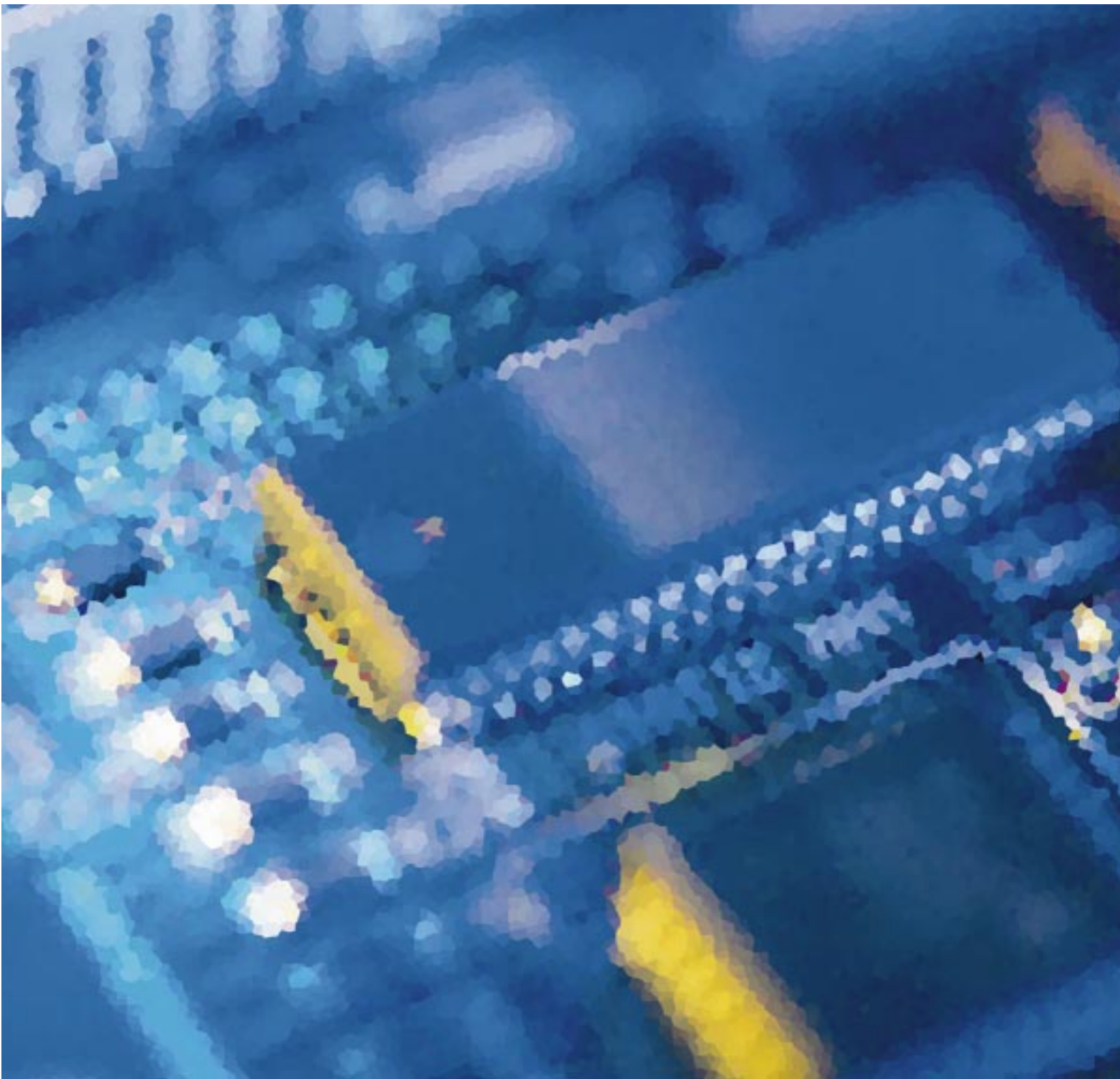
Shin-Etsu

Shin-Etsu Liquid Coating Materials for Electronic Devices

KJR Series & SEMICOAT Series

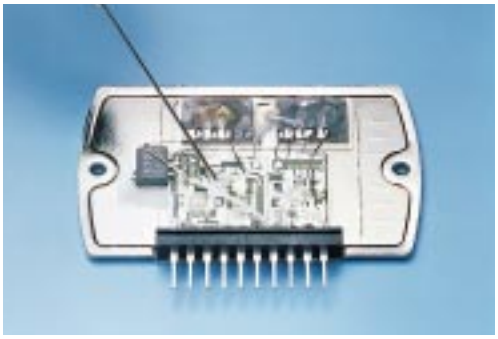


KJR Series

Junction Coating Resins
Liquid Type Silicone & Polyimide Silicone for Electronic, Electric and Optical Devices

Main Features

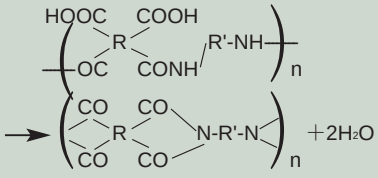
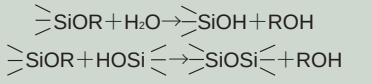
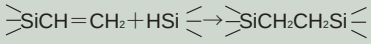
- ●Ultra High Purity
- ●High Thermal Stability
- ●High Electrical Stability
- ●High Mechanical Stability
- ●Excellent Adhesive Strength



Classification of KJR Series

The KJR Series can be classified into three categories according to the chemical curing mechanism used. The manufacturing process or some characteristic of the devices to be coated may dictate which group you select for particular application.

Chemical Curing Mechanisms

Type	Curing Condition	Chemical Mechanism	By-Product	Grade
Rigid	Heat (Condensation)		H_2O	KJR650E Series (Polyimide Silicone)
Flexible	Moisture (Condensation)		ROH	KJR4000E Series (Silicone)
Flexible・Gel	Heat (Addition)		None	KJR9000E Series (Silicone)

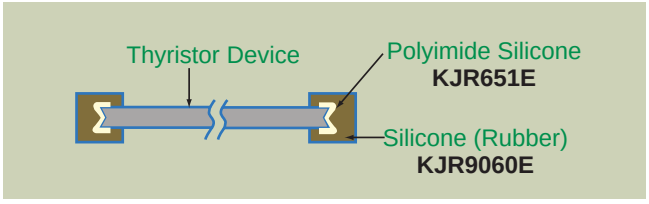
Rigid Type
After curing, this coating film hardens to a highly rigid polyimide.
Since it is also has excellent adhesive properties, it is ideal for coating of particularly high voltage resistant devices.

Flexible Type
After curing, this coating film has outstanding rubber elastic properties.
By absorbing stress due to external forces, it can prevent fracturing of devices or breakage of bonding wires.

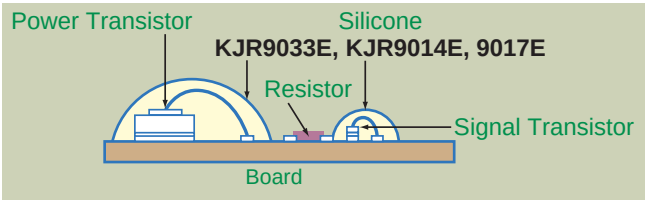
Gel Type
After curing, this coating film is a soft gel type of material.
It has extremely low stress compared with the rubber type, so maximum buffer effect can be achieved.
Since it has superb adhesion strength and lead sealing, it can provide the best humidity protection.

Typical Application of KJR Series for Various Devices

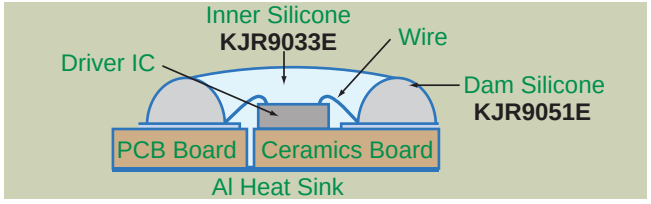
(a) GTO Thyristor Coating



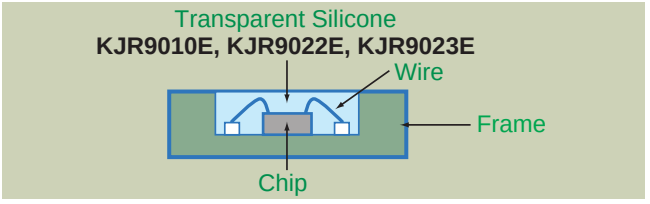
(b) Hybrid IC Chip Coating



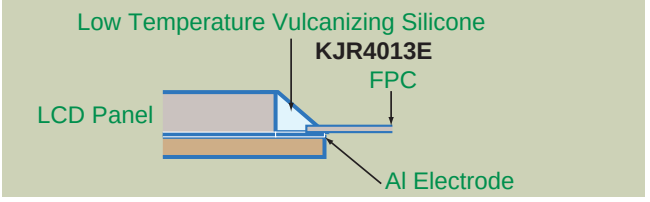
(c) Thermal Head Coating



(d) Photo Diode Coating



(e) LCD Electrode Protection Coating



Curing KJR Series Resins

The KJR Series resins maintain primarily two types of curing schedules—heat curable, and moisture curable. The heat curable type material requires a heat cure of 150℃ to 170℃ for one to four hours. Our moisture cure material requires more than 40 percent relative humidity for 24 hours at room temperature.

In most cases, post-curing is also required to obtain optimum properties with the greatest resistance to temperature extremes and improved reliability of coated devices.

Several of the KJR-9010E Series will remain in a gel state and do not require post-curing.

Type	Product Name	Cure Condition	Post Cure Condition
Flexible	9051E 9052E	80～100℃/1～4Hr	200℃/4～16Hr
	9022E 9023E 9050E	100～150℃/1～4Hr	200℃/4～16Hr
	9033E 9060E 9061E	150～170℃/1～4Hr	200℃/4～16Hr
	4010E 4013E 4012E 4050E	20～25℃/45～65% RHD/24Hr ＋150℃/1～4Hr	200℃/4～16Hr
Gel	9010E 9015E	100～150℃/1～4Hr	200℃/4～16Hr
	9014E 9017E	150～170℃/1～4Hr	200℃/4～16Hr
Rigid	651E 654E	150℃/1Hr＋200℃/1Hr＋250℃/4Hr	300℃/0.5～4Hr
	653E	150℃/1Hr＋200℃/16Hr	250℃/0.5～4Hr

KJR Series

Reduced Impurities, Higher Stability for Superior Semiconductors

Impurity

Very Low Ionic Impurity Reduces Risk of Corrosion

KJR Series resins are extremely pure, offering superior stability to all types of semiconductor devices. The most critical impurity, chloride ion, is kept to an absolute minimum, greatly reducing the risk of electrode corrosion.

Ionic Impurities (ppm)

Grade \ Ion	Na^+	K^+	Cl^-
KJR Series	0.1	0.2	1.0
General Silicone	0.5	5	5～10

Low Uranium Content for Alpha Particle Sensitive Devices

The low uranium content of KJR Series resins is an important feature in improving the performance of devices.

Content of Uranium (ppb)

Product	Uranium Content
KJR Series	Undetective
KJR651E	Undetective
Synthetic Quartz	＜1.0
Natural Quartz	＞30

fluorometric Method

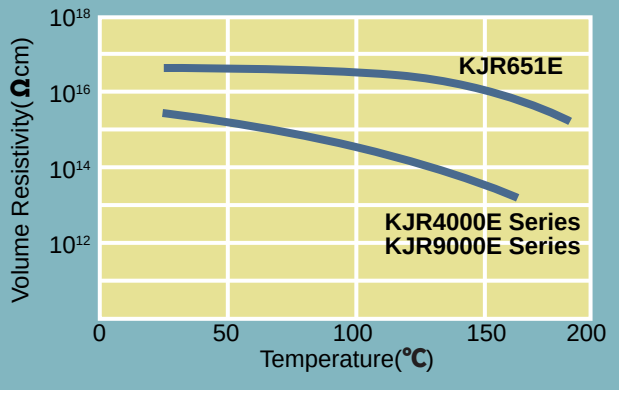
Electrical Stability

Electrical Stability over a Broad Temperature Range

At high and low temperature extremes, KJR Series resins maintain electrical stability, due to the combination of basic organo-siloxane bonding and the low content of ionic impurities. The result is a more reliable device that operates safely in a wide variety of conditions, even at very high temperatures.

The KJR651E, a copolymer structure composed of polyimide and polysiloxane, possesses superior high temperature properties.

Volume Resistivity vs. Temperature

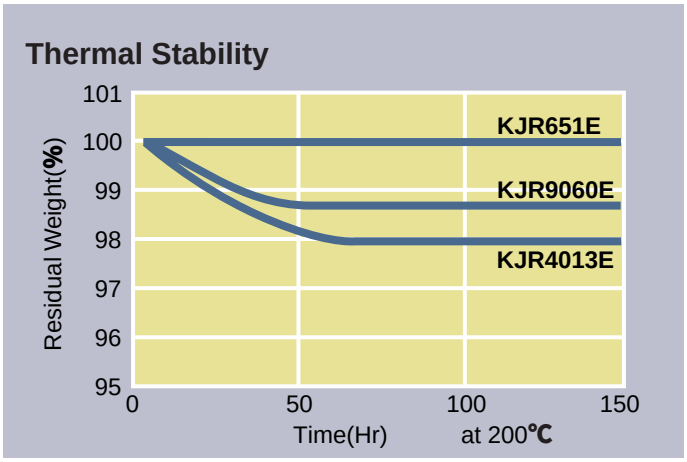


Thermal Stability

Thermal Stability Protects Against Extremes

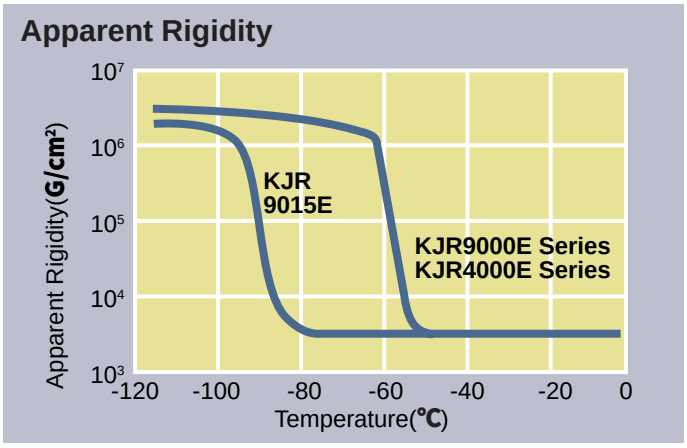
Thermal stability derived from the inherent properties of silicones gives the KJR Series the ability to protect devices from the extremes of heat shock, solder dip and other situations.

The KJR651E with its special copolymer structure is the most stable, capable of withstanding temperatures as high as 250℃.



Flexibility Down to −80℃

KJR9015E maintains its flexibility at temperatures as low as −80℃, providing an effective buffer against severe thermal shock.



Adhesive Property

Improved Breakdown Voltages with Higher Adhesive Strength

The KJR Series shows a very good affinity for the metallic and ceramic substrates used in semiconductor manufacturing. Higher breakdown voltages and lower leak currents result from the bonding properties of the KJR Series.

Post-curing is recommended to further improve the adhesive strength and stability of KJR Series resins.

＊1 Shear Strength(kg/cm²)
＊2 Area of JCR remaining on substrate after Shear Test(percent).

Adhesive Strength

		Silicon Substrate		Aluminum Substrate	
	GRADE	Strength＊1	Residual Area＊2	Strength＊1	Residual Area＊2
Flexible Type	4010E	3	100	3	100
	4012E	3	100	3	100
	4013E	8	100	8	100
	4050E	4	100	4	90
	9010E	—	100	—	100
	9014E	—	100	—	100
	9015E	—	100	—	100
	9022E	8	100	8	100
	9023E	2	100	2	100
	9033E	3	100	3	100
	9050E	4	100	6	100
	9051E	6	100	6	100
	9052E	3	100	3	100
	9060E	10	100	10	100
	9061E	10	100	10	100

KJR Series

General Properties

Type		Rigid Type							
Item \ Product Name	Unit	KJR651E	KJR653E	KJR654E	KJR4010E	KJR4012E	KJR4013E	KJR4050E	KJR9022E
Component		One	One	One	One	One	One	One	Two
Polymerization		Thermoset	Thermoset	Thermoset	Moisture cure	Moisture cure	Moisture cure	Moisture cure	Thermoset
Appearance		Brown	Brown	Brown	White	Translucent	White	Translucent	Transparent
Non volatile part	%	25	24	19	100	100	100	100	100
Solvent		N-Methyl-2-pyrrolidone	N-Methyl-2-pyrrolidone	Xylene-N-Methyl-2-pyrrolidone	None	None	None	None	None
Viscosity（25℃）	Poise	20	2.3	4	30	30	55	350	40
Shelf Life（5℃）	Month	3	3	3	6	6	6	6	6
Mixing Ration	Base/cure agent	—	—	—	—	—	—	—	100/10
Pot Life（25℃）	Hr	—	—	—	—	—	—	—	10
Tack Free Time（25℃）	Hr	—	—	—	2	2	2	1	—
Cure Condition	℃/Hr	150/1＋200/1＋250/4	150/1＋200/16	150/1＋200/1＋250/4	*1 25/24＋150/4	*1 25/21＋150/4	*1 25/24＋150/4	*1 25/24＋150/4	150/4
Specific gravity		—	—	—	1.05	1.05	1.26	1.05	1.01
Hardness	Shore	80(D)	80(D)	80(D)	22(A)	20(A)	38(A)	18(A)	42(A)
Tensile Strength	kg/cm²	1,400	800	1,400	15	12	20	17	50
Elongation	%	～30			200	200	150	300	150
Adhesive Strength Silicon	kg/cm²（%）	—	—	—	3(100)	3(100)	8(100)	4(100)	8(100)
Adhesive Strength Aluminum	kg/cm²（%）	—	—	—	3(90)	3(90)	8(100)	4(90)	8(100)
Volume Resistivity	Ω·cm	1×10^{16}	1×10^{16}	1×10^{16}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	5×10^{15}
Dielectric Strength	kV·mm	13(0.1mm)	10(0.1mm)	13(0.1mm)	24	22	25	23	25
Dielectric Constant	(50Hz)	3.1	3.1	3.1	3.0	3.0	3.3	3.0	2.9
Dissipation Factor	(50Hz)	3.1×10^{-3}	3.2×10^{-3}	3.1×10^{-3}	5×10^{-4}	5×10^{-4}	3×10^{-4}	5×10^{-4}	5×10^{-4}
Applicable Temperature	℃	−50～300	−50～300	−50～300	−50～200	−50～200	−50～200	−50～200	−50～200

Application									
Diode		●	●	●	●	●	●	●	
Rectifier		●	●	●		●	●	●	
Thyristor		●	●	●		●	●		
Transistor		●	●	●		●	●		
Opto Coupler									●
L.E.D.									●
LCD						●	●		
Integrated Circuit		●	●	●					
Hybrid IC					●	●			

∗1 More than 60% Relative Humidity ∗2 Penetration Measure

Flexible Type								Gel Type			
KJR9023E	KJR9025E	KJR9033E	KJR9060E	KJR9061E	KJR9050E	KJR9051E	KJR9052E	KJR9010E	KJR9014E	KJR9015E	KJR9017E
Two	Two	One	One	One	Two	Two	Two	Two	One	Two	One
Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset	Thermoset
Transparent	Translucent	White	Translucent	Translucent	Black	Gray	Translucent	Transparent	Translucent	Transparent	Transparent
100	100	100	100	100	100	100	100	100	100	100	100
None	None	None	None	None	None	None	None	None	None	None	None
40	70	50	90	170	300	50	90	7	100	8	8
6	6	3	3	3	6	6	6	6	3	6	3
100/10	100/100	—	—	—	100/10	100/10	100/10	100/10	—	100/100	—
24	24	—	—	—	24	24	24	8	—	8	—
—	—	—	—	—	—	—	—	—	—	—	—
150/4	80/2	150/4	150/4	150/4	150/4	80/2	80/2	150/2	150/2	150/2	150/2
0.99	1.00	1.0	1.0	1.0	1.04	1.18	1.00	0.97	1.00	0.99	0.99
22(A)	17(A)	20(A)	10(A)	13(A)	35(A)	41(A)	16(A)	65*2	65*2	65*2	65*2
7	5	5	16	—	15	15	7	—	—	—	—
150	200	150	600	600	180	150	180	—	—	—	—
2(100)	—	3(100)	10(100)	10(100)	4(70)	—	—	—	—	—	—
2(100)	—	3(100)	10(100)	10(100)	6(100)	—	—	—	—	—	—
1×10^{15}	5×10^{14}	1×10^{15}	2×10^{15}	2×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}
23	21	21	24	23	25	28	22	—	—	—	—
2.8	2.9	2.9	2.8	2.8	3.0	3.0	2.7	3.0	3.0	3.0	3.0
5×10^{-4}	5×10^{-4}	4×10^{-4}	4×10^{-4}	5×10^{-4}	5×10^{-4}	3×10^{-3}	2×10^{-4}	4×10^{-4}	4×10^{-4}	4×10^{-4}	4×10^{-4}
−50～200	−50～200	−50～200	−50～250	−50～250	−50～200	−50～200	−50～200	−50～200	−50～200	−80～250	−80～250
		●	●	●				●	●	●	●
		●	●	●				●	●	●	●
			●	●							
	●	●	●	●	●	●	●	●	●	●	●
●									●		
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	●										
			●					●	●	●	●
	●	●	●		●	●	●	●	●	●	●

Inhibitors Against KJR9000E Series

Curability of grade nos. with 9000E Series will decline if catalysts lose their activity by some compounds.
Before using 9000E Series, curing equipment and containers must be washed well and take care of contamination of inhibitors as follows;

Inhibitors

The compounds which will be the inhibitors have atoms of N, P, S, or Sn in their molecules.

N :Amines, Isocyanates, Amides, Nitriles, etc.
P :Phosphines, Phosphoxides, Phosphoric Esters, etc.
S :Mercaptans, Sulfonates, Sulfides, etc.
Sn :Organo-Tin Compounds(Chlorides, Esters, etc.), etc.

Strength of Inhibitors

The order strength of inhibitors as above is P ＞ S ＞ Sn, N.
Curability of 9000E Series decline if phosphor compounds are contaminated in several ppm.

Moisture

Moisture, other than the above mentioned inhibitors, has influence upon curability of 9000E Series.
So, please use them paying attention to invasion of moisture.

Handling KJR Series Resins

Storage

To prolong shelf-life, store KJR Series resins in a cool, dark place (such as a refrigerator). The seal of the bottle should be examined and kept tight to reduce the possibility of moisture or contaminants contacting the resins—particularly with moisture-cure grade resins.

Preparation

Stir KJR Series resins before using to prevent separation. All grades should be deaerated to minimize the risk of air bubbles in the coating. This is especially critical with the two-component variety. Deaeration should be carried out at a vacuum of less than 15mm Hg for approximately 20 minutes.
The resins should be mixed at the prescribed mix ratio, as shown in the selector guide(See General Properties).

Coating and Curing

During the coating process, dispense the resins mechanically with specially designed dispensing equipment, or manually by syringe. Protect the coatings from contamination due to moisture, ionic materials, and other foreign substances.
Ensure proper ventilation to remove condensation products from the curing oven.

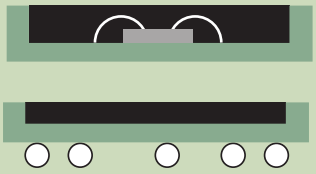
Post Cure

Perform post-cure at approximately 200℃ for four to sixteen hours. The post-cure process is essential in improving the resins' passivation quality for all grades with the exception of gel type KJR Series.

SEMICOAT Series

Liquid Epoxy Coating Agents for Semiconductors
One Component Thermosetting Type

Typical Application of SEMICOAT Series for Semiconductors

Application		Product Name
Potting for PGA, BGA etc.		SEMICOAT 114, SEMICOAT 115, X-43-5012A, SEMICOAT 122, SEMICOAT 124＊
Underfill for Flip Chip		X-43-5107, X-43-5107-1, X-43-5107-2, X-43-5123, X-43-5127
Glob Top for COB		SEMICOAT 220L, 220H, 227, SEMICOAT 120X-1, SEMICOAT 125H*
Dam Forming （Bank Agent）		X-43-5255

＊UL94V-0 recognized component

SEMICOAT Series

Potting for PGA, BGA etc.

Product Name			SEMICOAT 114	SEMICOAT 115	X-43-5012A	SEMICOAT 122	SEMICOAT 124*1
Feature			Low viscosity	Low viscosity Low stress	Low stress Good Adhesion	Low stress Small warpage	Low stress Flame resistance
Aspect Ratio*2			0.10	0.05	0.05	0.05	0.05
ITEM		UNIT					
Appearance			Black	Black	Black	Black	Black
Viscosity	25℃	poise	55	400	1000	400	900
Gelation Time	150℃	sec	60	70	70	60	70
Flexural Strength	25℃	kgf/mm^2	8	10	10	11	10
Flexural Modulus	25℃	kgf/mm^2	450	1100	1300	1300	1000
Coefficient of Thermal Expansion	α1	ppm/℃	45	20	15	15	20
	α2	ppm/℃	140	80	60	60	80
Glass Transition Temp.		℃	135	145	145	155	145
Volume Resistivity at 25℃		Ωcm	2×10^{16}	2×10^{16}	2×10^{16}	2×10^{16}	1×10^{16}
Dielectric Constant at 1kHz			4.0	3.5	3.3	3.6	3.5
Recommended Cure Condition			100℃/1Hr+150℃/1Hr	100℃/0.5Hr+150℃/2Hr	100℃/0.5Hr+150℃/2Hr	100℃/1Hr+150℃/2Hr	100℃/0.5Hr+150℃/2Hr
Dispense Condition(Device Temp.)		℃	22～50	*70～90	*70～90	*70～90	*70～90
Storage Condition		℃	Below－5	Below－5	Below－5	Below－40	Below－5

*to avoid trapping air in dispense process.

*1 UL94V-0 recognized component

Underfill for Flip Chip

Product Name			Special formulation			Standard type	
			X-43-5107	X-43-5107-1	X-43-5107-2	X-43-5123	X-43-5127
Feature			High reliability Good penetration	High reliability Better penetration	Low viscosity More better penetration	Low viscosity Good penetration	Low viscosity Better penetration
Possible Gap Size		μm	20～100	20～100	20～100	40～100	20～100
ITEM		UNIT					
Appearance			Black	Black	Black	Black	Black
Viscosity	25℃	poise	2500	1000	360	150	80
Viscosity	100℃	poise	7.8	3.5	1.8	2.0	1.5
Gelation Time	150℃	sec	330	330	330	75	75
Flexural Strength	25℃	kgf/mm^2	10	10	10	10	10
Flexural Modulus	25℃	kgf/mm^2	800	700	600	650	650
Coefficient of Thermal Expansion	α1	ppm/℃	27	32	38	32	32
	α2	ppm/℃	80	91	98	105	105
Glass Transition Temp.		℃	140	140	140	145	145
Volume Resistivity at 25℃		Ωcm	1×10^{16}	1×10^{16}	1×10^{16}	1×10^{16}	1×10^{16}
Dielectric Constant at 1kHz			3.8	3.8	3.8	3.5	3.5
Recommended Cure Condition			120℃/0.5 Hr + 150℃/2Hr			100℃/0.5 Hr + 150℃/2Hr	
Dispense Condition（Device Temp.）		℃	110～130			80～100	
Storage Condition		℃	Below－5			Below－5	

*1 UL94V-0 recognized component

Glob Top for COB(thixotropic type)

Product Name		SEMICOAT 220L	SEMICOAT 220H	SEMICOAT 227	SEMICOAT 120X-1	SEMICOAT 125H*1
Feature		Low thixotropy	Middle thixotropy	High thixotropy	Low stress Middle thixotropy	Hame resistance Middle thixotropy
Aspect Ratio*2		0.14	0.20	0.28	0.18	0.24
ITEM	UNIT					
Appearance		Black	Black	Black	Black	Black
Viscosity 25℃	poise	850	900	1000	1100	900
Gelation Time 150℃	sec	70	70	70	65	70
Flexural Strength 25℃	kgf/mm²	10	10	10	10	8
Flexural Modulus 25℃	kgf/mm²	800	800	800	1200	850
Coefficient of Thermal Expansion 1	ppm/℃	24	24	24	15	24
Coefficient of Thermal Expansion 2	ppm/℃	95	95	95	60	95
Glass Transition Temp.	℃	140	140	140	150	145
Volume Resistivity at 25℃	Ωcm	2×10^{16}	2×10^{16}	2×10^{16}	2×10^{16}	1×10^{16}
Dielectric Constant at 1kHz		3.5	3.5	3.5	3.6	3.5
Recommended Cure Condition		100℃/0.5Hr+150℃/2Hr	100℃/0.5Hr+150℃/2Hr	100℃/0.5Hr+150℃/2Hr	100℃/1Hr+150℃/2Hr	100℃/0.5Hr+150℃/2Hr
Dispense Condition（Device Temp.）	℃	60～80	60～80	60～80	60～80	60～80
Storage Condition	℃	Below−5	Below−5	Below−5	Below−40	Below−5

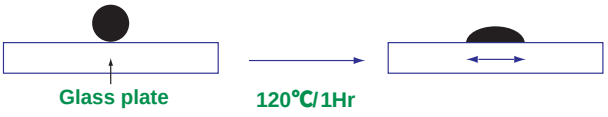
＊1　UL94V-0 recognized component

Dam Forming

Product Name		X-43-5255
Feature		High thixotropy Good shape retention
Aspect Ratio*3		0.75
ITEM	UNIT	
Appearance		Black
Viscosity 25℃	poise	7000
Gelation Time 150℃	sec	70
Flexural Strength 25℃	kgf/mm²	10
Flexural Modulus 25℃	kgf/mm²	8000
Coefficient of Thermal Expansion 1	ppm/℃	25
Coefficient of Thermal Expansion 2	ppm/℃	95
Glass Transition Temp.	℃	140
Volume Resistivity at 25℃	Ωcm	2×10^{16}
Dielectric Constant at 1kHz		3.5
Recommended Cure Condition		100℃/0.5Hr+150℃/2Hr
Dispense Condition（Device Temp.）	℃	22～50
Storage Condition	℃	Below−5

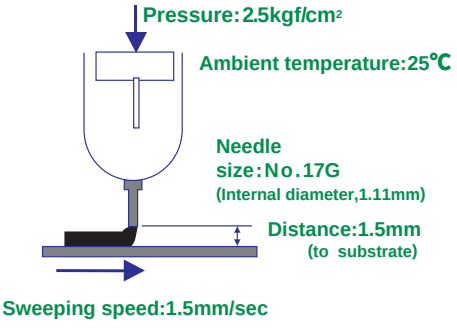
《Measurement Method》

＊2　0.1 g sample dropped



Aspect Ratio = Height / Width

＊3

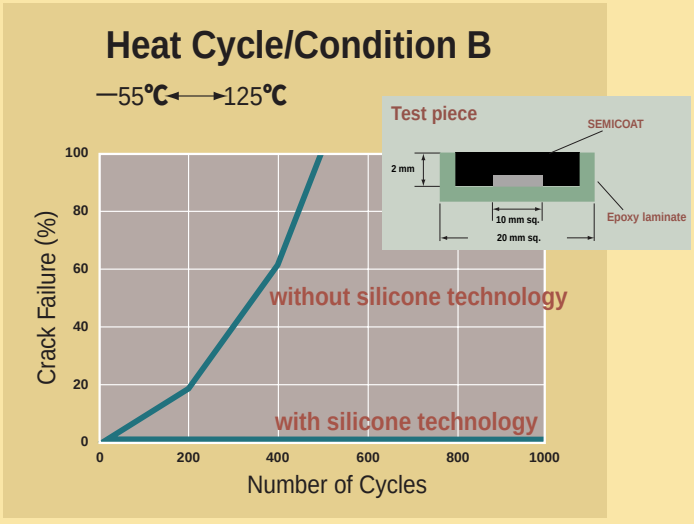


Aspect Ratio = Height / Width

Distinction of SEMICOAT—— Low Stress Performance

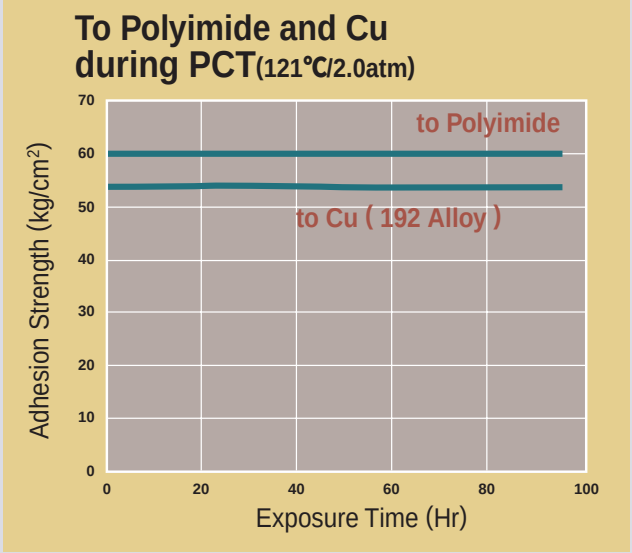
Security as great as the number of islands in the sea ——
This is the Shin-Etsu fine sea-island structure

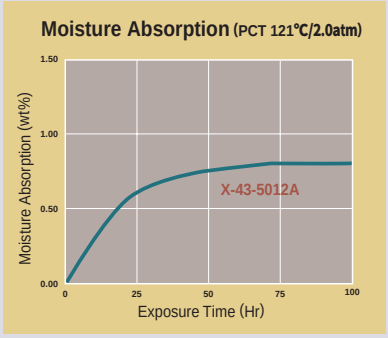
Fine sea-island structure means, just like islands in the sea, silicone is dispersed equally in epoxy resin.
If there is distortion, that silicone islands will absorb it.

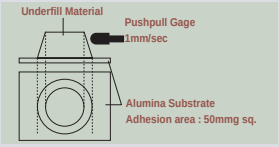


Potting

X-43-5012A Excellent Adhesion Property (Less Sensitivity to Moisture)



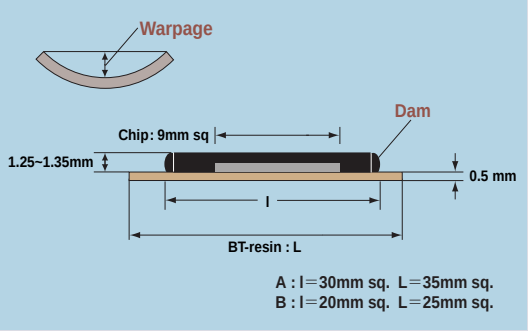




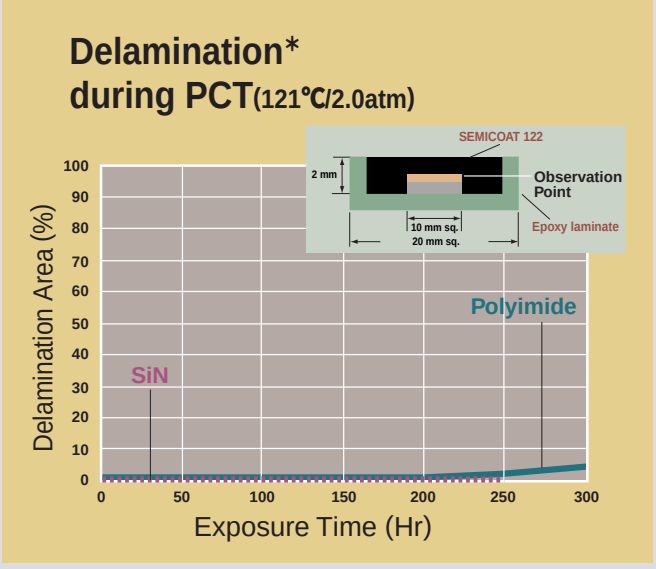
SEMICOAT 122

Small Warpage

Test Device	Cure Condition	Warpage(μm)
A	100℃/1Hr＋150℃/2Hr	150
A	90℃/3Hr＋150℃/2Hr	60
B	90℃/3Hr＋150℃/2Hr	30

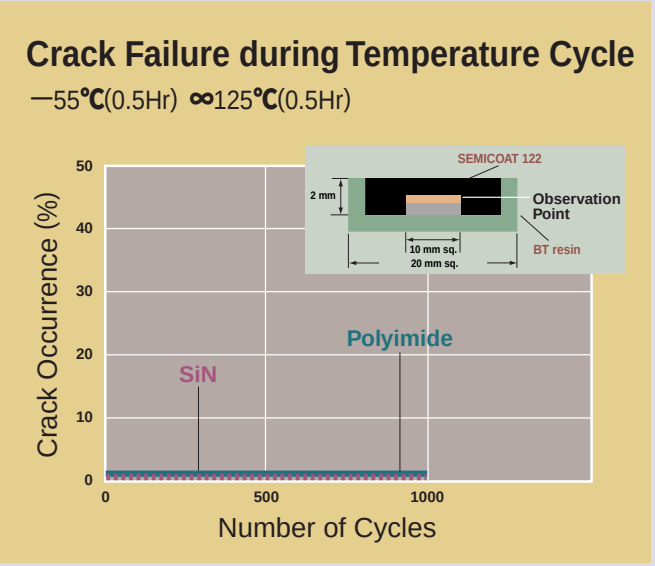


Good Adhesion to Organic and Inorganic Layer



＊Delamination between a coated die and SEMICOAT is checked by C-SAM.

Excellent Crack Resistane



Popcorn Resistance

Pass JEDEC Level 3 test.

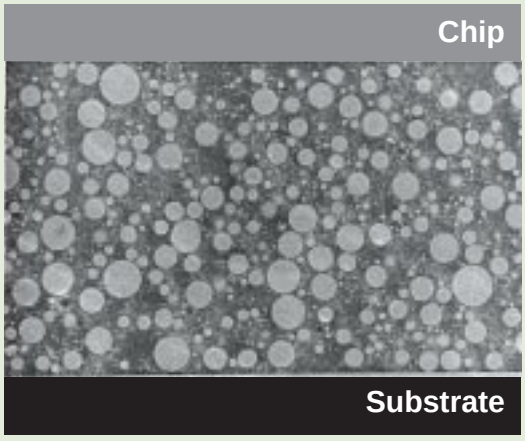
with 35mm sq. BGA device

1. Encapsulated devices are exposed to 30℃/60%RH for 192Hr.
2. Devices undergo IR reflow(Max 240℃).
3. Crack occurrence is checked at the interfacial layer between Polyimide and SEMICOAT.

SEMICOAT Series

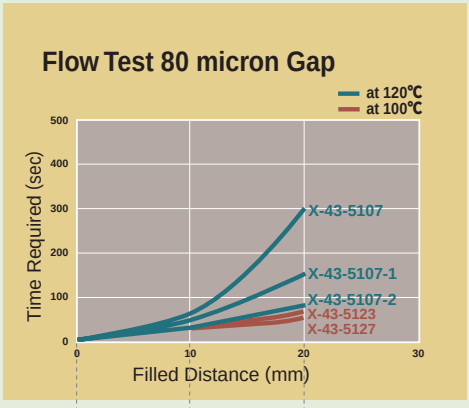
Underfill

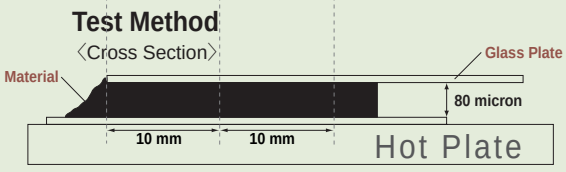
No Filler Settling



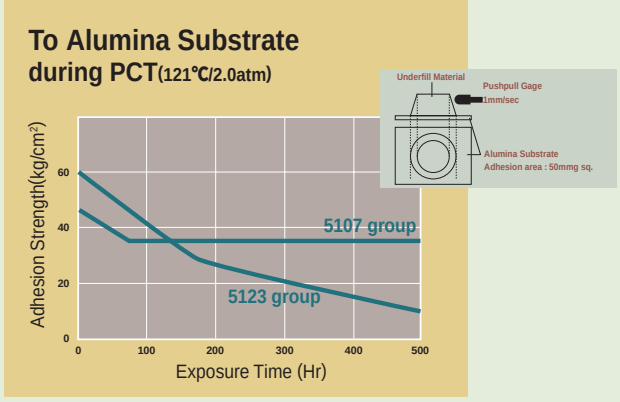
5107 cure condition（120℃/0.5Hr＋150℃/2Hr）
5123 cure condition（100℃/0.5Hr＋150℃/2Hr）

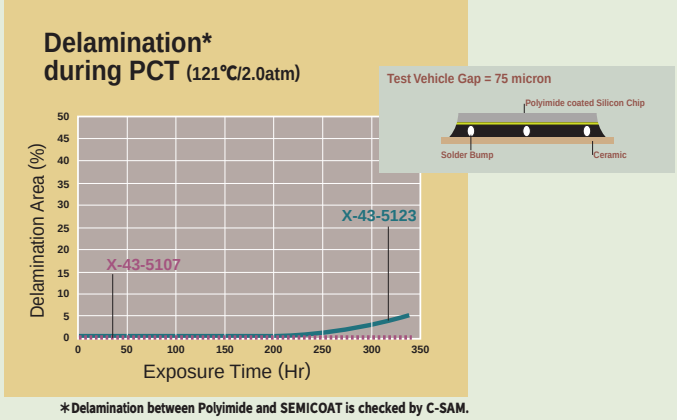
Penetration Speed





Excellent Adhesion Property (Less Sensitivity to Moisture)





*Delamination between Polyimide and SEMICOAT is checked by C-SAM.

Dam Forming

Make a Shape Control Easy

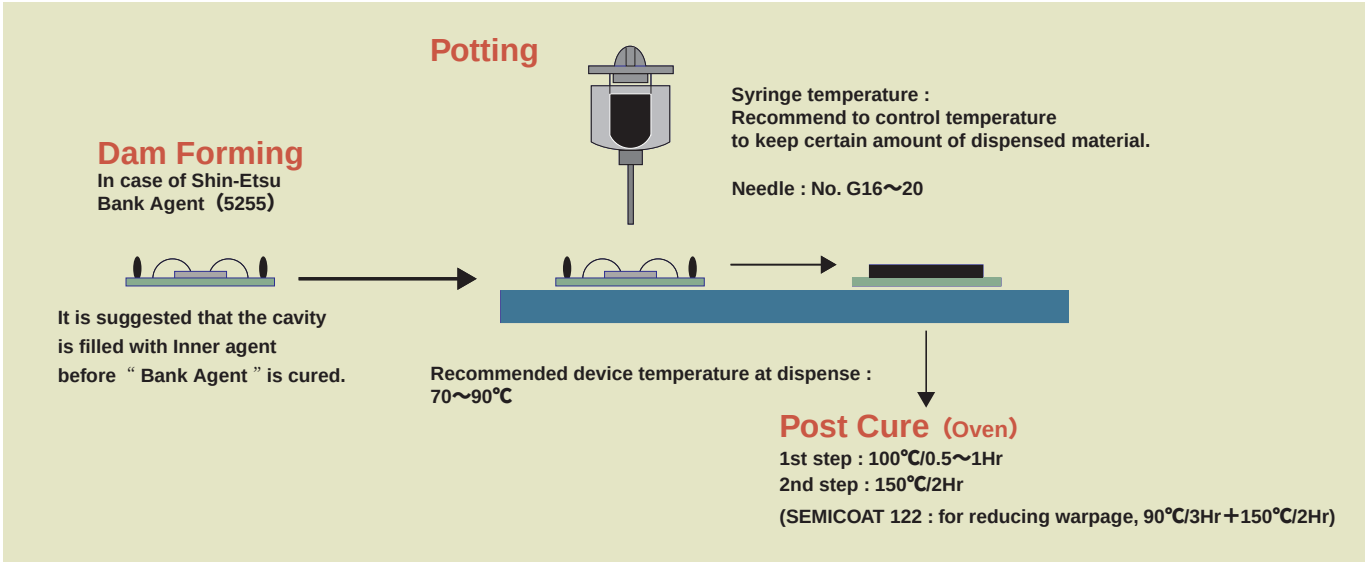
〈Eliminated Cure Process for Dam Forming〉

Both dam forming agent and potting material can be cured at the same time. The cure process for dam forming agent is no need, because of its less shape change that might happen between dispense and post cure.

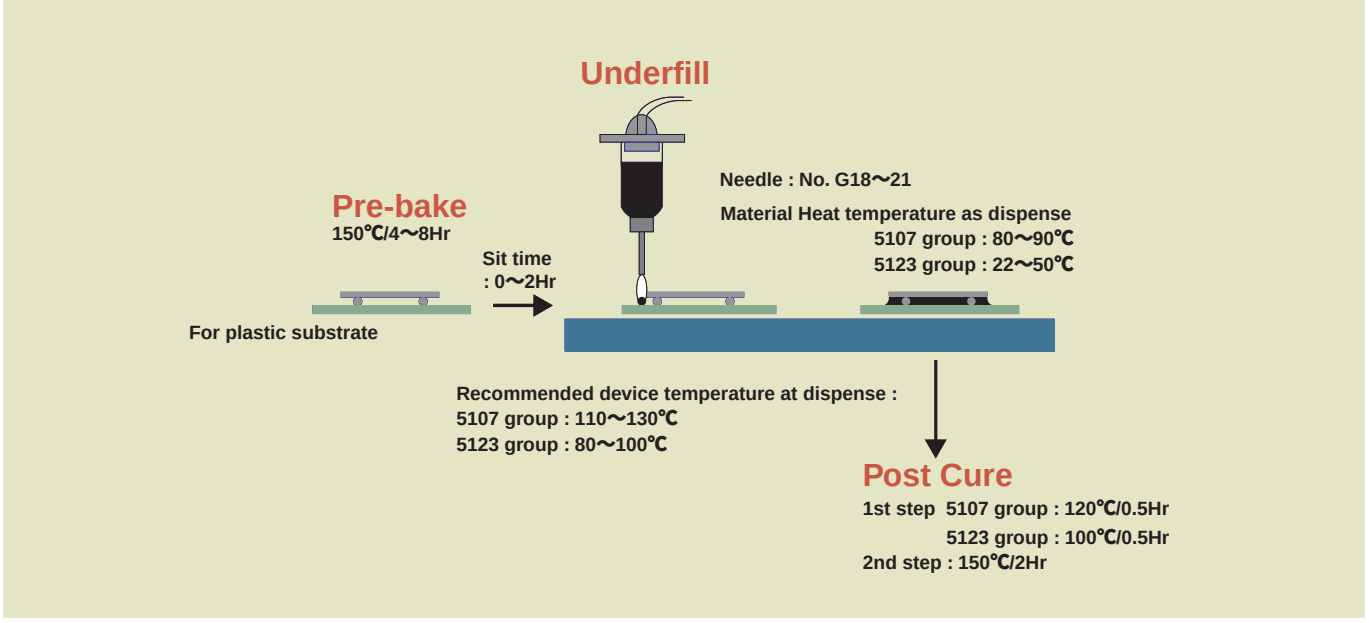
Ex.

Dam Forming
（5255 dispense）
↓
Potting
（115 dispense）
↓
Cure

How to Use Potting and Dam Forming Agent



How to Use Underfill



Handling

Prior to using the product, remove it from cold storage and return it to ambient temperature.

Keep the product and assembled device dry for optimum performance. Moisture contamination may cause voids and degrade other important characteristics.

For safe handling, avoid skin contact and breathing vapor or dust during the use of this product. It is recommended to wear proper safety gears. If skin contact occurs, wash thoroughly with soap and water.

For details, please refer to MSDS.

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