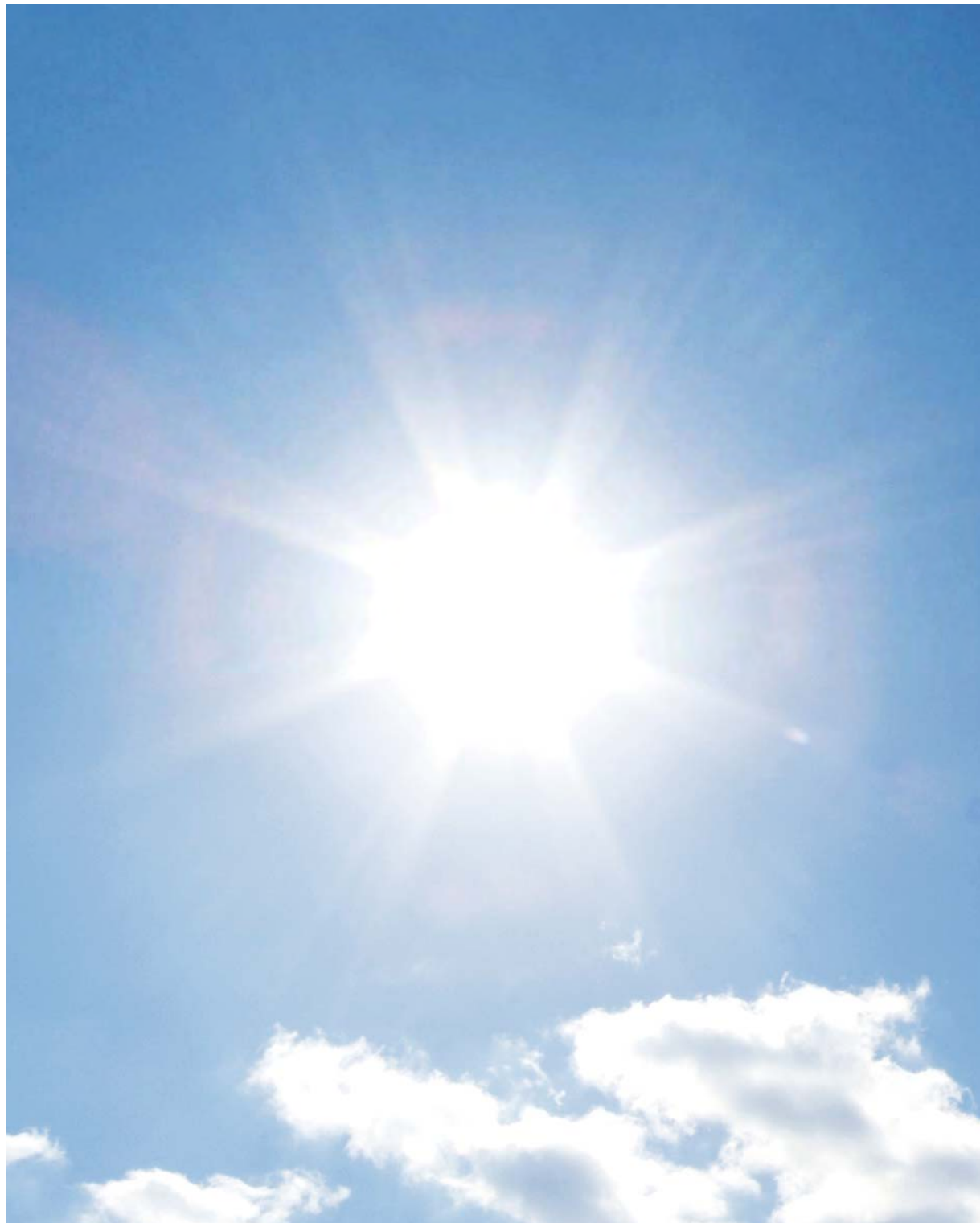




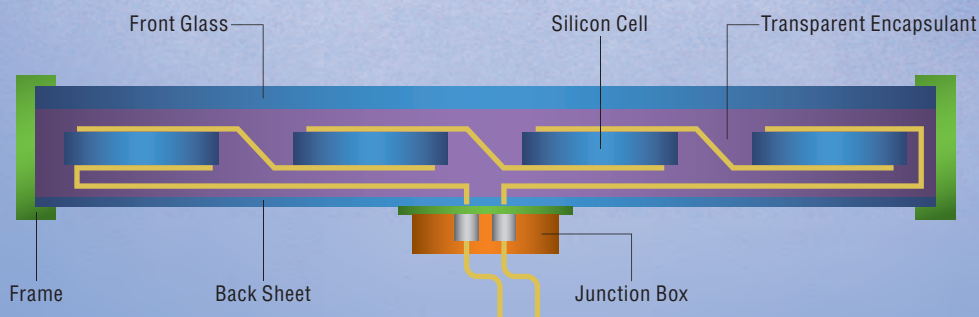
Shin-Etsu Silicone

Silicone Products for Photovoltaic Modules



Shin-Etsu Silicone Materials unique features are utilized in Photovoltaic applications to improve their reliability and stability.

Application



Potting

KE-200, KE-200F, KE-205, KE-205F, KE-210, KE-210F

Sealing

KE-45, KE-4528, KE-4529, KE-4828, KE-4829, KE-220

Transparent Encapsulant

X-32-3038A/B, X-32-3161A/B



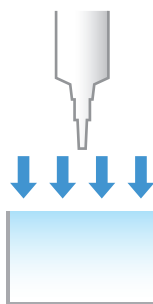
Advantages of Shin-Etsu Potting Materials

FCS (Fast Cure Silicone) system improves productivity.

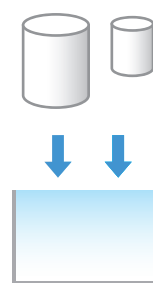


* FCS system: Reaction of Ketone and Amine generates H₂O.

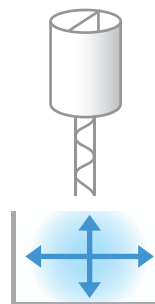
One component



Two component



FCS system



Shin-Etsu Silicone potting materials in the KE-200 series have excellent weather and heat resistance in airtight conditions due to the unique FCS curing system.

In addition to the generally superior features of silicone, the KE-200 series is especially fast curing at room temperature. Suitable for automated dispensing, the KE-200 series is 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 (15min for F-type).
- Ideal for mass production.
- Reduced low-molecular-weight siloxane
 - ΣD_3 to D_{10} below 300ppm (KE-200, KE-200F).
- UL94 HB approved (KE-200, KE-200F, KE-205, KE-205F).
- UL94 V-0 approved (KE-210, KE-210F).



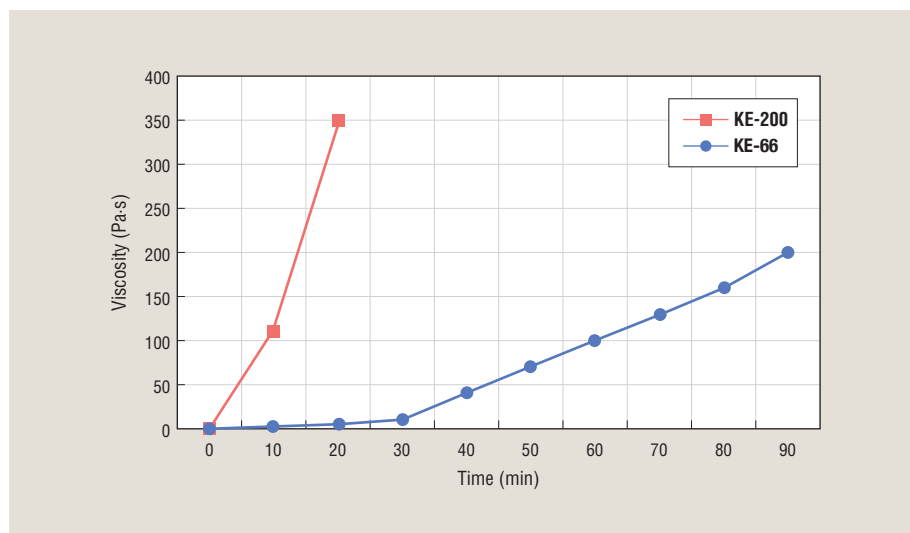
General Properties

Parameter		Grade	KE-200	KE-200F	KE-205	KE-205F	KE-210	KE-210F	
Before Curing	Appearance	Color	Colorless to light yellow	Colorless to light yellow	Bluish white	Bluish white	Black	Black	
		Transparency	Translucent	Translucent	—	—	—	—	
	Viscosity at 23°C	Pa·s	2.5	2.0	2.5	2.0	5.8	4.1	
	Density at 23°C	g/cm ³	1.01		1.18		1.24		
	Catalyst		CX-200		CAT-205		CAT-210		
	Mixing Ratio by weight		100 : 10		100 : 10		100 : 10		
	Flow Stop Time at 23°C	min	35	15	25	15	25	15	
After Curing*	Hardness Durometer A		23	23	20	23	29	29	
	Tensile Strength		MPa	0.5	0.5	0.4	0.4	0.7	0.7
	Elongation at break		%	140	120	110	85	90	110
	Volume Resistivity		TΩ·m	60	60	2	2	11	11
	Dielectric Breakdown Strength 1mm		kV	26	28	25	25	27	27
	Lap Shear Strength (AL/AL)		MPa	0.5	0.5	0.3	0.3	0.6	0.6
	Thermal Conductivity		W/m·K	0.21	0.21	0.21	0.21	0.3	0.3
Flammability UL94			HB	HB	HB	HB	V-0	V-0	

* Curing condition: 23 ± 2°C / 50 ± 5%RH x 3 days

(Not specified values)

Comparison of curing time of KE-200 against a conventional product (KE-66)



Property changes of KE-200F after durability testing

Parameter		Condition	Initial	85°C/85%RH x 1,000 h	TC x 200 cycles	140°C x1,000h	HF x 12 cycles
Mechanical	Hardness		23	13	25	28	13
	Elongation	%	120	210	140	130	170
	Tensile Strength	MPa	0.5	0.4	0.6	0.7	0.3
Adhesion (AL/AL)		MPa/CF	0.4 / 100	0.6 / 100	0.5 / 100	0.4 / 100	0.6 / 100
Thermal Conductivity		W/m-K	0.21	0.22	0.21	0.23	0.21
Dielectric Properties	Volume Resistivity	TΩ·m	60	42	36	61	26
	Breakdown Strength	kV/mm	28	29	28	29	27
Density		g/cm ³	1.01	1.01	1.01	1.01	1.02

* Initial curing condition: 23 ± 2°C / 50 ± 5%RH x 3 days

TC: Thermal cycling test: -40°C ↔ +85°C

HF: Humidity-freeze test: -40°C ↔ +85°C / 85%RH

(Not specified values)

Packaging

- **KE-200, KE-200F (Main component)** 1kg Plastic pail / 18kg Pail
- **CX-200 (Catalyst)** 100g Glass bottle / 900g Tin can
- **KE-205, KE-205F (Main component)** 1kg Plastic pail / 20kg Pail
- **CAT-205 (Catalyst)** 100g Glass bottle / 1kg Tin can
- **KE-210, KE-210F (Main component)** 1kg Plastic pail / 20kg Pail
- **CAT-210 (Catalyst)** 100g Glass bottle / 1kg Tin can

* Caution

Chemical compositions in the catalyst hydrolyze when react 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-4528, KE-4529,
KE-4828, KE-4829, KE-220**

Shin-Etsu Silicone sealing products 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 (Except KE-220).
- 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-4528, KE-4828, KE-220).



General Properties

Parameter		Grade	KE-45	KE-4528	KE-4529	KE-4828	KE-4829	KE-220	
Before Curing	Appearance	Color	White, Black, Gray Translucent	White, Black	White, Black	White, Black	White, Black Translucent	White, Black	
		Consistency	Paste	Paste	Paste	Paste	Paste	Paste	
	Curing System		Oxime	Oxime	Oxime	Alcohol	Alcohol	Alcohol	
	Catalyst		NA	NA	NA	NA	NA	CAT-220	
	Mixing Ratio by volume		NA	NA	NA	NA	NA	100:10	
	Tack free time	min	6	3	2	6	2	10	
	Work life	min	NA	NA	NA	NA	NA	20	
After Curing*	Density at 23°C	g/cm ³	1.05	1.45	1.26	1.40	1.06	1.43	
	Hardness Durometer A		30	56	42	35	33	54	
	Tensile Strength		MPa	2.0	2.6	1.9	1.6	1.5	1.7
	Elongation at break		%	350	320	230	350	440	160
	Volume Resistivity		TΩ·m	5	4	22	1	10	1
	Dielectric Breakdown Strength 1mm		kV	23	28	25	27	25	28
	Lap Shear Strength		MPa	1.0 (AL/AL)	2.4 (GL/GL)	1.4 (AL/AL)	1.0 (AL/AL)	1.6 (AL/AL)	1.3 (GL/GL)
	Flammability UL94			HB	HB	HB equivalent	HB	HB equivalent	HB

* Curing condition: One component RTV: 23 ± 2°C / 50 ± 5%RH x 7 days
KE-220: 23 ± 2°C / 50 ± 5%RH x 3 days

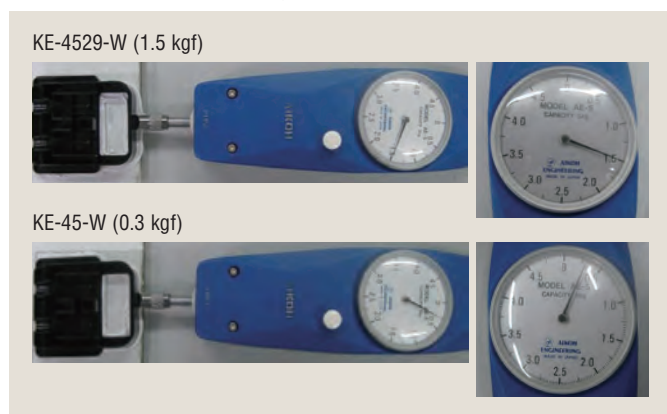
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Push Test

■ Procedure

- Apply KE-4529-W and KE-45-W (as a comparison) between glass and glass at 0.6 mm thickness.
- Leave specimens for a certain period.
- Push the corner of the glass by “PUSH GAUGE” and measure the force when the glass has moved.

■ Push Test with J-Box, after 20 min.



■ Results

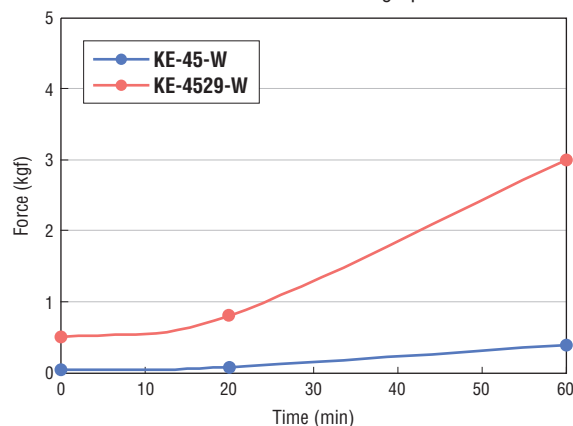
Push Test Results

Unit: kgf

Time	20 min	60 min
KE-45-W	0.02	0.4
KE-4529-W	0.8	3.0

(Not specified values)

Push Test Results in graph



Open Time Test

■ Procedure

- Apply KE-4529-W on the CF test piece and leave it for 3 and 5 min. (Longer period than tack free time).
- Measure lap shear strength and CF rate.

■ Results

Lap shear strength MPa (CF rate)

Condition	Grade	KE-4529-W
Blank		1.1 (100)
After 3 min.		1.0 (100)
After 5 min.		0.9 (100)

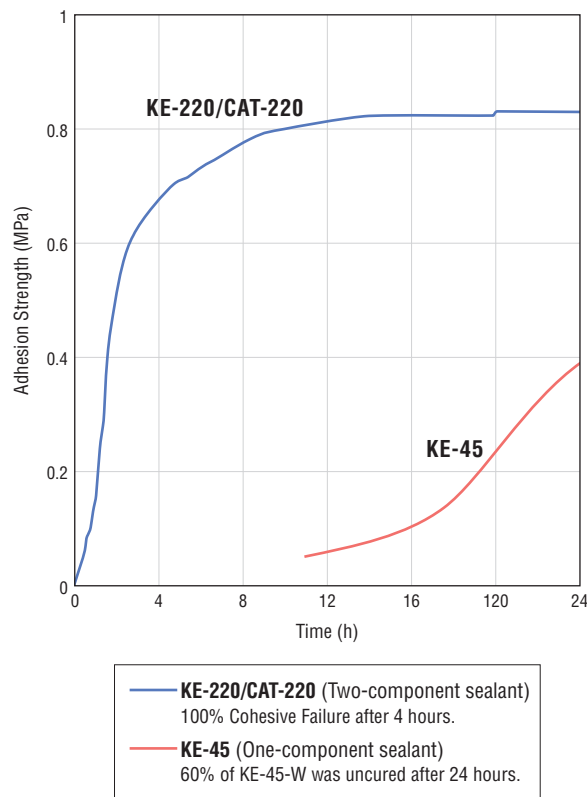
Packaging

● KE-45	330ml Cartridge / 20l Pail
● KE-4528	310ml Cartridge
● KE-4529	310ml Cartridge
● KE-4828	310ml Cartridge / 20l Pail
● KE-4829	310ml Cartridge
● KE-220 (Main component)	20kg Pail / 200kg Drum
● CAT-220 (Catalyst)	20kg Pail

* Caution

Chemical composition in CAT-220 hydrolyzes when reacts with moisture. Upon storage, please avoid high temperature, high humidity and direct sunlight. Once open, please use all.

■ Adhesion Strength



Shin-Etsu Silicone Materials X-32-3038A/B and X-32-3161A/B are transparent Silicone encapsulants that have excellent light transmittance, especially in a UV environment.

After cure, they form a soft elastomer 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, metals and PVF.
 - Excellent light transmittance over the visible light spectrum.



General Properties

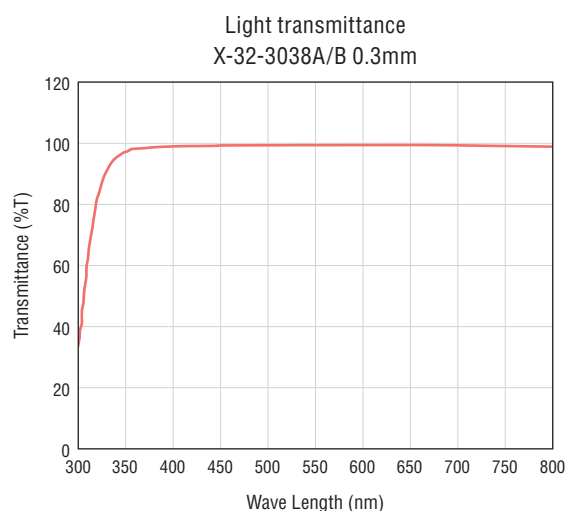
Parameter		Grade	X-32-3038A/B		X-32-3161A/B		
			A	B	A	B	
Feature			Low Viscosity		High Lap Shear Strength		
Before Curing	Appearance (Color)		Transparent (Colorless)	Transparent (Colorless)	Transparent (Colorless)	Transparent (Colorless)	
	Viscosity	Pa·s	5	2	68	26	
	Viscosity after A/B mixed	Pa·s	3		48		
After Curing*	Density at 25°C	g/cm ³	1.02		1.02		
	Hardness Durometer A		24		19		
	Tensile Strength	MPa	3.6		2.7		
	Lap Shear Strength*1	GL/GL		0.5 / 100		0.9 / 100	
		MPa/CF	PVF/PVF	0.36 / 100		0.6 / 100	
Light Transmissivity*2	450nm %		99		97		

* Curing condition: 100°C x 1h

(Not specified values)

*1 2 mm thickness sheet

*2 0.3 mm thickness sheet



Packaging

- **X-32-3038A/B** 1kg Tin can / 20kg Pail
- **X-32-3161A/B** 1kg Tin can / 20kg Pail

Handling precautions

1. One component RTV products react with moisture in the air and begin to cure from the surface. During curing, small amount of Methanol (KE-4828, KE-4829 and KE-220), Oxime (KE-45, KE-4528 and KE-4529), or Acetone (KE-200 series) are 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 series and KE-220, use of an automatic two-component dispenser is recommended.

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.
3. Contact lens wearers should exercise adequate caution; if uncured RTV rubbers enter the eye, the contact lens may become bonded to the eye.
4. When using, be careful not to rub eyes with hands. Please take appropriate precautions such as wearing safety glasses.
5. Keep out of reach of children.
6. KE-45, KE-4528 and KE-4529 release 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.
7. Please read the Material Safety Data Sheet (MSDS) before use. MSDS can be obtained from our Sales Department.

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