

Silanes & Silicones for Epoxy Resins

Modifying Epoxy Resin Performance:

- Adhesion*
- Thermal Stress Relaxation*
- Low Temperature Properties*
- Rheology*
- Dielectric Properties*
- Optical Properties*
- Controlled Release*



Enabling your technology



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Silanes & Silicones for Epoxy Resins

The outstanding properties of epoxy resins- toughness, rigidity, elevated temperature performance, chemical resistance and adhesive properties have enabled their acceptance in a wide range of critical electronic, optical and aerospace applications. Silicon-based materials play key roles in extending the range of physical properties of conventional epoxy resin systems enabling acceptance in applications with challenging requirements such as ULSI encapsulation, die-attach adhesives, optical component mounting, aerospace nanocomposites, UV-cure controlled release and controlled coefficient of friction coatings.

The main categories of silicon-based materials used in conjunction with epoxy resins are:

- **Silane Coupling Agents** (p.2). These find applications as adhesion promoters for composites, coatings and adhesives.
- **Difunctional and Multifunctional Epoxy Terminated Silicones** (p.10). These include lower molecular weight siloxanes with discrete structures and higher molecular weight silicones with either pendant or terminal epoxy functionalization. Depending on specific structures and formulations they selectively impart a wide range of properties associated with silicones- low-stress, low temperature properties, dielectric properties, release, and optical stability.

- **Silicone Resin Modifiers-Monofunctional Silicones** (p.12). Siloxane and silicone diluents can reduce viscosity of epoxy systems as well as lower surface tension allowing ease of handling, facilitating higher filler loading and infiltration of prepregs and fine structural components.

- **Cycloaliphatic Silanes and Silicones** (p.13). These materials, characterized by a combination of cycloaliphatic and siloxane structures, have outstanding weathering characteristics, controlled release and coefficient of friction along with excellent electrical properties. They can be cured either by cationic UV photoinitiators or conventional epoxy hardeners.

- **Silane and Silicone Hardeners** (p.14). These materials, include siloxane and silicone with diamine, polyamine and dianhydride functionalities.

- **Organosilane Modified Silica Nanoparticles** (p.16). A range of silica structures from 20nm to 1 micron have been modified with silanes to reduce hydroxyl content allowing improved dispersion. Other versions have monolayers with isolated amine functionality, providing controlled interactions with resins.

With proper selection, formulators can achieve a balance of performance properties, thereby taking advantage of the unique properties of epoxies and silicones.

General Comparison of Silicone & Bisphenol Based Epoxies

	Silicone Epoxies	Bisphenol Epoxies
<u>Electrical Properties</u>		
Dielectric Constant	2.4-3.0	3.5-5.0
Chloride, Ionic Impurities	<25ppm	30-1000
<u>Optical</u>		
Color, Gardner	<1	>1
Refractive Index	1.40-1.47	1.57-1.60
<u>Thermal</u>		
Low Temp. (Tg)	<-60°C	~60°C
Thermal Stress Relaxation (piezo)	-2 to -3	-6 to -7

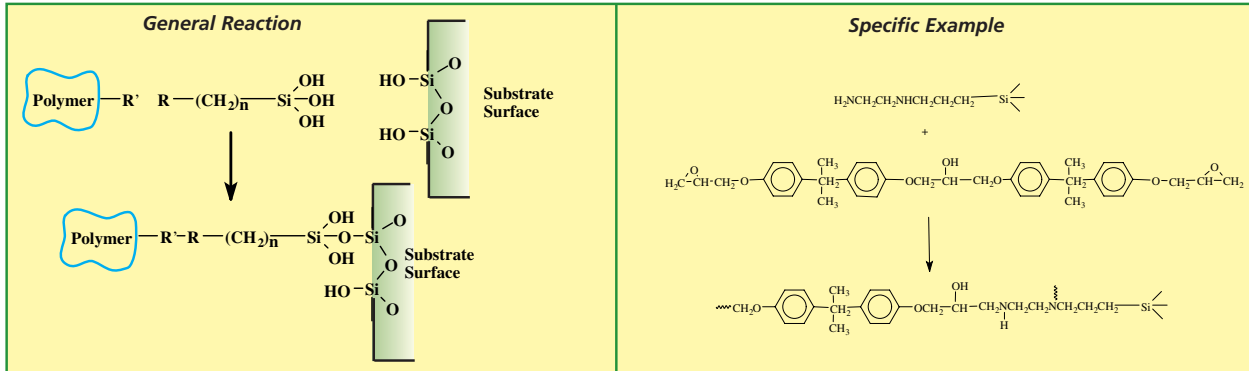
Silane Coupling Agents

Silane Coupling Agents find application as adhesion promoters for composites and coatings. Silanes have the ability to form covalent bonds with inorganic substrates and epoxy resins.

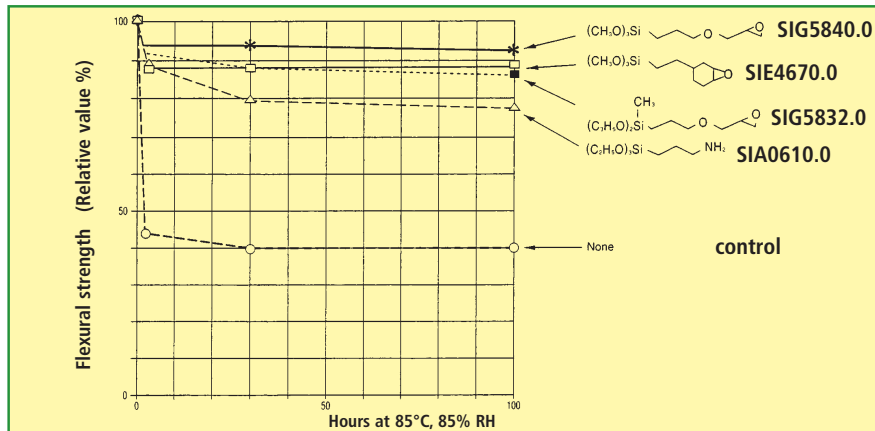
Most commonly, epoxycyclohexyl and glycidoxy functional silanes are used to pre-

treat fillers or are blended with the epoxy resin. Amine functional silanes can likewise be used to pretreat the filler or blended with the hardener component of two-part systems. Treatment of fillers in epoxy adhesives improves dispersibility, increases mechanical properties and improves humidity resistance.

Epoxy Coupling Reactions



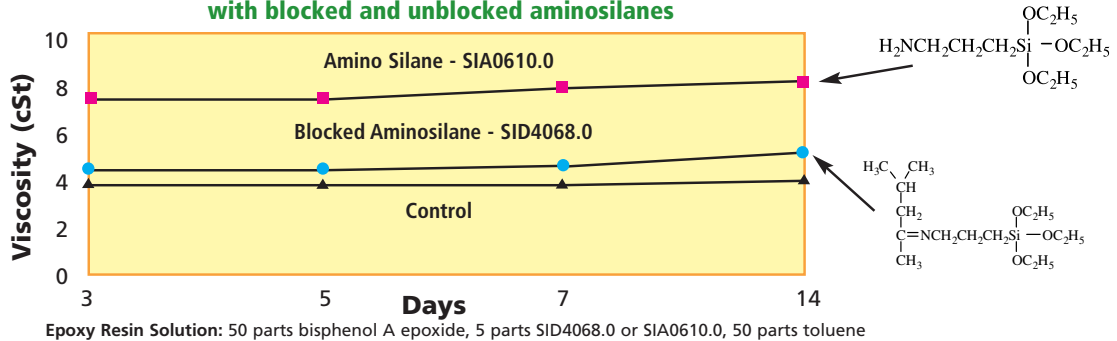
Humidity Resistance vs. Flexural Strength of Epoxy Molding Compounds



Single-component liquid cure epoxy adhesives and coatings employ dimethylbutylidene blocked amino silanes. These materials show excellent storage stability in resin systems, but are activated by moisture provided

by water adsorbed on substrate surfaces or from humidity. Deblocking begins in minutes and is generally complete within two hours in sections with a diffusional thickness of less than 1mm.

Storage Stability of Epoxy Coating Solutions with blocked and unblocked aminosilanes



Epoxy Resin Solution: 50 parts bisphenol A epoxide, 5 parts SID4068.0 or SIA0610.0, 50 parts toluene

Primer coatings for metal substrates utilize dipodal silanes to improve wet adhesion. Comparative results for the addition of a non-functional dipodal silane (SIB1817.0 bis(triethoxysilyl)ethane) in an EVA system are shown below. Epoxy

systems use non-functional dipodal silanes in conjunction with epoxysilanes. Functional dipodal silanes such as SIB1833.0 bis(triethoxysilylpropyl)amine are used with aminosilanes.

Effect of dipodal -SiCH₂CH₂Si- on the bond strength of a crosslinkable ethylene-vinyl acetate primer formulation

Primer on metal 10% in <i>i</i> -PrOH	Wet adhesion to metals (N/cm)*	
	Titanium	Cold-rolled steel
No silane	Nil	Nil
Methacryloxypropylsilane	0.25	7.0
Methacryloxypropylsilane + 10% dipodal	10.75	28.0 (cohesive failure)

*90° peel strength after 2 h in 80°C water.

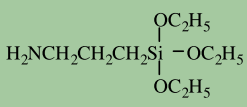
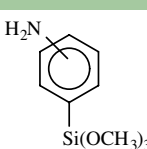
P. Pape et al, in Silanes and Other Coupling Agents, ed. K. Mittal, 1992, VSP, p105

Silane Coupling Agents for Epoxy Resins Selection Chart

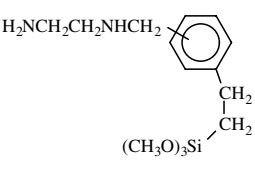
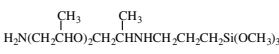
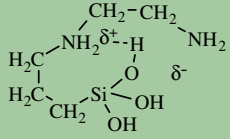
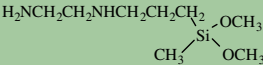
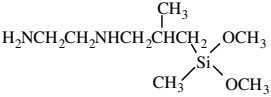
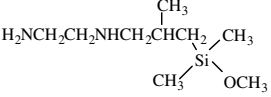
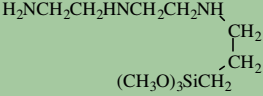
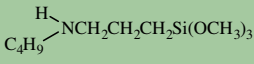
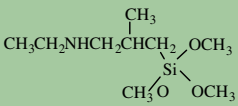
Resin Type	Coupling Agent Class	Suggestions for Primary Screening	
Epoxy (linear aliphatic or bisphenol A)	Amine	SIA0591.0	SIT8398.0
	Anhydride	SIT8192.6	
	Blocked Amine	SID4068.0	
	Epoxy	SIG5840.0	SIG5832.0
Epoxy, UV Cure (cycloaliphatic)	Amine	SIA0591.0	SIT8398.0
	Epoxy	SIE4668.0	SIE4670.0
Epoxidized Rubber	Sulfur/Mercapto	SIM6476.0	SIM6474.0

Amino Functional Silanes

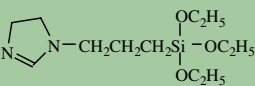
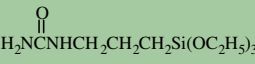
name **MW** **bp/mm (mp)** **D₄²⁰** **n_D²⁰**
Monoamine Functional Silanes - Trialkoxy

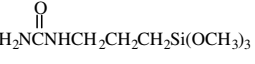
	SIA0610.0 3-AMINOPROPYLTRIEHOXYSILANE C ₉ H ₂₃ NO ₃ Si AMEO, GAPS flashpoint: 104°C (220°F) ΔHvap: 11.8 kcal/mole viscosity: 1.6 cSt. versatile coupling agent most widely used coupling agent for epoxy coatings [1919-30-2] TSCA HMIS: 3-1-1-X	221.37	122-3°/30	0.951	1.4225	Commercial
	SIA0611.0 3-AMINOPROPYLTRIMETHOXYSILANE C ₆ H ₁₇ NO ₃ Si hydrolysis rate vs AMEO (SIA0610.0): 6:1 [13822-56-5] TSCA HMIS: 3-2-1-X	179.29	80°/8	1.027	1.4240	
	SIA0599.2 AMINOPHENYLTRIMETHOXYSILANE, mixed isomers typically 60-70% para, 30-40% meta C ₉ H ₁₅ NO ₃ Si for pure isomers, see SIA0559.0, SIA0559.1 coupling agent for high temperature composites [33976-43-1] HMIS: 3-1-1-X	213.31	110-4°/0.6	1.19		Developmental
		5.0g/\$64.00		25g/\$256.00		

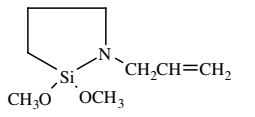
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	SIA0614.0 3-AMINOPROPYLTRIS(METHOXYETHOXY)ETHOXY)SILANE, 95% C ₁₈ H ₄₁ NO ₉ Si coupling agent for melt compounding of polyamides and epoxies. [87794-64-7] HMIS: 3-2-1-X	443.61 flashpoint: 68°C (155°F)		1.066	1.448	Developmental
	SIA0598.0 3-(m-AMINOPHENOXY)PROPYLTRIMETHOXY-SILANE, 95% amber liquid C ₁₂ H ₂₁ NO ₄ Si [55648-29-8] HMIS: 3-1-1-X	271.39		1.02	1.495	
	SID4068.0 3-(1,3-DIMETHYLBUTYLIDENE)AMINO-PROPYLTRIETHOXY-SILANE C ₁₅ H ₃₃ NO ₃ Si coupling agent for epoxy coatings blocked amine - moisture deblocked [116229-43-7] HMIS: 2-2-1-X	303.52 flashpoint: 131°C (268°F)	134°/5	0.93	1.437 ²⁵	Commercial
	SIA0608.0 AMINOPROPYLSILANETRIOL, 22-25% in water C ₃ H ₁₁ NO ₃ Si mainly oligomers pH: 10.0-10.5 internal hydrogen bonding stabilizes solution [29159-37-3] TSCA HMIS: 2-0-0-X	137.21 flashpoint: >110°C(230°F)		1.06		
	SIA0605.0 3-AMINOPROPYLMETHYLDIETHOXY-SILANE C ₈ H ₂₁ NO ₂ Si coupling agent for foundry resins [3179-76-8] TSCA HMIS: 3-2-1-X	191.34 flashpoint: 85°C(185°F) TOXICITY- oral rat, LD50: 4760mg/kg	85-8°/8	0.916	1.4272	Developmental
	SIA0603.0 3-AMINOPROPYLDIMETHYLETHOXY-SILANE C ₇ H ₁₉ NOSi Δ Hform: 147.6 kcal/mole [18306-79-1] TSCA HMIS: 3-2-1-X	161.32 flashpoint: 73°C (163°F)	78-9°/24	0.857 ²⁵	1.427 ²⁵	
	SIA0591.0 N-(2-AMINOETHYL)-3-AMINOPROPYLTRI-METHOXY-SILANE N-[3-(TRIMETHOXSILYL)PROPYL]ETHYLENEDIAMINE DAMO C ₈ H ₂₂ N ₂ O ₃ Si visc: 6.5 cSt Ce: 0.8 γc, treated surface: 36.5 dynes/cm coupling agent for epoxy adhesives with good film forming properties and copper/brass adhesion [1760-24-3] TSCA HMIS: 3-1-1-X	226.36 flashpoint: 150°C (302°F) TOXICITY- oral rat, LD50: 7460mg/kg specific wetting surface: 358 m ² /g	140°/15	1.019 ²⁵	1.450 ²⁵	Commercial
	SIA0590.5 N-(2-AMINOETHYL)-3-AMINOPROPYLTRI-ETHOXY-SILANE, 95% C ₁₁ H ₂₈ N ₂ O ₃ Si [5089-72-5] TSCA HMIS: 3-1-1-X	264.55 flashpoint: 148°C (298°F)	156°/15	0.994	1.4367 ²⁵	
	SIA0593.0 N-(6-AMINOHEXYL)AMINOMETHYL-TRIMETHOXY-SILANE, 95% C ₁₀ H ₂₆ N ₂ O ₃ Si [172684-43-4] HMIS: 3-2-1-X	250.42 flashpoint: >110°C (>230°F)	160-5°/0.2	0.928 ²⁵	1.4385 ²⁵	Developmental
	SIA0595.0 N-(2-AMINOETHYL)-11-AMINOUNDECYL-TRIMETHOXY-SILANE C ₁₆ H ₃₈ N ₂ O ₃ Si coupling agent with extended spacer-group for remote substrate binding HMIS: 3-1-1-X	334.57 5.0g/\$130.00	155-9°/0.4	0.873 ²⁵	1.4515	

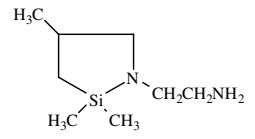
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	SIA0588.0 (AMINOETHYLAMINOMETHYL)PHENETHYL-TRIMETHOXSILANE, 90% mixed m,p isomers C ₁₄ H ₂₆ N ₂ O ₃ Si coupling agent for polyimides photochemically sensitive (194nm) ¹ self-assembled monolayers ² . 1. W. Dressick et al, Thin Solid Films, 284, 568, 1996 2. C Harnett et al, Appl. Phys. Lett., 76, 2466, 2000.	298.46	126-30°/0.2 flashpoint: > 110°C(>230°F)	1.02	1.5083	Developmental
	[74113-77-2] TSCA HMIS: 3-1-1-X	25g/\$82.00		100g/\$266.00		
	SIA0599.4 N-3-[(AMINO(POLYPROPYLENOXY))AMINO-PROPYL]TRIMETHOXSILANE coupling agent with film-forming capability HMIS: 2-2-1-X	337-435	3-4 propyleneoxy units			Developmental
		25g/\$72.00				
Diamine Functional Silanes - Water-borne						
	SIA0590.0 N-(2-AMINOETHYL)-3-AMINOPROPYL-SILANETRIOL, 25% in water mainly oligomers C ₅ H ₁₇ N ₂ O ₃ Si internal hydrogen bonding stabilizes solution	180.28	flashpoint: >110°C(230°F) pH: 10.0-10.5	1.00		Commercial
	[68400-09-9] TSCA HMIS: 2-0-0-X	100g/\$10.00		2.0kg/\$130.00		
Diamine Functional Silanes - Dialkoxy						
	SIA0589.0 N-(2-AMINOETHYL)-3-AMINOPROPYLMETHYL-DIMETHOXSILANE C ₈ H ₂₂ N ₂ O ₂ Si comonomer for silicones in textile softeners and haircare formulations	206.36	265° flashpoint: 90°C(194°F) auto-ignition temp: 280°C specific wetting surface: 380 m ² /g	0.975 ²⁵	1.4447 ²⁵	Commercial
	[3069-29-2] TSCA HMIS: 3-1-1-X	25g/\$10.00		2.0kg/\$168.00		
Diamine Functional Silanes - Monoalkoxy						
	SIA0587.5 N-(2-AMINOETHYL)-3-AMINOISOBUTYL-METHYLDIMETHOXSILANE, 95% C ₉ H ₂₄ N ₂ O ₂ Si [23410-40-4] TSCA HMIS: 3-2-1-X	220.39	131°/15 flashpoint: 96°C(205°F)	0.960	1.4518	Developmental
		25g/\$90.00				
	SIA0587.2 (AMINOETHYLAMINO)-3-ISOBUTYLDI-METHYLMETHOXSILANE, 95% C ₉ H ₂₄ N ₂ O ₂ Si [31024-49-4] HMIS: 3-2-1-X	204.39	85-9°/2	0.900 ²⁵	1.4513 ²⁵	Developmental
		25g/\$84.00				
Triamine Functional Silanes						
	SIT8398.0 (3-TRIMETHOXSILYL)PROPYL)DIETHYLENE-TRIAMINE, 95% C ₁₀ H ₂₇ N ₃ O ₃ Si hardener, coupling agent for epoxies	265.43	114-8°/2 flashpoint: 137°C(279°F) γ of treated surface: 37.5 dynes/cm	1.030	1.4590	Commercial
	[35141-30-1] TSCA HMIS: 3-1-1-X	100g/\$19.00		2.0kg/\$248.00		
Secondary Amine Functional Silanes						
	SIB1932.2 n-BUTYLAMINOPROPYLTRIMETHOXY-SILANE C ₁₀ H ₂₅ NO ₃ Si coupling agent for urethane coatings	235.40	102°/3.5 flashpoint: 110°C (230°F)	0.947	1.4246 ²⁵	Commercial
	[31024-56-3] TSCA HMIS: 2-2-1-X	25g/\$12.00		2.0kg/\$240.00		
	SIE4886.0 N-ETHYLAMINOISOBUTYLTRIMETHOXY-SILANE C ₉ H ₂₃ NO ₃ Si adhesion promoter for polyurethane coatings	221.37	95°/10 flashpoint: 91°C(196°F)	0.952 ²⁵	1.4234	Commercial
	[227085-51-0] TSCA HMIS: 3-2-1-X	25g/\$18.00		2.0kg/\$360.00		

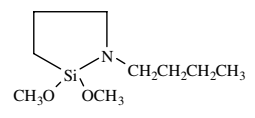
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	SIM6500.0 N-METHYLAMINOPROPYLTRIMETHOXY-SILANE C ₇ H ₁₉ NO ₃ Si pK _a ²⁵ H ₂ O: 5.18 orients liquid crystals [3069-25-8] TSCA HMIS: 3-2-1-X	193.32	106°/30 flashpoint: 82°C(179°F) γ _c of treated surface: 31 dynes/cm	0.978 ²⁵	1.4194	Commercial
	SIP6724.0 N-PHENYLAMINOPROPYLTRIMETHOXY-SILANE, 95% C ₁₂ H ₂₁ NO ₃ Si oxidatively stable coupling agent for polyimides, phenolics, epoxies [3068-76-6] TSCA HMIS: 3-1-1-X	255.38	132-5°/0.3 flashpoint: 165°C(329°F) specific wetting surface: 307m ² /g	1.07	1.504	
	SIA0400.0 3-(N-ALLYLAMINO)PROPYLTRIMETHOXY-SILANE, 95% C ₉ H ₂₁ NO ₃ Si coupling agent for polyesters coupling agent for acrylic coatings for glass containers ¹ . 1. Y. Hashimoto et al, Eur. Pat. Appl. EP 289,325, 1988 [31024-46-1] HMIS: 3-2-1-X	219.36	106-9°/25 flashpoint: 88°C(190°F)	0.989 ²⁵	1.4990 ²⁵	Developmental
	SIP6723.7 N-PHENYLAMINOMETHYLTRIETHOXSILANE C ₁₃ H ₂₃ NO ₃ Si [3473-76-5] HMIS: 3-2-1-X	269.42	135-7°/4	1.004 ²⁵	1.485 ²⁵	
	SIM6498.0 N-METHYLAMINOPROPYLMETHYL-DIMETHOXSILANE C ₇ H ₁₉ NO ₂ Si [31024-35-8] HMIS: 3-2-1-X	177.32	93°/25 flashpoint: 80°C(176°F)	0.9173 ²⁵	1.4224 ²⁵	
Dipodal Amine Functional Silanes						
	SIB1833.0 BIS(TRIMETHOXSILYL)PROPYLAMINE, 95% C ₁₂ H ₃₁ NO ₆ Si ₂ dipodal coupling agent [82985-35-1] TSCA HMIS: 3-1-1-X	341.56	152°/4 flashpoint: 113°C (235°)	1.040	1.4320	Commercial
	SIB1834.0 BIS[(3-TRIMETHOXSILYL)PROPYL]-ETHYLENEDIAMINE, 62% in methanol C ₁₄ H ₃₆ N ₂ O ₆ Si ₂ dipodal coupling agent for polyamides with enhanced hydrolytic stability [68845-16-9] TSCA HMIS: 3-4-1-X	384.62	flashpoint: 11°C(52°F)	0.89		
	SIB1824.5 BIS(TRIETHOXSILYL)PROPYLAMINE, 95% C ₁₈ H ₄₃ NO ₆ Si ₂ HYDROLYTIC SENSITIVITY: 7 Si-OR reacts slowly with water/moisture [13497-18-2] TSCA HMIS: 2-2-1-X	425.71	160°/0.6 flashpoint: >140°C (284°F)	0.97		Developmental
	SIB1834.1 BIS[(3-TRIMETHOXSILYL)PROPYL]-ETHYLENEDIAMINE, 95% C ₁₄ H ₃₆ N ₂ O ₆ Si ₂ coupling agent for polyamides with enhanced hydrolytic stability [68845-16-9] TSCA HMIS: 3-2-1-X	384.62	flashpoint: >110°C(>230°F)	1.050		
	SIB1828.0 BIS[3-(TRIETHOXSILYL)PROPYL]UREA, 60% in ethanol C ₁₉ H ₄₄ N ₂ O ₇ Si ₂ [69465-84-5] HMIS: 2-1-1-X	440.66		0.923		
	SIB1620.0 BIS(METHYLDIETHOXSILYL)PROPYLAMINE 95% C ₁₆ H ₃₉ NO ₄ Si ₂ dipodal coupling agent [31020-47-0] HMIS: 2-1-1-X	365.66	155°/0.6	0.937	1.4385	

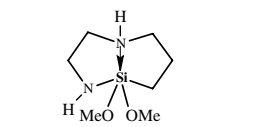
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	Specialty Amine Functional Silanes					
	SIT8187.5 N-(3-TRIETHOXYSILYL)PROPYL- 4,5-DIHYDROIMIDAZOLE 3-(2-IMIDAZOLIN-1-YL)PROPYLTRIETHOXYSILANE C ₁₂ H ₂₆ N ₂ O ₃ Si coupling agent for elevated temperature cure epoxies utilized in HPLC of metal chelates ¹ . forms proton vacancy conducting polymers w/sulfonamides by sol-gel ² . 1. T. Suzuki et al, Chem. Lett, 881, 1994 2. V. De Zea Bermudez et al, Sol-Gel Optics II, SPIE Proc. 1728, 180, 1992 [58068-97-6] TSCA HMIS: 2-1-1-X	274.43	134°/2 flashpoint: >110°C (>230°F)	1.005	1.452	Commercial
viscosity: 5 cSt.						
	SIU9055.0 UREIDOPROPYLTRIETHOXYSILANE, 50% in methanol C ₁₀ H ₂₄ N ₂ O ₄ Si contains ureidopropyltrimethoxysilane and related transesterification products coupling agent for polyamides, area-formaldehyde resins [23779-32-0] TSCA HMIS: 2-3-1-X	264.40	(-97°)mp flashpoint: 14°C (58°F)	0.92	1.386	Commercial
	25g/\$10.00	100g/\$62.00	2.0kg/\$680.00			

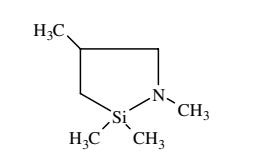
	SIU9058.0 UREIDOPROPYLTRIMETHOXYSILANE C ₇ H ₁₈ N ₂ O ₄ Si [23843-64-3] TSCA HMIS: 2-3-1-X	222.32	217-225° flashpoint: 99°C(210°F)	1.150	1.386 ²⁵	Commercial
	25g/\$10.00	100g/\$32.00				

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	Cyclic Azasilanes					
	SIA0380.0 N-ALLYL-AZA-2,2-DIMETHOXYSILA- CYCLOPENTANE C ₈ H ₁₇ NO ₂ Si HMIS: 3-3-1-X	187.31	52-4°/3			Developmental
10g/\$110.00						

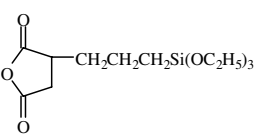
	SIA0592.0 N-AMINOETHYL-AZA-2,2,4-TRIMETHYL- SILACYCLOPENTANE C ₈ H ₂₀ N ₂ Si coupling agent for vapor phase modification of nanoparticles see also SID3543.0 [18246-33-8] HMIS: 3-2-1-X	172.35	54-6°/2	0.905	1.4769	Developmental
	10g/\$60.00					

	SIB1932.4 N-n-BUTYL-AZA-2,2-DIMETHOXYSILA- CYCLOPENTANE C ₉ H ₂₁ NO ₂ Si HMIS: 3-2-1-X	203.36	69-71°/3 flashpoint: 85°C (185°F)	0.941	1.438	Developmental
	25g/\$64.00					

	SID3543.0 2,2-DIMETHOXY-1,6-DIAZA-2-SILACYCLO- OCTANE C ₇ H ₁₈ N ₂ O ₂ Si [182008-07-7] HMIS: 3-2-1-X	190.32	71-3°/2.5 (61-2°)mp			Developmental
	25g/\$80.00					

	SIM6501.4 N-METHYL-AZA-2,2,4-TRIMETHYLSILA- CYCLOPENTANE C ₇ H ₁₇ NSi employed in vapor phase modification of nanoparticles see also SIB1932.4 [18387-19-4] TSCA HMIS: 3-4-1-X	143.30	137° flashpoint: 14°C (58°F)	0.813	1.4308	Developmental
	25g/\$48.00	100g/\$156.00				

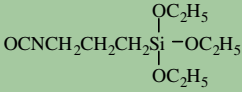
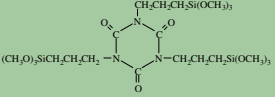
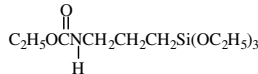
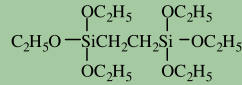
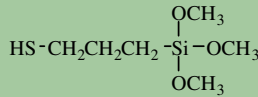
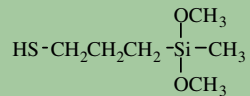
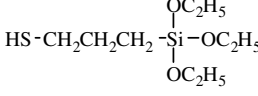
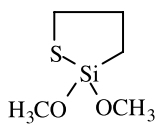
Anhydride Functional Silanes

	SIT8192.6 3-(TRIETHOXYSILYL)PROPYLSUCCINIC ANHYDRIDE, 95% 3-(TRIETHOXYSILYL)PROPYL)DIHYDRO-3,5-FURANDIONE C ₁₃ H ₂₄ O ₆ Si hardener, coupling agent for epoxy resins coupling agent for dibasic surfaces acetic acid-catalyzed hydrolysis yields succinic acid derivative. [93642-68-3] HMIS: 2-1-1-X	304.41	135°/0.2 flashpoint: >100°C(>212°F)	1.070	1.4405	Commercial
	25g/\$45.00	100g/\$146.00				

Epoxy Functional Silanes

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
Epoxy Functional Silanes - Trialkoxy						
	SIE4668.0 2-(3,4-EPOXYCYCLOHEXYL)ETHYLTRIETHOXSILANE C ₁₄ H ₂₈ O ₄ Si coupling agent for water-borne emulsions [10217-34-2] TSCA HMIS: 2-1-1-X	288.46	114-7°/0.4 flashpoint: 104°C(220°F)	1.015	1.4455	Commercial
	SIE4670.0 2-(3,4-EPOXYCYCLOHEXYL)ETHYL-TRIMETHOXSILANE C ₁₁ H ₂₂ O ₄ Si viscosity: 5.2 cSt coefficient of thermal expansion: 0.8 x 10 ⁻³ vapor pressure, 152°: 10mm ring epoxide more reactive than glycidoxypropyl systems. UV initiated polymerization of epoxy group with weak acid donors. forms UV-cureable coating resins by controlled hydrolysis ¹ . 1. J. Crivello et al, Chem. Mater. 9, 1554, 1997. [3388-04-3] TSCA HMIS: 3-1-1-X	246.38	95-7°/0.25 TOXICITY- oral rat, LD50: 12,300mg/kg flashpoint: 146°C(295°F) γc of treated surface: 39.5 dynes/cm specific wetting surface: 317 m ² /g	1.065	1.449	
	SIG5840.0 (3-GLYCIDOXYPROPYL)TRIMETHOXSILANE 3-(2,3-EPOXYPROPOXY)PROPYLTRIMETHOXSILANE C ₉ H ₂₀ O ₅ Si coupling agent for epoxy composites employed in electronic "chip" encapsulation. [2530-83-8] TSCA HMIS: 3-1-1-X	236.34	120°/2 (<-70°)mp TOXICITY- oral rat, LD50: 8,400 mg/kg	1.070	1.4290	Commercial
	SIG5839.0 (3-GLYCIDOXYPROPYL)TRIETHOXSILANE C ₁₂ H ₂₆ O ₅ Si [2602-34-8] HMIS:3-2-1-X	278.42	124°/3 flashpoint: 144°C(291°F) 100g/\$110.00	1.00	1.425	
	SIE4675.0 5,6-EPOXYHEXYLTRIETHOXSILANE C ₁₂ H ₂₆ O ₄ Si HMIS: 3-2-1-X	262.42	115-9°/1.5 flashpoint: 99°C(210°F) 10g/\$84.00	0.960 ²⁵	1.4254 ²⁵	Developmental
	Epoxy Functional Silanes - Dialkoxy					
	SIG5832.0 (3-GLYCIDOXYPROPYL)METHYLDIETHOXY-SILANE C ₁₁ H ₂₄ O ₄ Si employed in scratch-resistant coatings for eyeglasses. [2897-60-1] TSCA HMIS: 2-1-1-X	248.39	122-6°/5 TOXICITY- oral rat, LD50: >2000mg/kg flashpoint: 122°C(252°F) viscosity: 3.0 cSt	0.978 ²⁵	1.431	Commercial
	SIG5836.0 (3-GLYCIDOXYPROPYL)METHYLDIMETHOXY-SILANE C ₉ H ₂₀ O ₄ Si relative hydrolysis rate vs. SIG5840.0: 7.5:1 [65799-47-5] TSCA-L HMIS: 3-1-1-X	220.34	100°/4 flashpoint: 105°C (221°F)	1.02	1.431 ²⁵	
	SIG5825.0 (3-GLYCIDOXYPROPYL)DIMETHYLETHOXY-SILANE C ₁₀ H ₂₂ O ₃ Si coupling agent for epoxy nanocomposites [17963-04-1] TSCA HMIS: 3-2-1-X	218.37	100°/3 flashpoint: 87°C(189°F)	0.950	1.4337 ²⁵	Developmental
	SIG5825.0 (3-GLYCIDOXYPROPYL)DIMETHYLETHOXY-SILANE C ₁₀ H ₂₂ O ₃ Si coupling agent for epoxy nanocomposites [17963-04-1] TSCA HMIS: 3-2-1-X	218.37	100°/3 flashpoint: 87°C(189°F)	0.950	1.4337 ²⁵	

Isocyanate and Masked Isocyanate Functional Silanes

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
Isocyanate Functional Silanes - Trialkoxy						
	SII6455.0 3-ISOCYANATOPROPYLTRIETHOXSILANE, 95%- coupling agent for urethanes, polyols, amines. C ₁₀ H ₂₁ NO ₄ Si [24801-88-5] TSCA HMIS: 3-2-1-X	247.37	130°/20 flashpoint: 80°C(176°F)	0.99	1.419	Commercial
		25g/\$14.00	100g/\$45.00	2.0kg/\$220.00		
Masked Isocyanate Silanes						
	SIT8717.0 TRIS(3-TRIMETHOXSILYLPROPYL)ISO-CYANURATE, 95% C ₂₁ H ₄₅ N ₃ O ₁₂ Si ₃ [26115-70-8] TSCA HMIS: 2-1-1-X	615.86	102°C(216°F) viscosity: 325-350 cSt	1.170	1.4610	Commercial
		25g/\$12.00	100g/\$39.00	2.0kg/\$380.00		
	SIT8188.0 TRIETHOXSILYLPROPYLETHYLCARBAMATE C ₁₂ H ₂₇ NO ₅ Si masked isocyanate - deblocks >160°C [17945-05-0] TSCA HMIS: 2-1-1-X	293.44	124-6°/0.5 flashpoint: 95°C(203°F)	1.015		Developmental
		25g/\$24.00		100g/\$80.00		
Non-Functional Dipodal Silanes						
	SIB1817.0 BIS(TRIETHOXSILYL)ETHANE HEXAETHOXYDISILETHYLENE C ₁₄ H ₃₄ O ₆ Si ₂ ΔHvap: 101.5 kJ/mole additive to silane coupling agent formulations that enhances hydrolytic stability employed in corrosion resistant coatings/primers for steel and aluminum ^{1,2} . 1. W. Van Ooij et al, J. Adhes. Sci. Tech. 11, 29, 1997 2. W. Van Ooij et al, Chemtech., 28, 26, 1998.	354.59	96°/0.3 flashpoint: 107°C(225°F) vapor pressure, 150°: 10mm	0.957	1.4052	Commercial
		[16068-37-4] TSCA-5 HMIS: 3-1-1-X	25g/\$15.00	100g/\$49.00	2.0kg/\$420.00	
Sulfur Functional Silanes						
	SIM6476.0 3-MERCAPTOPROPYLTRIMETHOXSILANE C ₆ H ₁₆ O ₃ SSi viscosity: 2 cSt γc of treated surface: 41 dynes/cm specific wetting surface: 348 m ² /g coupling agent for EPDM rubbers and polysulfide adhesives	196.34	93°/40 flashpoint: 96°C(205°F) primary irritation index: 0.19	1.051 ²⁵	1.4502 ²⁵	Commercial
		[4420-74-0] TSCA HMIS: 3-2-1-X	100g/\$16.00	2kg/\$164.00	18kg/\$630.00	
	SIM6474.0 3-MERCAPTOPROPYLMETHYLDIMETHOXY-SILANE C ₆ H ₁₆ O ₂ SSi intermediate for silicones in thiol-ene UV cure systems	180.34	96°/30 flashpoint: 93°C(199°F)	1.00	1.4502	Commercial
		[31001-77-1] TSCA HMIS: 3-2-1-X	100g/\$23.00		500g/\$92.00	
	SIM6475.0 3-MERCAPTOPROPYLTRIETHOXY-SILANE, 95% C ₉ H ₂₂ O ₃ SSi [14814-09-6] TSCA HMIS: 2-2-1-X	238.42	210° flashpoint: 88°C(190°F) TOXICITY- oral rat, LD50: > 2000mg/kg	0.9325	1.4331	Developmental
		25g/\$35.00		100g/\$114.00		
	SID3545.0 2,2-DIMETHOXY-1-THIA-2-SILACYCLOPENTANE C ₅ H ₁₂ O ₂ SSi reagent for modification of silver and gold surfaces; coupling agent for rubber HYDROLYTIC SENSITIVITY: 8 reacts rapidly with moisture, water, protic solvents	164.29	57-8°/7			Developmental
		[26903-85-5] HMIS: 3-3-1-X	25g/\$84.00			

Difunctional and Multifunctional Epoxy Terminated Silicones

These include lower molecular weight siloxanes with discrete structures and higher molecular weight silicones with either pendant or terminal epoxy functionalization. Depending on specific structures and formulations, they selectively impart a wide range of properties, associated with silicones - low-stress, low temperature properties, dielectric properties and release. Properties of cured silicone modified epoxies vary from hydrophilic to hydrophobic depending on the epoxy content, degree of substitution and ring-opening of epoxides to form diols. The ring-strained epoxy-cyclohexyl group is more reactive than the epoxypropoxy group and undergoes thermally or chemically induced reactions with

nucleophiles including protic surfaces such as cellulose or polyacrylate resins.

The compatibility of epoxy functional silicones with conventional epoxies varies. In simple unfilled systems, total solubility is required. For filled systems, it is often desirable to consider systems that are miscible but have only limited solubility since microphase separation can allow a mechanism for stress-relief.

Epoxy silicones with methoxy groups can be used to improve adhesion to substrates such as titanium, glass or silicon. They also can improve chemical resistance of coatings by forming siloxane crosslinks upon exposure to moisture.

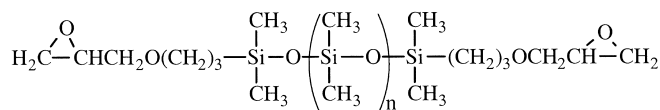
Silicone - Epoxy Compatibility

Gelest Product	Bisphenol	Epoxy Type	
		Polyglycol	Cycloaliphatic
SIB1092.0	miscible	soluble	soluble
SIB1110.0	soluble	soluble	soluble
SIB1115.0	soluble	soluble	soluble
DMS-E11	insoluble	miscible	miscible
EMS-622	insoluble	miscible	insoluble

(10% silicone 90% epoxy)

Difunctional Siloxanes

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	SIB1092.0 BIS[2-(3,4-EPOXYCYCLOHEXYL)ETHYL]- TETRAMETHYLDISILOXANE, 90% C ₂₀ H ₃₈ O ₃ Si ₂ viscosity: 40cSt. UV-initiated polymerization with weak acid donors [18724-32-8] TSCA HMIS: 2-1-1-X	382.69	(-34°)mp	0.998	1.4758	
		25g/\$35.00		100g/\$114.00		
	SIB1110.0 1,5-BIS(GLYCIDOXYPROPYL)-3-PHENYL- 1,1,3,5,5-PENTAMETHYLTRISILOXANE C ₂₃ H ₄₂ O ₆ Si ₃ monomer for silicone-modified epoxy resins HMIS: 2-1-0-X	498.84		1.106	1.4763	
		25g/\$64.00				
	SIB1115.0 1,3-BIS(GLYCIDOXYPROPYL)TETRAMETHYL- DISILOXANE C ₁₆ H ₃₄ O ₅ Si ₂ monomer for silicone modified epoxy resins end-capper for epoxy terminated silicones [126-80-7] TSCA HMIS: 3-1-0-X	362.61	184-7°/2 (-46 to -50°)mp	0.996	1.452	Commercial
		25g/\$20.00	100g/\$65.00	2kg/\$830.00		



Epoxypropoxypropyl Terminated PolyDimethylsiloxanes

[102782-97-8] TSCA

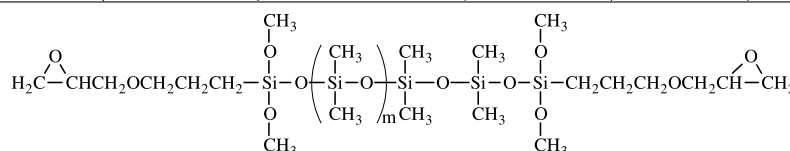
Code	Viscosity	Molecular Weight	Epoxy - Eq/kg	Specific Gravity	Refractive Index	Price 100g	Price 1kg
DMS-E09	8-11	363	5.5	0.99	1.446	\$60.00	\$420.00
DMS-E11	12-18	500-600	1.9-2.2	0.98	1.419	\$90.00	\$540.00
DMS-E12	20-35	1000-1400	1.6-1.9	0.98	1.417	\$120.00	\$840.00
DMS-E21	100-140	4500-5500	0.45-3.5	0.98	1.408	\$120.00	\$840.00

Epoxycyclohexylethyl Terminated PolyDimethylsiloxanes

DMS-EC13	25-35	900-1100	1.9-2.0	0.99	1.433	\$180.00	
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Epoxypropoxypropyl Terminated PolyPhenylMethylsiloxanes

PMS-E11	15-30	500-600	3.6-4.0	1.01	1.475	\$180.00	
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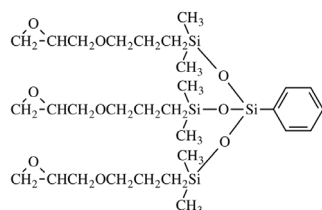


Epoxypropoxypropyl)dimethoxysilyl Terminated PolyDimethylsiloxanes

[188958-73-8] TSCA

DMS-EX21	80-120	3500-4000	0.48-0.5	0.98	1.408	\$16.00	\$96.00
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Multifunctional Siloxanes



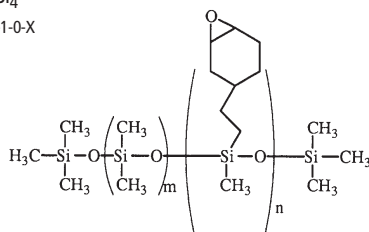
name

SIT8715.6
 TRIS(GLYCIDOXYPROPYLDIMETHYLSILOXY)-
 PHENYLSILANE, 95% amber liquid
 $\text{C}_{30}\text{H}_{56}\text{O}_9\text{Si}_4$
 HMIS: 2-1-0-X

MW **bp/mm (mp)** **D₄²⁰** **n_D²⁰**

673.11 (-73°)mp 1.05 1.4742²⁵
 viscosity: 30-35 cSt.

25g/\$55.00



(EpoxycyclohexylethylMethylsiloxane) Dimethylsiloxane Copolymers

CAS: [6772-95-2] TSCA

Code	Viscosity	Molecular Weight	Mole % (Epoxycyclohexyl)-ethylMethylSiloxane	Specific Gravity	Refractive Index	Price 100g	Price 1 kg	Price 10 kg
ECMS-227	650-800	18,000-20,000	2-3	0.98	1.407	\$19.00	\$114.00	\$799.00
ECMS-327	650-850	18,000-20,000	3-4	0.99	1.409	\$19.00	\$114.00	\$799.00
ECMS-924	300-450	10,000-12,000	8-10	0.97	1.421	\$19.00	\$114.00	\$799.00

(EpoxypropoxypropylMethylsiloxane)-(Dimethylsiloxane) Copolymers

CAS: [68440-71-1] TSCA

EMS-622	200-300	7,000-9,000	5-7	0.99	1.412	\$16.00	\$96.00	
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(2-3% EpoxycyclohexylethylMethylsiloxane)(10-15% MethoxypolyalkyleneoxyMethylSiloxane)-(Dimethylsiloxane) Terpolymer

CAS: [69669-36-9] TSCA

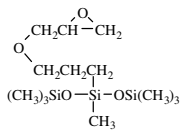
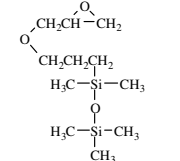
EBP-234	4000-5000	25,000-36,000	0.75-0.80	1.03	1.445	\$22.00	\$132.00	\$924.00
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Silicone Resin Modifiers - Monofunctional Silicones

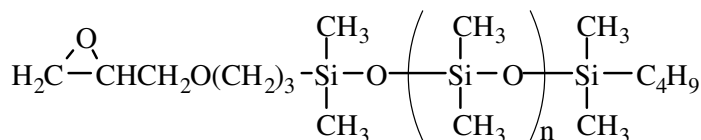
Siloxane and silicone diluents can reduce the viscosity of epoxy systems as well as lowering surface tension allowing ease of handling, facilitating higher filler loading and infiltration of prepregs and fine structural components. Monofunctional silicone compounds with molecular weights high enough to be considered polymers are

sometimes referred to as macromers. Copolymerization of macromers with traditional monomers offers a route to polymers with properties that are usually associated with grafting. Modification of organic polymers with silicon-containing macromers has led to new applications in coatings and pigment vehicles.

Monofunctional Siloxanes

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
	SIG5820.0 (3-GLYCIDOXYPROPYL)BIS(TRIMETHYL- SILOXY)METHYLSILANE C ₁₃ H ₃₂ O ₄ Si ₃ [7422-52-8] TSCA HMIS: 3-1-1-X	336.65 flashpoint: >110°C (>230°F)	96°/0.5	0.910	1.4206
		50g/\$82.00			
	SIG5838.0 (3-GLYCIDOXYPROPYL)PENTAMETHYL- DISILOXANE C ₁₁ H ₂₆ O ₃ Si ₂ [18044-44-5] HMIS: 3-2-0-X	262.50 flashpoint: 83°C (181°F)	81°/1.5	0.915 ²⁵	1.4267
		5.0g/\$54.00			

Monofunctional Siloxane Fluids (Macromers)



Mono-(2,3-Epoxy)Propylether Terminated PolyDimethylsiloxane

CAS: [127947-26-6]

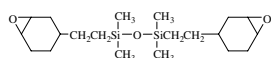
MCR-E11	10-15	1000	1.410	0.96	100g/\$186.00
MCR-E21	100-120	5000	1.408	0.97	100g/\$186.00

Cycloaliphatic Silanes and Silicones

These materials, characterized by a combination of cycloaliphatic and siloxane structures, have outstanding weathering characteristics, controlled release and coefficient of friction and excellent electrical properties. They can be cured either by cationic UV photoinitiators or conventional epoxy hardeners. In cationic UV-cure systems the

cycloaliphatic epoxy silicones combine the properties of reactive diluents with surfactant properties. The release properties can be employed to make parting layers for multilayer films. If high levels of epoxy functional silicones are used in UV cure formulations, cationic photoinitiators with hydrophobic substitution are preferred.

Difunctional Siloxanes



name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
SIB1092.0 BIS[2-(3,4-EPOXYCYCLOHEXYL)ETHYL]- TETRAMETHYLDISILOXANE C ₂₀ H ₃₈ O ₃ Si ₂ viscosity: 40cSt. UV-initiated polymerization with weak acid donors [18724-32-8 TSCA HMIS:2-1-1-X	382.69	(-34°)mp	0.998	1.4758
			TOXICITY- oral rat, LD50: >2000mg/kg flashpoint: 200°C (392°F)	
	25g/\$35.00		100g/\$114.00	

Epoxy cyclohexylethyl Terminated PolyDimethylsiloxanes

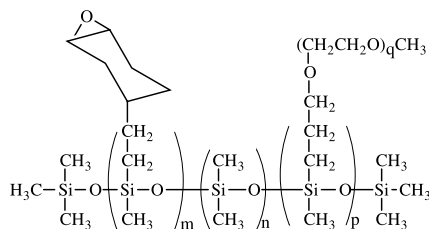
Code	Viscosity	M.W.	Epoxy - Eq/kg	Specific Gravity	Refractive Index	Price/ 100g
DMS-EC13	25-35	900-1100	1.9-2.0	0.99	1.433	\$180.00

Multifunctional Siloxanes

(Epoxy cyclohexylethylMethylsiloxane)-Dimethylsiloxane Copolymers

CAS: [6772-95-2] TSCA

Code	Viscosity	Molecular Weight	Mole % (Epoxy cyclohexylethyl)-MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/ 1 kg	Price/10 kg
ECMS-227	650-800	18,000-20,000	2-3	0.98	1.407	\$19.00	\$114.00	\$799.00
ECMS-327	650-850	18,000-20,000	3-4	0.99	1.409	\$19.00	\$114.00	\$799.00
ECMS-924	300-450	10,000-12,000	8-10	0.97	1.421	\$19.00	\$114.00	\$799.00



(2-3% Epoxy cyclohexylethylMethylsiloxane)(10-15% MethoxypolyalkyleneoxyMethylSiloxane)- (Dimethylsiloxane) Terpolymer

CAS: [69669-36-9] TSCA

Code	Viscosity	Molecular Weight	Epoxy- Eq/kg	Specific Gravity	Refractive Index	Price/100g	Price/ 1 kg	Price/10 kg
EBP-234	4000-5000	25,000-36,000	0.75-0.80	1.03	1.445	\$22.00	\$132.00	\$924.00

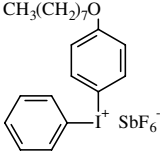
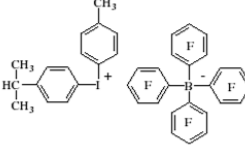
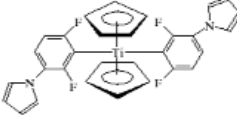
(EpoxypropoxypropylMethylsiloxane)-(Dimethylsiloxane) Copolymers

CAS: [68440-71-1] TSCA

Code	Viscosity	Molecular Weight	Epoxy- Eq/kg	Specific Gravity	Refractive Index	Price/100g	Price/ 1 kg
EMS-622	200-300	7,000-9,000	5-7	0.99	1.412	\$16.00	\$96.00

Photoinitiators

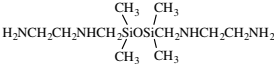
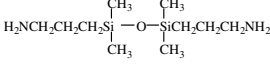
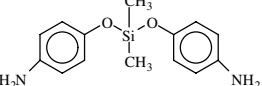
Gelest offers cationic and long-wavelength UV initiators that are hydrophobic and soluble in silicone systems.

	name	MW	bp/mm (mp)	D₄²⁰	n_D²⁰
	OMAN071 p-(OCTYLOXYPHENYL)PHENYLIODONIUM- HEXAFLUOROANTIMONATE C ₂₀ H ₂₆ F ₆ IOSb [121239-74-5] TSCA 3-1-1-X	645.07	(57-8°)mp 25g/\$29.00		
	OMBO037 (p-ISOPROPYLPHENYL)(p-METHYLPHENYL)- IODONIUM TETRAKIS(PENTAFLUOROPHENYL)BORATE C ₄₀ H ₁₈ BF ₂ OI UV max: 235nm UV initiator for cycloaliphatic epoxide functionalized silicones [178233-72-2] TSCA HMIS: 2-1-0-X	1015.7	(120-133°)mp TOXICITY- oral rat, LD50: 1500-2000mg/kg 5.0g/\$48.00		25g/\$192.00
	OMTI014 BIS(2,6-DIFLUORO-3-(1-HYDROPYRROL-1-YL)- PHENYL)TITANOCENE 534.4 (160-170°)mp color: orange-yellow soluble: acetone, methylethylketone, > hexanediol diacrylate, toluene visible (blue-green) light and UV photoinitiator long wavelength photoinitiator with Al- (488nm) and FD Nd/YAG- (532nm) lasers [12051-32-3] TSCA HMIS: 3-2-1 store<5°				10g/\$110.00

Silane and Silicone Hardeners

Difunctional Siloxane Curing Agents

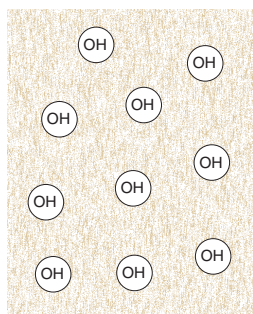
These materials include siloxanes and silicones with diamine, polyamine structures, and dianhydride structures.

	name	MW	bp/mm (mp)	D₄²⁰	n_D²⁰
	SIB1021.5 1,3-BIS(2-AMINOETHYLAMINOMETHYL)- TETRAMETHYLDISILOXANE C ₁₀ H ₃₀ N ₄ O ₂ Si ₂ curing agent for epoxies [83936-41-8] HMIS: 3-2-0-X	278.55	140-5°/2 25g/\$160.00	0.941	
	SIB1024.0 BIS(3-AMINOPROPYL)TETRAMETHYL- DISILOXANE C ₁₀ H ₂₈ N ₂ O ₂ Si ₂ flexibilizing hardener for epoxies, endcapper for aminopropyl terminated silicones [2469-55-8] TSCA HMIS: 3-2-0-X	248.52	132-9°/11 flashpoint: 91°C(196°F) pKb: 5.5 10g/\$25.00	0.897 ²⁵	1.4480 ²⁵
	SIB1022.0 BIS(p-AMINOPHENOXY)DIMETHYLSILANE C ₁₄ H ₁₈ N ₂ O ₂ Si intermediate for polyimides [1223-16-1] HMIS: 3-1-0-X	274.39	195-9°/0.5 (64°)mp flashpoint: >110°C(>230°F) 5.0g/\$45.00		25g/\$180.00

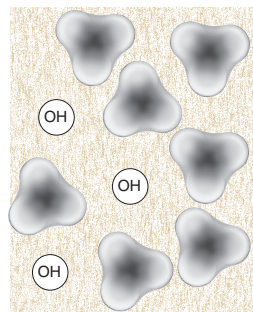
Organosilane-Modified Silica Nanoparticles

A range of silica structures from 20nm to 1 micron have been modified with silanes to reduce hydroxyl content allowing improved dispersion. Other versions have monolayers with isolated secondary amine functionality, providing controlled interac-

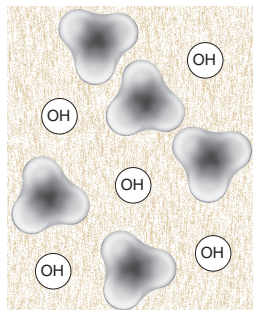
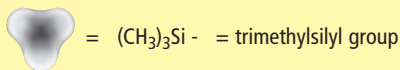
tions with resins. Systems that maintain low levels of hydroxyls have improved electrical properties. Introduction of low levels of secondary amines impart improved mechanical properties particularly in high humidity environments.



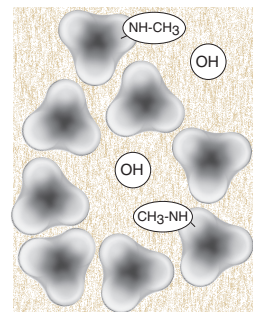
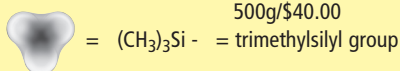
name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
SIS6960.0 SILICON DIOXIDE, amorphous fumed silica SiO ₂ surface area, 200m ² /g isoelectric point: 2.2 [112945-52-5] TSCA HMIS: 2-0-0-X	60.09	(>1600°)mp	2.2	1.46
	TOXICITY- oral rat, LD50: 8160mg/kg ultimate particle size: 0.02μ γc: 44 pH, (4% aqueous slurry): 3.5-4.5 500g/\$15.00 2kg/\$45.00			



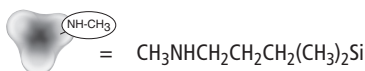
SIS6962.0 SILICON DIOXIDE, amorphous HEXAMETHYLDISILAZANE TREATED fumed silica, HMDZ TREATED SiO ₂ carbon content: 3% approximate ratio: (CH ₃) ₃ Si/HO-Si: 2/1 [68909-20-6] TSCA HMIS: 2-0-0-X	60.09	(>1600°)mp	2.2	1.46
	surface area, 150-200m ² /g ultimate particle size: 0.02μ 500g/\$40.00 2kg/\$128.00			



SIS6962.1M30 SILICON DIOXIDE, amorphous HEXAMETHYLDISILAZANE TREATED fumed silica, HMDZ TREATED SiO ₂ carbon content: 2-3% calculated ratio: (CH ₃) ₃ Si/HO-Si: 1/1 [68909-20-6] TSCA HMIS: 2-0-0-X	60.09	(>1600°)mp	2.2	1.46
	surface area, 150-200m ² /g ultimate particle size: 0.02μ 500g/\$40.00 2kg/\$128.00			



SIS6962.1N30 SILICON DIOXIDE, amorphous CYCLIC AZASILANE/HEXAMETHYLDISILAZANE TREATED fumed silica, N-Methylaminopropylfunctional SiO ₂ carbon content: 4-7% calculated ratio: CH ₃ NHCH ₂ CH ₂ CH ₂ Si/(CH ₃) ₃ Si:HO-Si:1/2/1 [68909-20-6] TSCA HMIS: 2-0-0-X	60.09	(>1600°)mp	2.2	1.46
	surface area, 150-200m ² /g ultimate particle size: 0.02μ 500g/\$84.00			

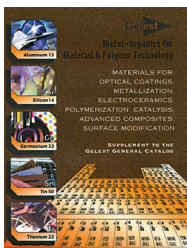


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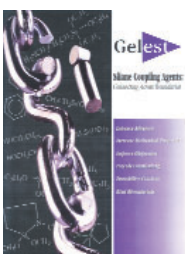
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