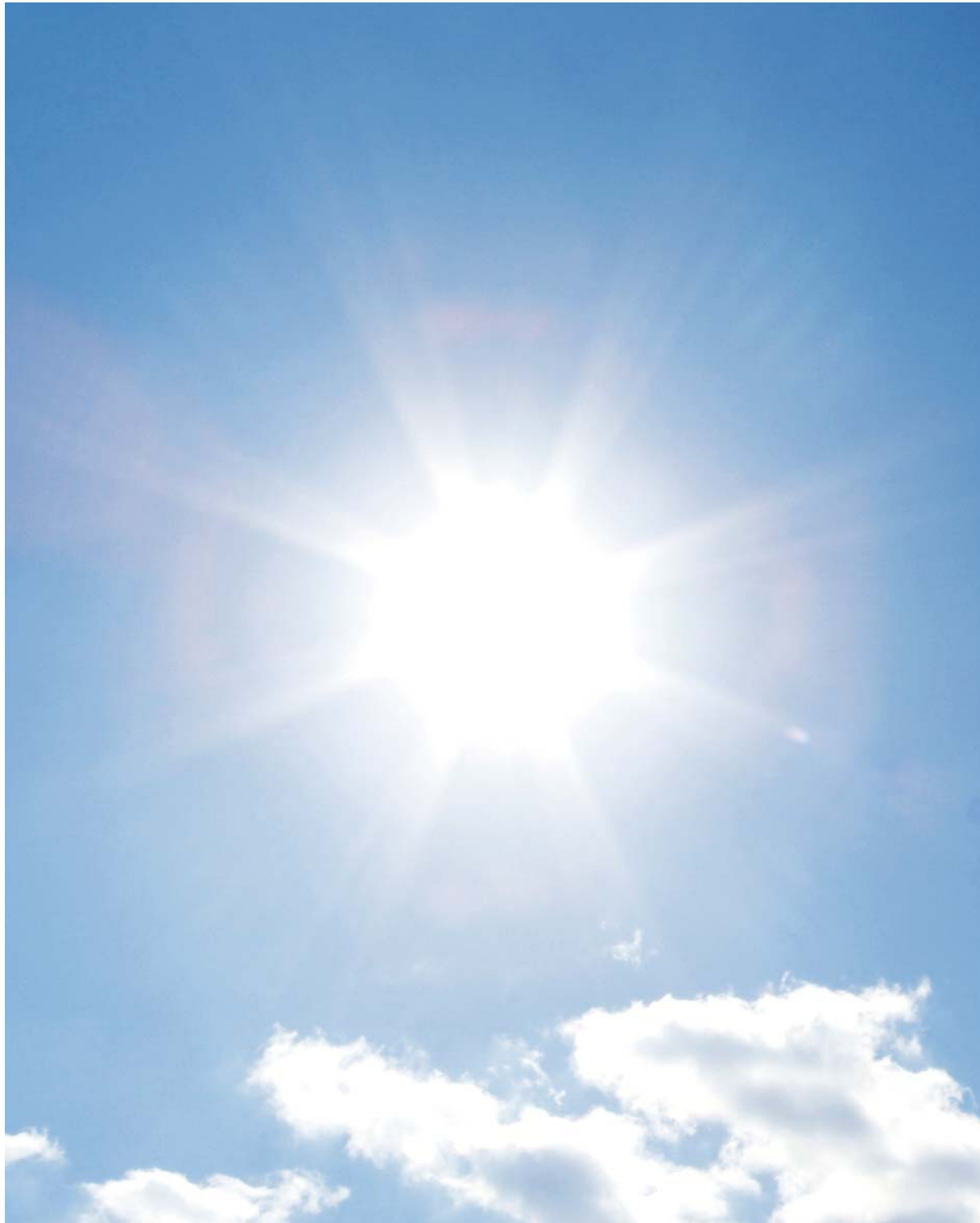




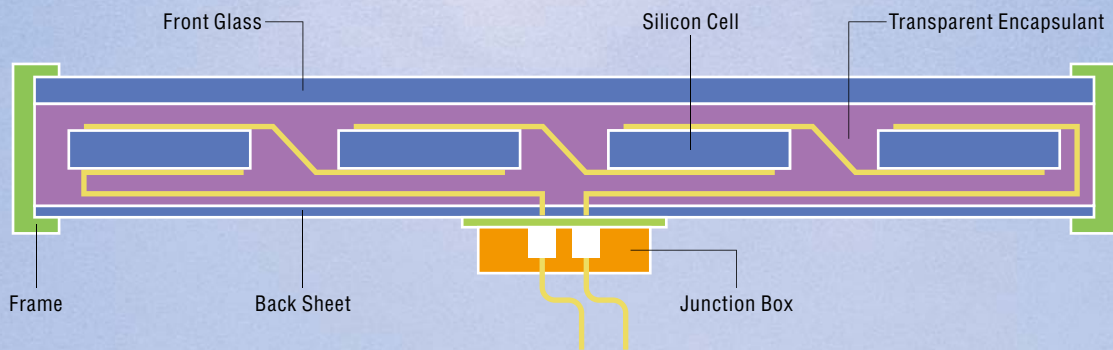
**Shin-Etsu Silicone**

# **Silicone Products for Photovoltaic Modules**



# Shin-Etsu Silicone Materials are utilized for Photovoltaic Module applications to improve their reliability and stable operation due to their unique features.

## ■ Application



### Potting

**KE-200, KE-200F, KE-210, KE-210F**

### Sealing

**KE-45, KE-4828, KE-220**

### Transparent Encapsulant

**X-32-3038A/B**

Shin-Etsu Silicone potting materials KE-200 / KE-210 have excellent weather resistance and heat resistance in the airtight condition.

In addition to the general silicone features, KE-200 / KE-210 are especially fast curing room temperature. Suitable for automated dispensing, KE-200 / KE-210 are ideal for mass production.

## ■ Features

- Fast Cure at room temperature, excellent deep section cure.
- Easy handling due to 10:1 mixing ratio.
- Excellent heat resistance in airtight condition
  - No reversion.
- Excellent adhesion strength to various substrates.
- Suitable for Automated Dispensing.
- Panel can be turned over within 60min.
- Ideal for mass production.
- Reduced low-molecular-weight siloxane
  - $\Sigma D_3$  to  $D_{10}$  below 300ppm.
- UL94 HB approved (KE-200, KE-200F).
- UL94 V-0 equivalent (KE-210, KE-210F).



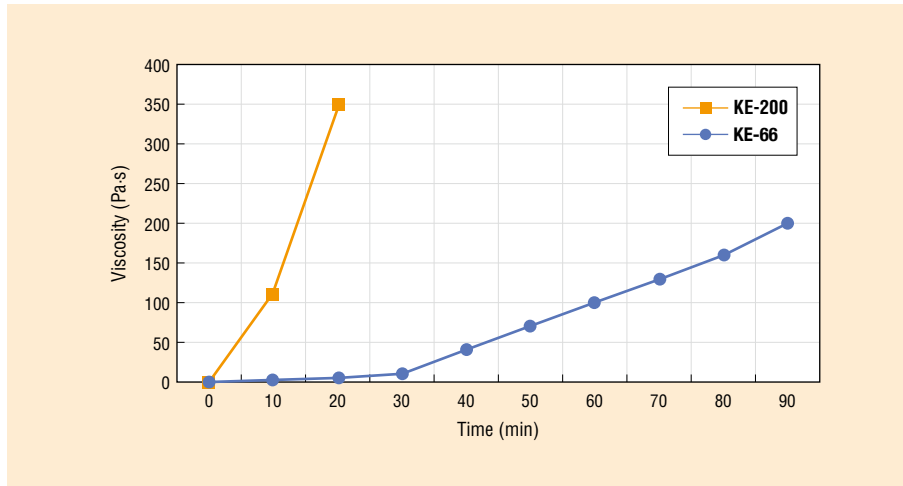
## ■ General Properties

Parameter		Grade	KE-200	KE-200F	KE-210	KE-210F
Before Curing	Appearance	Color	Colorless to light yellow	Colorless to light yellow	Black	Black
		Transparency	Translucent	Translucent	—	—
	Viscosity at 23°C	Pa·s	1.85	1.85	4.0	4.0
	Density at 23°C	g/cm <sup>3</sup>	1.01	1.01	1.29	1.29
	Catalyst		CX-200	CX-200	CAT-210	CAT-210
	Mixing Ratio by weight		100 : 10	100 : 10	100 : 10	100 : 10
Pot life: Flow at 23°C	min	35	15	25	15	
After Curing*	Hardness Durometer A		23	23	35	35
	Tensile Strength	MPa	0.52	0.52	0.8	0.8
	Elongation at break	%	140	140	90	90
	Volume Resistivity	TΩ·m	60	60	10	10
	Dielectric Breakdown Strength 1mm	kV	26	26	26	26
	Dielectric Constant (ε) 50Hz		2.9	2.9	—	—
	Dielectric Dissipation Factor (δ) 50Hz		2×10 <sup>-4</sup>	2×10 <sup>-4</sup>	—	—
	Thermal Conductivity	W/m·K	0.21	0.21	0.5	0.5
Flammability UL94		HB	HB	V-0 (2mm) equivalent	V-0 (2mm) equivalent	

\* Curing condition: After 3 days cure at 23°C ± 2°C / 50 ± 5%RH

(Not specified values)

## Comparison on curing time of KE-200 with a conventional product (KE-66)



## Property changes after various durability tests for KE-200

### ■ Mechanical Property Change

Parameter	Condition	Initial	85°C / 85% / 1,000h	-40°C / +85°C 200 cycles
Hardness Durometer A		23	14	21
Elongation at break	%	140	170	100
Tensile Strength	MPa	0.50	0.32	0.32

(Not specified values)

### ■ Electrical Property Change

Parameter	Condition	Initial	85°C / 85% / 1,000h
Volume Resistivity	TΩ·m	60	60
Dielectric Breakdown Strength 1mm	kV	26	29

(Not specified values)

### ■ Adhesion Property Change

Parameter	Condition	Initial	85°C / 85% / 1,000h
Lap Shear Strength	Al	0.42	0.60
	ABS	0.24	0.25
	m-PPO	0.16	0.18

(Not specified values)

## Packaging

- KE-200, KE-200F (Main component) 1kg Tin can / 18kg Pail
- CX-200 (Catalyst) 100g Glass bottle / 900g Tin can
- KE-210, KE-210F (Main component) 1kg Tin can / 20kg Pail
- CAT-210 (Catalyst) 100g Glass bottle / 1kg Tin can

\* Caution  
 Chemical composition in CX-200 hydrolyzes when reacts with moisture.  
 Upon storage, please avoid high temperature,  
 high humidity and direct sunlight. Once open, please use all.

# Sealing between Junction Box/Back Sheet and Water Proof Sealing for Frame

KE-45  
KE-4828  
KE-220

Shin-Etsu Silicone KE-45, KE-4828 and KE-220 have excellent adhesive properties to back sheet materials such as PVF and PET.

They maintain good elasticity over a wide temperature range (-40 to 180°C) with excellent weatherability and electrical insulation properties.

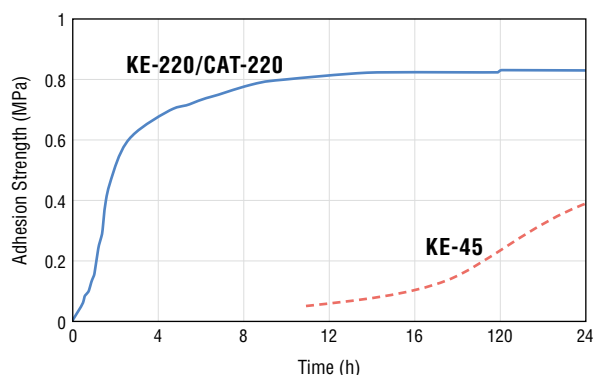
## ■ Features

- One-component, room temperature cure (KE-45, KE-4828).
- Two-component, room temperature, super fast cure (KE-220).
- Strong adhesion to back sheet of PV module.
- Excellent weatherability.
- Flexible Silicone Rubber from -40°C to +180°C.
- Excellent electrical properties.
- UL94 HB approved (KE-45, KE-4828).
- UL94 HB equivalent (KE-220).



— KE-220/CAT-220 (Two-component sealant)  
100% Cohesive failure after 4 hours.  
- - - KE-45 (One-component sealant)  
60% of KE-45-W was uncured after 24 hours.

Adhesion Strength (Cohesion Failure, PET film/Aluminum)



## ■ General Properties

Parameter		Grade	KE-45	KE-4828	KE-220
Before Curing	Appearance	Color	White, Black, Transparent	White, Black	White
		Consistency	Paste	Paste	Paste
	Curing System		Oxime	Alcohol	Alcohol
	Catalyst		—	—	CAT-220
	Mixing Ratio by volume		—	—	100:10
	Tack free time	min	6	6	10
	Pot life		—	—	20
After Curing*	Density at 23°C	g/cm <sup>3</sup>	1.05	1.40	1.43
	Hardness Durometer A		30	35	54
	Tensile Strength	MPa	2.0	1.6	1.7
	Elongation at break	%	350	350	160
	Volume Resistivity	TΩ·m	5.0	1.1	—
	Dielectric Breakdown Strength 1mm	kV	23	27	—
	Lap Shear Strength	MPa	1.0 (AL/AL)	1.0 (AL/AL)	1.5 (Glass/Glass)
	Flammability UL94		HB	HB	HB equivalent

\* Curing condition: KE-45, KE-4828: 23°C±2°C / 50±5%RH x 7 days  
KE-220: 23°C±2°C / 50±5%RH x 3 days

(Not specified values)

## Durability Test Results

### ● Test Condition

Substrate Used: PVF, PET

Thermal Cycle Test: -40°C↔85°C/200 cycles, holding time in each temp. at 30min.

Damp-Heat test: 85°C/85%RH/1,000h

Test Items: Lap Shear Strength, Cohesion Failure

### ■ Lap Shear Strength MPa (Cohesion Failure %)

Condition \ Grade	PVF			PET		
	Initial	-40°C↔85°C 200 cycles	85°C/85% 1,000h	Initial	-40°C↔85°C 200 cycles	85°C/85% 1,000h
<b>KE-45-W</b>	0.99 (100)	0.94 (100)	0.50 (100)	0.95 (90)	0.83 (100)	0.53 (100)
<b>KE-4828-W</b>	0.98 (100)	1.09 (100)	0.77 (90)	0.96 (90)	1.26 (100)	0.66 (100)

(Not specified values)

## Packaging

- **KE-45** 330ml Cartridge / 20 l Pail
- **KE-4828** 310ml Cartridge / 20 l Pail
- **KE-220 (Main component)** 1kg Tin can / 25kg Pail
- **CAT-220 (Catalyst)** 100g Glass bottle / 1kg Tin can

## Handling precautions

1. KE-45 and KE-4828 react with moisture in the air and begin to cure from the surface. During curing, small amount of Methanol (KE-4828, KE-220), Oxime (KE-45), or Acetone (KE-200) is gradually generated. Consequently, the cure speed will vary according to the temperature and humidity of the environment.
2. Store between 1°C to 25°C, out of direct sunlight.
3. RTV rubbers may discolor over time, but this does not negatively affect the characteristic properties.
4. When using an air gun, be sure to set the pressure at a safe and proper level. Pressure should generally not exceed 0.2-0.3MPa.
5. When applying KE-200 and KE-220, use of an automatic two-component dispenser is recommended (KE-45, KE-4828).

Shin-Etsu Silicone X-32-3038A/B is a transparent Silicone encapsulant that has an excellent light transmittance especially around UV area.

After X-32-3038A/B cures, it forms a soft elastmer that can absorb the inner stress of various devices.

### ■ Features

- High transparent, two-component material with 100:100 mixing ratio.
- Good adhesion to the glass and metals.
- Excellent light transmittance over the visible light spectrum.



### ■ General Properties

Parameter		Grade	X-32-3038	
			A	B
Before Curing	Appearance (Color)		Light yellow, Transparent	Translucent
	Viscosity	mPas·s	1,350	800
	Viscosity after A/B mixed	mPas·s	1,100	
After Curing*	Density at 25°C	g/cm <sup>3</sup>	0.98	
	Hardness Ascar C		45	
	Tensile Strength	MPa	0.4	
	Lap Shear Strength*1	MPa	1.15 (Glass/Glass)	
	Light Transmissivity*2 450nm	%	98.9	

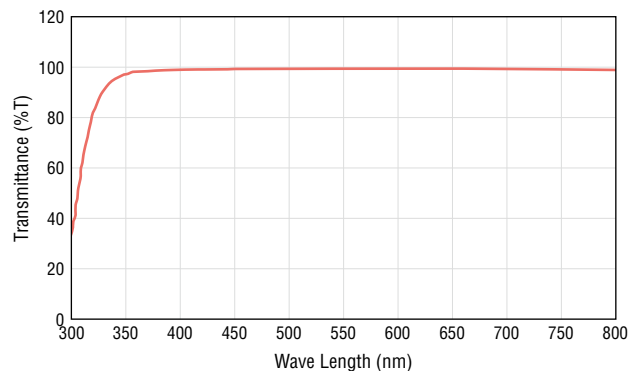
\* Curing Condition: 80°C /30min in the oven

(Not specified values)

\*1 2 mm thickness sheet

\*2 0.3 mm thickness sheet

Light transmittance  
X-32-3038A/B 0.3mm



### Packaging

- X-32-3038A/B 1kg Tin can / 20kg Pail

### Safety and hygiene

1. Be sure to provide adequate ventilation when using RTV rubbers and any solvents. If you experience any unpleasant symptoms please move to an area with fresh air.
2. Uncured RTV rubbers may irritate skin and mucous membranes, so avoid eye contact and prolonged skin contact. In case of accidental eye contact, flush with water for at least 15 minutes and seek a physician. In case of skin contact, immediately wipe off with a dry cloth and wash with soapy water. Contact lens wearers should exercise adequate caution; if uncured RTV rubbers enter the eye, the contact lens may become bonded to the eye.
3. When using, be careful not to rub eyes with hands. Please take appropriate precautions such as wearing safety glasses.
4. Keep out of reach of children.
5. KE-45 releases methyl ethyl ketoxime (MEKO) when curing. Therefore be sure to provide adequate ventilation when using. If you feel dizziness, move to an area with fresh air.
6. Please read the Material Safety Data Sheet (MSDS) before use. MSDS can be obtained from our Sales Department.

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