Information About *Dow Corning®* brand Silicone Encapsulants

Silicones and Electronics

Long-term, reliable protection of sensitive circuits and components is becoming more important in many of today's delicate and demanding electronic applications. Silicones function as durable dielectric insulation, as barriers against environmental contaminants and as stress-relieving shock and vibration absorbers over a wide temperature and humidity range.

In addition to sustaining their physical and electrical properties over a broad range of operating conditions, silicones are resistant to ozone and ultraviolet degradation, have good chemical stability and are available in a variety of useful forms as conformal coatings, encapsulants and adhesives. Dow Corning's broad range of general purpose and specialty products offers you a choice of materials for your application needs.

DESCRIPTION

Dow Corning® silicone encapsulants are supplied as two-part liquid component kits comprised of:

Mix Ratio	Components
(by weight or volume)	(as supplied)
1:1	Part A/Part B
10:1	Base/Curing agent

When liquid components are thoroughly mixed, the mixture cures to a flexible elastomer, which is suited for the protection of electrical/electronic applications. *Dow Corning* silicone encapsulants cure without exotherm at a constant rate regardless of sectional thickness or degree of confinement. *Dow Corning* silicone elastomers require no post cure and can be placed in service immediately following the completion of the cure schedule with an operating temperature range of -45 to 200°C (-49 to 392°F). Select materials have been classified by Underwriters Laboratories and/or meet military specifications. Standard silicone encapsulants require a surface treatment with a primer in addition to good cleaning for adhesion while primerless silicone encapsulants require only good cleaning.

Silicone Encapsulants

Type

Two-part silicone elastomer

Physical Form

Flowable liquid; cures to flexible elastomer

Special Properties

Constant cure rate, regardless of sectional thickness or degree of confinement; service range of -45 to 200°C (-49 to 392°F); no post cure required

Potential Uses

Protection of electrical/electronic devices



Product 1673921"供	<u></u> Description	Features
Silicone Encapsulants		
Sylgard [®] 160 Silicone Low cost; good thermal conductivity Elastomer		Two part; 1:1 mix; RT/HA cure; minimal shrinkage; no exotherm during cure; no solvents or cure byproducts; repairable; good dielectric properties; deep section cure; flexible elastomer
<i>Sylgard</i> [®] 165 Silicone Elastomer	Fast cure; low cost; good thermal conductivity	
Sylgard [®] 170 Silicone Elastomer	Low viscosity	
Sylgard [®] 170 Fast Cure Silicone Elastomer	Fast cure; low viscosity	
Dow Corning® 96-082 A & B Encapsulant	Very low viscosity; flame retardant; nonmelting; self- extinguishing; extremely long pot life; wide temperature range	
Sylgard [®] 182 Silicone Elastomer	Transparent; long pot life; heat cure	Two part; 10:1 mix; minimal shrinkage; no exotherm during cure; no solvents or cure by-products; deep section cure; repairable; good dielectric properties;
<i>Sylgard</i> [®] 184 Silicone Elastomer	Transparent; RT/HA cure	flexible elastomer
Sylgard [®] 186 Silicone Elastomer	Clear; RT/HA cure; high tear strength	
Dow Corning [®] 3-6121 Encapsulating Elastomer	Low-temperature performance below -65°C (-85°F); clear; high tear and tensile strength; RT/HA cure; high refractive index	
Primerless Silicone Encapsula	ants	
<i>Sylgard</i> [®] 275 Silicone Elastomer	Excellent unprimed adhesion; heat cure; elastomeric	Two part; 1:1 mix; heat cure; minimal shrinkage; no exotherm during cure; no solvents or cure byproducts; repairable; good dielectric properties
Dow Corning [®] 3-6642 Thermally Conductive Adhesive	Excellent thermal conductivity; self-priming; low viscosity liquid; elastomeric	
Dow Corning® 3-8264 Primerless Silicone Adhesive	Excellent unprimed adhesion; heat cure; elastomeric	
Dow Corning® 567 Primerless Silicone Encapsulant	Heat cure; unprimed adhesion; elastomeric	

查询 "1673921"供	Potential Uses	Application Methods	Cure ^{1,2}	
Silicone Encapsulants				
<i>Sylgard</i> [®] 160 Silicone Elastomer	General potting applications: power supplies, connectors, sensors, industrial controls, transformers, amplifiers, high voltage resistor packs, relays	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated mixing and dispensing; manual mixing	24 hours at 25°C (77°F) 10 minutes at 100°C (212°F) 5 minutes at 150°C (302°F)	
<i>Sylgard</i> [®] 165 Silicone Elastomer		Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated mixing and dispensing	5 minutes at 25°C (77°F)	
<i>Sylgard</i> [®] 170 Silicone Elastomer		Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated mixing and dispensing; manual mixing	24 hours at 25°C (77°F) 20 minutes at 70°C (158°F) 15 minutes at 85°C (185°F) 10 minutes at 100°C (212°F)	
<i>Sylgard</i> [®] 170 Fast Cure Silicone Elastomer		Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated mixing and dispensing	10 minutes at 25°C (77°F)	
<i>Dow Corning[®]</i> 96-082 A & B Encapsulant	Applications requiring the thorough impregnation possible only with a very low viscosity resin	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated mixing and dispensing; manual mixing	30 minutes at 150°C (302°F)	
<i>Sylgard</i> [®] 182 Silicone Elastomer	General potting applications: power supplies, connectors, sensors, industrial controls, transformers, amplifiers, high	Supplied as two-part liquid component kits comprised of Base/Curing Agent to be mixed in a 10:1 ratio by weight or volume; automated mixing and dispensing; manual mixing	45 minutes at 100°C (212°F) 20 minutes at 125°C (257°F) 10 minutes at 150°C (302°F)	
<i>Sylgard</i> [®] 184 Silicone Elastomer	voltage resistor packs, relays; adhesive/ encapsulant for solar cells; adhesive handling beam lead integrated circuits during processing		~48 hours at room temp 45 minutes at 100°C (212°F) 20 minutes at 125°C (257°F) 10 minutes at 150°C (302°F)	
<i>Sylgard</i> [®] 186 Silicone Elastomer			~48 hours at room temp 30 minutes at 100°C (212°F) 15 minutes at 150°C (302°F)	
Dow Corning [®] 3-6121 Encapsulating Elastomer	Low-temperature encapsulating applications; optical applications requiring high refractive index		~48 hours at room temp 20 minutes at 100°C (212°F) 10 minutes at 150°C (302°F)	
Primerless Silicone En	capsulants			
<i>Sylgard</i> [®] 275 Silicone Elastomer	Encapsulating applications requiring good primerless adhesion and lower heat cure temperatures	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated or manual mixing and dispensing can be used	45 minutes at room temp <5 minutes at 80°C (176°F)	
Dow Corning [®] 3-6642 Thermally Conductive Adhesive	Encapsulating applications requiring high thermal conductivity and/or good primerless adhesion	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated or manual mixing and dispensing can be used	20 minutes at 100°C (212°F) 5 minutes at 150°C (302°F)	
		Note: For full shelf life, product must be refrigerated during storage.		
Dow Corning [®] 3-8264 Primerless Silicone Adhesive	Encapsulating applications requiring good primerless adhesion and lower heat cure temperatures	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated or manual mixing and dispensing can be used	150 minutes at 70°C (158°F) 30 minutes at 115°C (239°F)	
Dow Corning [®] 567 Primerless Silicone Encapsulant	Low cost primerless adhesion encapsulation applications	Supplied as two-part liquid component kits comprised of Part A/Part B to be mixed in a 1:1 ratio by weight or volume; automated or manual mixing and dispensing can be used	90 minutes at 100°C (212°F) 60 minutes at 125°C (257°F) 15 minutes at 150°C (302°F)	

¹These data were collected on 50-100 gram samples of a lot believed to be typical and should be used as initial estimates of cure times. Times will vary slightly from batch to batch and can be longer or shorter due to thermal mass of your parts and your heating ramp rate. Pretesting is recommended to confirm adequate cure for your application.

²For primerless adhesion products, cure time is based on time to reach durometer. Full adhesion may take more time at the cure temperature.

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These values are not intended for use in preparing specifications.

	Mix Ratio					Unprimed Adhesion, Lap Shear			Thermal Conductivity			ths	
Product		Color	Mix Ratio	Viscosity, centipoise or mPa·s	Durometer, Shore A	Specific Gravity	Working Time at RT	psi	MPa	$ m kgf/cm^2$	Watt-meter-°K	cal/cm•sec°C	Linear Coefficient of Thermal Expansion, µm/m-°C or ppm
Silicone Encapsulants					'		•	•		•			
Sylgard® 160 Silicone Elastomer	1:1	Gray	4000	60	1.57	30 min	NA	NA	NA	0.58	1.4 x 10 ⁻³	240	18
Sylgard® 165 Silicone Elastomer	1:1	Gray	5000	52	1.57	<2 min	NA	NA	NA	0.58	1.4 x 10 ⁻³	230	18
Sylgard [®] 170 Silicone Elastomer	1:1	Dark gray to black	2900	40	1.37	15 min	NA	NA	NA	0.40	9.6 x 10 ⁻⁴	270	24
<i>Sylgard</i> [®] 170 Fast Cure Silicone Elastomer	1:1	Dark gray to black	2850	42	1.37	<5 min	NA	NA	NA	0.40	9.6 x 10 ⁻⁴	_	18
Dow Corning® 96-082 A & B Encapsulant	1:1	Black	1100	31	1.21	14 days	NA	NA	NA	0.30	7.2 x 10 ⁻⁴	285	12
Sylgard [®] 182 Silicone Elastomer	10:1	Clear	3900	50	1.03	>8 hours	NA	NA	NA	0.18	4.3 x 10 ⁻⁴	310	24
Sylgard® 184 Silicone Elastomer	10:1	Clear	3900	50	1.03	>2 hours	NA	NA	NA	0.18	4.3 x 10 ⁻⁴	310	24
Sylgard® 186 Silicone Elastomer	10:1	Trans- lucent	65,000	24	1.12	2 hours	NA	NA	NA	0.2	4.8 x 10 ⁻⁴	330	12
Dow Corning [®] 3-6121 Encapsulating Elastomer	10:1	Trans- lucent	25,000	30	1.13	2 hours	NA	NA	NA	0.18	4.3 x 10 ⁻⁴	290	18
Primerless Silicone Enc	capsulants												
Sylgard® 275 Silicone Elastomer	1:1	Gray	2100	40	1.37	<15 min	230	1.6	16.2	0.45	1.1 x 10 ⁻³	NA	6
Dow Corning® 3-6642 Thermally Conductive Adhesive	1:1	Gray	5100	82	2.21	0.5 hour	470	3.2	33.0	1.00	2.4 x 10 ⁻³	180	8 @ <5°C (41°F)
Dow Corning® 3-8264 Primerless Silicone Adhesive	1:1	Black	2900	45	1.32	5 hours	385	2.6	27.0	0.35	8.4 x 10 ⁻⁴	290	9
Dow Corning® 567 Primerless Silicone Encapsulant	1:1	Black	1500	45	1.24	>3 days	140	1.0	9.8	0.30	7.2 x 10 ⁻⁴	300	24

Specification Writers: Please obtain copies of the Dow Corning Sales Specifications for these products and use them as a basis for your specifications. They may be obtained from any Dow Corning Sales Office, or from Dow Corning Customer Service in Midland, MI. Call (517) 496-6000.

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	ULI	isting	Military S _I	pecification		Dielectric Strength					
Product	Flammability Classification	UL Temperature Index, Electrical/ Mechnical, °C	Specification	Type, Class, Group	volts/mil	kV/mm	Dielectric Constant at 100 Hz	Dielectric Constant at 100 kHz	Volume Resistivity, ohm-cm	Dissipation Factor at 100 Hz	Dissipation Factor at 100 kHz
Sylgard [®] 160 Silicone Elastomer	94 V-0	105/105	NA	NA	530	20.9	3.30	3.20	1.0×10^{15}	0.01	0.002
Sylgard [®] 165 Silicone Elastomer	94 V-0	105/105	NA	NA	530	20.9	3.30	3.20	1.0×10^{15}	0.01	0.002
Sylgard [®] 170 Silicone Elastomer	94 V-0	170/170	MIL-PRF- 23586F (Grade B2)	Type I, Class II, QPL	480	18.9	3.17	3.16	3.1×10^{13}	0.003	<0.001
Sylgard [®] 170 Fast Cure Silicone Elastomer	94 V-0	170/170	NA	NA	530	20.9	2.97	2.90	1.4×10^{15}	0.005	<0.001
Dow Corning [®] 96-082 A & B Encapsulant	94 V-0	170/170	NA	NA	500	19.7	3.14	3.12	9.5×10^{14}	0.0055	<0.001
Sylgard [®] 182 Silicone Elastomer	94 V-1	130/130	MIL-I- 81550C	Type II, QPL	540	21.2	2.65	2.65	1.2×10^{14}	0.0005	<0.001
Sylgard [®] 184 Silicone Elastomer	94 V-1	130/130	MIL-I- 81550C	Type I, QPL	540	21.2	2.65	2.65	1.2×10^{14}	0.0005	<0.001
Sylgard [®] 186 Silicone Elastomer	94 HB	140/140	NA	NA	450	17.7	2.93	2.87	1.1×10^{14}	0.0012	<0.001
Dow Corning® 3-6121 Encapsulating Elastomer	NA	NA	NA	NA	415	16.3	2.92	2.92	1.4×10^{14}	0.01	<0.001
									•		
Sylgard [®] 275 Silicone Elastomer	94 V-0	105/105	NA	NA	480	18.9	3.31	3.00	6.4×10^{14}	0.087	0.006
Dow Corning® 3-6642 Thermally Conductive Adhesive	94 V-0	105/105	NA	NA	440	17.3	-	4.20	1.1×10^{13}	_	0.0013
Dow Corning® 3-8264 Primerless Silicone Adhesive	NA	NA	NA	NA	545	21.4	3.11	3.05	3.5×10^{14}	0.007	<0.001
Dow Corning® 567 Primerless Silicone Encapsulant	94 V-0	105/105	MIL-PRF- 23586F (Grade B2)	Type I, Class IV, QPL	520	20.5	2.85	2.79	1.0 x 10 ¹⁴	0.008	0.002

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Mixing - 1:1/Part A:Part B

Dow Corning silicone 1:1 encapsulants are supplied in two parts that do not require lot matching. The 1:1 mix ratio, by weight or volume, simplifies the proportioning process. To ensure uniform distribution of filler, Parts A and B must each be thoroughly mixed prior to their combination in a 1:1 ratio. When thoroughly blended, the Part A and B liquid mixture should have a uniform appearance. The presence of light-colored streaks or marbling indicates inadequate mixing and will result in incomplete cure.

Due to the fast-curing characteristics of some encapsulants included in this datasheet, automated mix and dispense equipment should be utilized. In applications sensitive to air entrapment, deairing with 28 to 30 inches Hg vacuum is required.

Mixing -10:1/Base:Curing Agent

Dow Corning silicone 10:1 encapsulants are supplied in two parts as lot-matched base and curing agent that are mixed in a ratio of 10 parts base to one part curing agent, by weight. After thoroughly mixing base and curing agent, agitate gently to reduce the amount of air introduced. Allowing the mixture to set for 30 minutes before pouring may be adequate for removal of the air introduced during mixing. If air bubbles are still present, vacuum deairing may be required. Deair in a container with at least four times the liquid volume to allow for expansion of material. Air entrapped in the mixture can be removed by using a vacuum of 28 to 30 inches Hg. Continue the vacuum until the liquid

expands and settles to its original volume and bubbling subsides. This may take 15 minutes to 2 hours depending on the amount of air introduced during stirring. For best curing results, glassware and glass or metal stirring implements should be used. Mix with a smooth action that does not introduce excess air.

Pot Life/Working Time

Cure reaction begins with the mixing process. Initially, cure is evidenced by a gradual increase in viscosity, followed by gelation and conversion to a solid elastomer. Pot life is defined as the time required for viscosity to double after Parts A and B (base and curing agent) are mixed. Please refer to individual pot life for each silicone encapsulant.

Processing and Curing

Thoroughly mixed *Dow Corning* silicone encapsulant may be poured/dispensed directly into the container in which it is to be cured. Care should be taken to minimize air entrapment. When practical, pouring/dispensing should be done under vacuum, particularly if the component being potted or encapsulated has many small voids. If this technique cannot be used, the unit should be evacuated after the silicone encapsulant has been poured/dispensed.

Dow Corning silicone encapsulants may be either room temperature (25°C/77°F) or heat cured. Room temperature cure encapsulants may also be heat accelerated for faster cure. Ideal cure conditions for each product are given in the Product Selection Table.

PRIMER SELECTION GUIDE

These values are not intended for use in preparing specifications.

Dow Corning® brand Primer or Adhesion Promoter	Flash Point, °C (°F)	Volatile Organic Content (VOC), grams/ liter ⁴	Special Properties	For Use On	For Use With	Silicone Product Examples	
P5200 Clear ¹	32 (90)	110/705					
1200 Clear	17 (63)	748		Most metals, glass, ceramics and some	Pigmented two-part	160, 165, 170	
1200 Red	17 (63)	774	Colored for easier	plastics	addition cure		
P5200 Red ²	32 (90)	110/705	identification				
1204	15 (59)	774		Most metals, glass	All one-part alcohol	3140, 3145, 838, 3-1753	
P5204 ³	18 (64)	205/591		and ceramics	cure		
1205	5 (41)	861	Film-forming	Most plastics	All	0 1,00	
3-6060	37 (99)	780	Improves inhibition resistance	Most plastics and metals			
92-023	-4 (25)	678	Tesistance	Most motals gless	All two-part addition cure	182, 184, 186	
Sylgard [®] Prime Coat	-3 (27)	687		Most metals, glass and ceramics	undition cure		

¹P5200 Clear is a low-VOC alternative to 1200 Clear.

²P5200 Red is a low-VOC alternative to 1200 Red.

³P5204 is a low-VOC alternative to 1204.

⁴The lower VOC value is for states and air quality management districts that have recognized volatile methylsiloxanes as VOC exempt.

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In applications requiring adhesion, priming will be required for the silicone encapsulants. See the Primer Selection Guide for the correct primer to use with a given product. For best results, the primer should be applied in a very thin, uniform coating and then wiped off after application. After application, it should be thoroughly air dried prior to application of the silicone elastomer. Additional instructions for primer usage can be found in the Dow Corning literature, "How To Use *Dow Corning* Primers and Adhesion Promotors" (Form No. 10-366) and in the information sheets specific to the individual primers.

USEFUL TEMPERATURE RANGES

For most uses, silicone elastomers should be operational over a temperature range of -45 to 200°C (-49 to 392°F) for long periods of time. However, at both the low and high temperature ends of the spectrum, behavior of the materials and performance in particular applications can become more complex and require additional considerations.

For low-temperature performance, thermal cycling to conditions such as -55°C (-67°F) may be possible, but performance should be verified for your parts or assemblies. Factors that may influence performance are configuration and stress sensitivity of components, cooling rates and hold times, and prior temperature history. There are specialized products including *Dow Corning*® 3-6121 Encapsulating Elastomer that can perform at -65°C (-85°F) and below.

At the high-temperture end, the durability of the cured silicone elastomer is time and temperature dependent. As expected, the higher the temperature, the shorter the time the material will remain useable.

COMPATIBILITY

Certain materials, chemicals, curing agents and plasticizers can inhibit the cure of *Dow Corning* silicone encapsulants. Most notable of these include:

- Organotin and other organometallic compounds
- Silicone rubber containing organotin catalyst
- Sulfur, polysulfides, polysulfones or other sulfurcontaining materials
- Amines, urethanes or amine-containing materials
- Unsaturated hydrocarbon plasticizers
- Some solder flux residues

If a substrate or material is questionable with respect to potentially causing inhibition of cure, it is recommended that a small scale compatibility test be run to ascertain suitability in a given application. The presence of liquid or uncured product at the interface between the questionable substrate and the cured gel indicates incompatibility and inhibition of cure.

REPAIRABILITY

In the manufacture of electrical/electronic devices it is often desirable to salvage or reclaim damaged or defective units. With most non-silicone rigid potting/encapsulating

materials, removal or entry is difficult or impossible without causing excessive damage to internal circuitry. *Dow Corning* silicone encapsulants can be selectively removed with relative ease, any repairs or changes accomplished, and the repaired area repotted in place with additional product.

To remove silicone elastomers, simply cut with a sharp blade or knife and tear and remove unwanted material from the area to be repaired. Sections of the adhered elastomer are best removed from substrates and circuitry by mechanical action such as scraping or rubbing and can be assisted by applying *Dow Corning®* brand OS Fluids.

Before applying additional encapsulant to a repaired device, roughen the exposed surfaces of the cured encapsulant with an abrasive paper and rinse with a suitable solvent. This will enhance adhesion and permit the repaired material to become an integral matrix with the existing encapsulant. Silicone prime coats are not recommended for adhering product to themselves.

STORAGE AND SHELF LIFE

Shelf life is indicated by the "Use By" date found on the product label.

For best results, Dow Corning silicone encapsulants should be stored at or below 25°C (77°F). Special precautions must be taken to prevent moisture from contacting these materials. Containers should be kept tightly closed and head or air space minimized. Partially filled containers should be purged with dry air or other gases, such as nitrogen.

Any special storage and handling instructions will be printed on the product containers.

LIMITATIONS

This product is neither tested nor represented as suitable for medical or pharmaceutical uses.

PACKAGING

In general, *Dow Corning* silicone 1:1 mix ratio encapsulants are supplied in nominal 0.45-, 3.6-, 18- and 200-kg (1-, 8-, 40- and 440-lb.) containers, net weight. *Dow Corning* silicone 10:1 mix ratio encapsulants are supplied in nominal 0.5-, 5-, 25- and 225-kg (1.1-, 11-, 55- and 495-lb) containers, net weight. Packaging options may vary by product. Consult Dow Corning Customer Service at (517) 496-6000 for additional packaging options.

SAFE HANDLING INFORMATION

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY WRITING TO DOW CORNING CUSTOMER SERVICE, OR BY CALLING (517) 496-6000.

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