standard)			KEG-2001-50A/B (Fast Curing)		
	T10	T50	T90	T10	T50	T90
110°C	151	167	227	58	70	141
130°C	31	38	64	18	23	35
150°C	13	18	25	10	14	20
175°C	8	11	15	7	10	13
200°C	5	9	11	5	8	10

T10; How long it takes time until the cured torque has achieved to 10% of maximum torque.

T50; Up to 50% of maximum torque.

T90; Up to 90% of maximum torque.

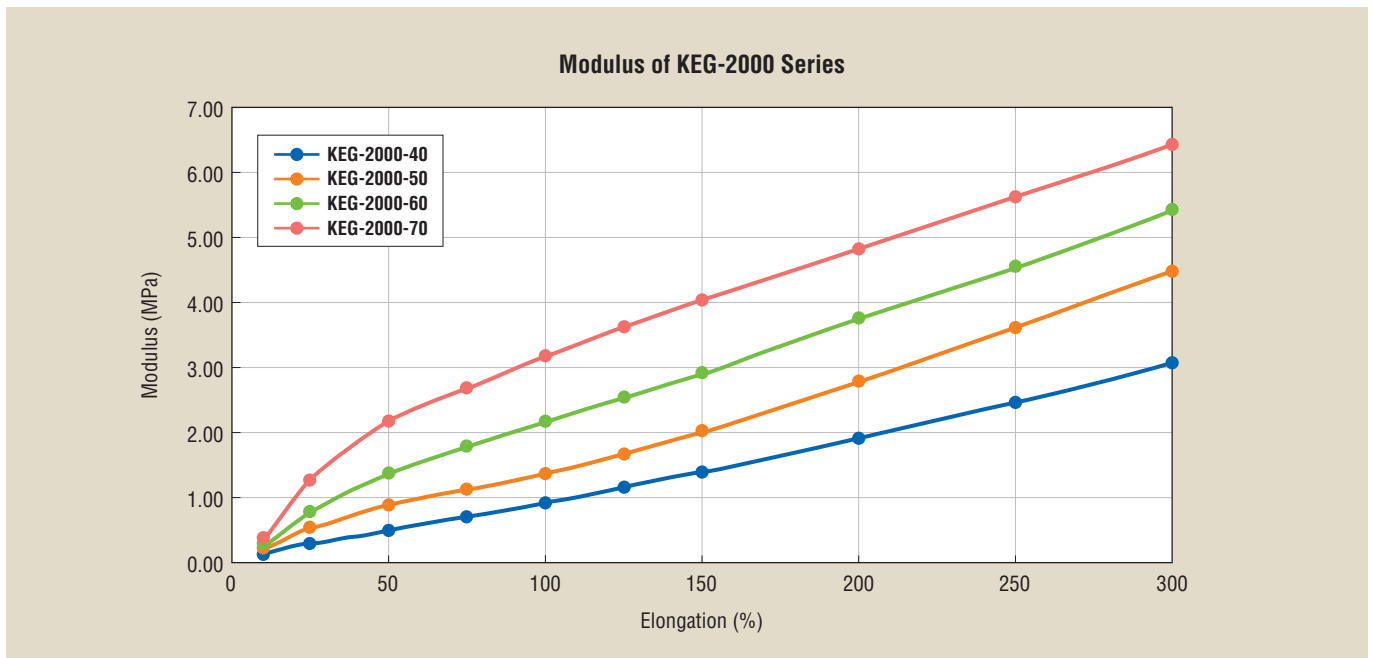


### Modulus of KEG-2000 Series

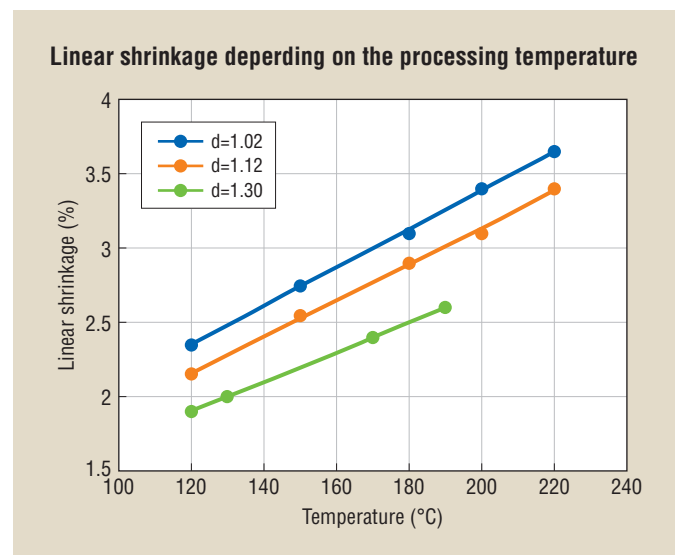
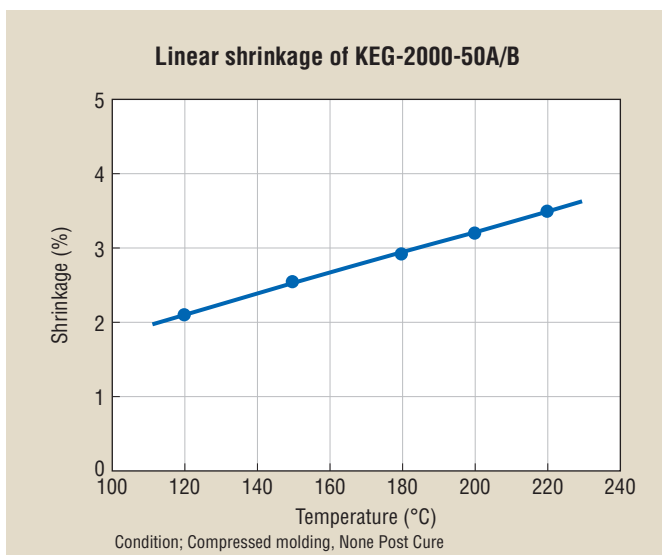
(Unit: MPa)

	KEG-2000-40	KEG-2000-50	KEG-2000-60	KEG-2000-70
10%	0.15	0.22	0.23	0.35
25%	0.28	0.53	0.76	1.24
50%	0.49	0.85	1.36	2.14
75%	0.68	1.10	1.77	2.68
100%	0.90	1.36	2.14	3.15
125%	1.14	1.66	2.52	3.59
150%	1.37	2.00	2.92	4.01
200%	1.89	2.76	3.73	4.83
250%	2.45	3.60	4.55	5.62
300%	3.05	4.48	5.40	6.42

Curing condition; 10min/120°C + 1h/150°C



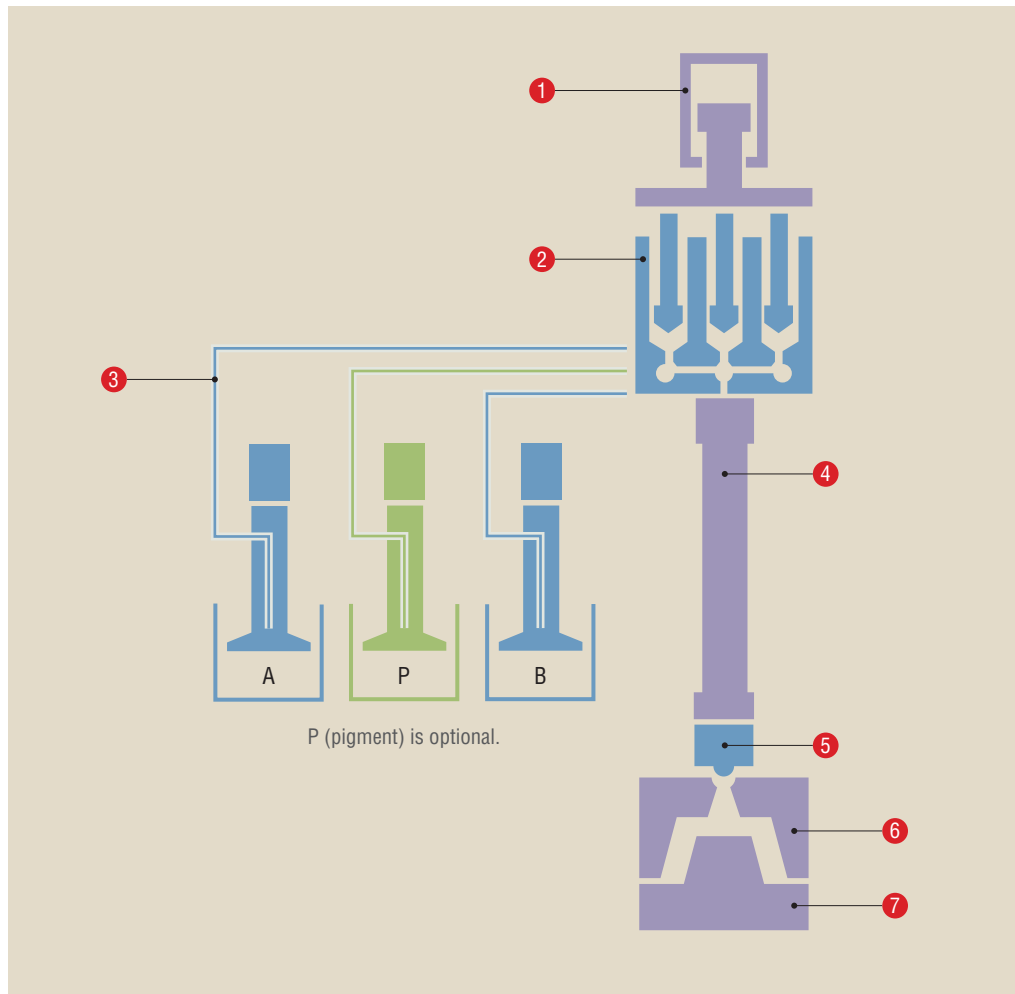
### Linear Shrinkage of KEG-2000 Series



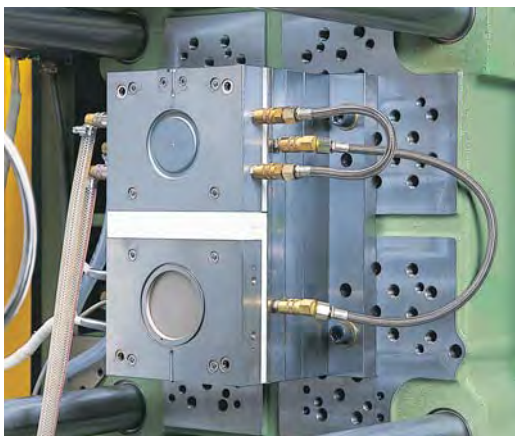
## LIMS molding machines

At room temperature, the viscosity of these special liquid silicone rubbers is between 50 Pa·s and 2,000 Pa·s. They are used with molding machines designed for materials in this viscosity range. A basic injection molding system has a metered delivery pump unit and an injection unit equipped with a mixing apparatus, typically a dynamic mixer or static mixer. All these elements are integrated in compact, high precision, specialized LIMS injection molding machines. Talk to a Shin-Etsu representative for more information about molding machines.

### Basic configuration of a LIMS molding machine



- 1 Injection unit**  
An advantage of LIMS systems is that molding can be done at low injection pressures. The user sets the pressure and injection rate.
- 2 Metering unit**  
A pump pressurizes the liquid components (A & B), which are metered accurately and ejected simultaneously at a constant ratio (1:1).
- 3 Materials supply unit**  
The pails (or drums) of liquids A and B are set in place to connect with the pumps.
- 4 Mixing unit**  
The two components are mixed thoroughly by a dynamic or static mixer. The mixture is pressurized and injected directly into the mold.
- 5 Shut-off nozzle**  
The nozzle features a shut-off mechanism, preventing the molding compound from leaking from the nozzle.
- 6 Mold clamping unit**  
The mold is clamped and opened in coordination with the operation of the supply unit, metering pump and injection unit.
- 7 Mold**



A typical mold

## ■ Points to consider when putting together a system

- The most important consideration when putting together a system is the material to be used for the seals. For example, for sliding and rotating parts, use nitrided steel or ceramic, avoid metal-on-metal contact, and use 1-3 Teflon-based gaskets.
- Be careful to prevent leakage, because the liquid molding compound can easily seep into gaps.
- The inorganic fillers contained in the molding compounds can cause increased wear on the mechanical components (mixing unit, mold). This should be considered when selecting materials for the components.
- In designing the mechanisms "downstream" of the mixing unit (shut-off nozzle, mold clamping unit, mold, etc.), take care to avoid configurations that create spots where the molding compound can collect.
- The molding compounds are compressible fluids, so be sure to adjust the timing so that the liquids flow into the mixing system simultaneously.
- Be sure the mold configuration permits air bleeding.

\* For more information, please talk to a Shin-Etsu representative.

## ■ Molding defects: causes and remedies

Problem	Cause	Remedy
Blistering	Insufficient cure	Increase curing time, increase temperature.
	Insufficient molding pressure	Increase pressure.
	Air bubbles	Thoroughly remove air from pails. Adjust injection rate.
	Uneven heating	Adjust heating unit.
Voids Surface bubbles Uneven color	Insufficient cure	Increase curing time.
	Insufficient air removal	Thoroughly remove air from pail.
	Trapped air	Prevent introduction of air during injection.
	Mold temperature too high	Reduce mold temperature. Be aware of temperature distribution throughout mold.
	Uneven mixing	Adjust injection rate. Check mixing unit.
Weld marks	Improper mix ratio and uneven mixing	Adjust mix ratio. Adjust injection rate.
	Improper molding pressure	Increase pressure. Reduce temperature.
	Injection time too long	Reduce injection time.
	Insufficient air-bleed at the fused sections	Make an air bleed.
	Unbalanced gates	Balance the gates.
Poor gloss	Insufficient cure	Increase curing time. Raise mold temperature.
	Roughness of the mold surface	Polish and use hard chrome plating. Use weaker release agent.
Poor mold release	Improper curing conditions	Increase curing time.
	Poor mold surface	Repair mold.
	Uneven surface temperature distribution	Consider changing heating method.
Nozzle leaks	Worn or damaged nozzle	Inspect shut-off nozzle.
Poor cure	Curing inhibition	Eliminate curing inhibitors.
	Mix ratio	Check mixing system.

## ■ General-purpose primer

### Primer No. 4

This is a general-purpose, quick-drying primer. Easy to use due to its low viscosity.

#### Instructions for use

- Apply by dipping, spray on, or apply by brush, etc.
- Allow primer to dry for 15 minutes at room temperature.
- As a general rule, mold should be used within 24 hours after primer application.

#### General properties

Grade	Primer No. 4
Appearance	Colorless, transparent
Viscosity	0.2-1.0 mm <sup>2</sup> /s
Specific gravity	0.77-0.78
Nonvolatile content	6-8 %
Solvent	n-Heptane
Usable time (after application)	24 h
Drying conditions	Air dry 15 min

UN Classification: Flammable Liquids, UN No: 1133

(Not specified values)

## ■ For plastics

### Primer X-33-156-20

This primer is designed for plastic molds. It can be air-dried or baked on.

#### Instructions for use

- Apply by dipping, spray on, or apply by brush, etc.
- When using an air-dry type, allow primer to dry for 30 minutes at room temperature. If the situation permits, after air drying, bake on at 80-120°C for 10-20 minutes to ensure more consistent adhesion.
- As a general rule, mold should be used within 24 hours after primer application.
- After use, seal container tightly and store in a cool, dark place.
- Contains n-heptane (solvent). Handle with caution.

#### General properties

Grade	Primer X-33-156-20
Appearance	Pale yellow
Viscosity	0.2-1.0 mm <sup>2</sup> /s
Specific gravity	0.69-0.75
Nonvolatile content	3-5 %
Usable time (after application)	24 h

UN Classification: Flammable Liquids, UN No: 1133

(Not specified values)

## Handling Precautions

### Preserving quality

1. LIMS liquid silicone rubbers may not cure properly if they come in contact with certain substances, including amines, sulfur, organophosphorus compounds and organotin compounds. If there is a possibility of curing inhibition, the user should perform a test to determine whether the product will cure properly.

### Some curing inhibitors

- Chloroprene and other synthetic rubbers
  - Sulfur compounds
  - Soft PVC
  - Amine-cure epoxies
  - PVC insulating tape
  - Soldering flux that contains rosin
2. Keep out of rain and away from excessive humidity. Store in a cool, dark place.

### Safety and hygiene

1. If these LIMS materials are to be used to manufacture items that will be used in contact with food, be sure to determine whether the materials meet relevant food sanitation laws.
2. Avoid prolonged and repeated contact with the skin. Especially about primer, avoid direct contact to the skin. If contact occurs, wipe off with a dry cloth and then wash thoroughly with soap and water.
3. In case of eye contact, immediately flush thoroughly with water and seek medical attention if necessary.
4. Primers contain organic solvents. Always use in a ventilated area and wear protective gear (goggles, gloves, etc.). If using these products in a poorly-ventilated area, wear a respirator mask designed to filter organic gases.
5. Mixing Liquid B with alkaline substances produces flammable hydrogen gas, so handle with caution.
6. The primers mentioned herein may be classified as hazardous materials under federal or state fire prevention laws, and must be stored and handled accordingly. Contact Shin-Etsu for details.
7. Please read the Material Safety Data Sheet (MSDS) before use. MSDS can be obtained from our Sales Department.

## Packaging

All products are supplied in 20 L pails (Net Wt. 20 kg) or 200 L drums (Net Wt. 200 kg).

## Hazardous Materials Classification

All products are NOT classified as UN Hazardous Materials.

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