



Silanes and Silicones for Epoxy Resins

Modifying Epoxy Resin Performance

Adhesion

Rheology

Optical Properties

Controlled Release

Dielectric Properties

Thermal Stress Relaxation

Low Temperature Properties

- **Silane Coupling Agents**
- **Epoxy Functional Silicones**
- **Silane and Silicone Hardeners**
- **Organosilane Modified Silica**



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.1). 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 preregs 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 20 nm 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
Electrical Properties		
Dielectric Constant	2.4-3.0	3.5-5.0
Chloride, Ionic Impurities	<25ppm	30-1000ppm
Optical		
Color, Gardner	<1	>1
Refractive Index	1.40-1.47	1.57-1.60
Thermal		
Low Temp. (Tg)	<-60°C	~60°C
Thermal Stress Relaxation (piezo)	-2 to -3	-6 to -7

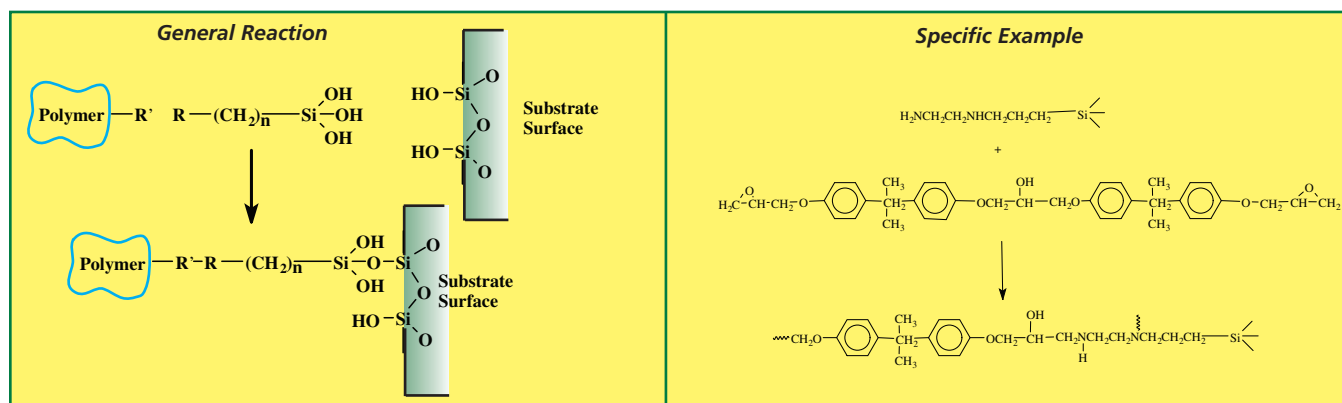
Silane Coupling Agents

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

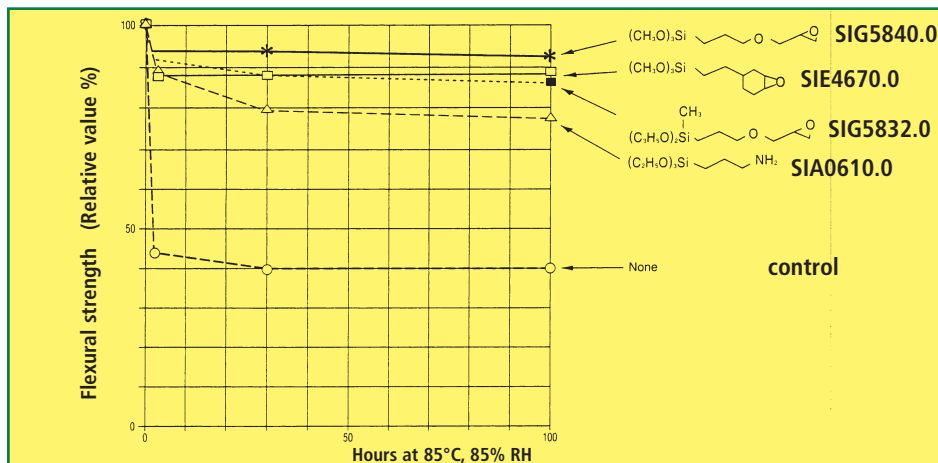
Most commonly, epoxycyclohexyl and glycidoxo functional silanes are used to pretreat fillers or

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



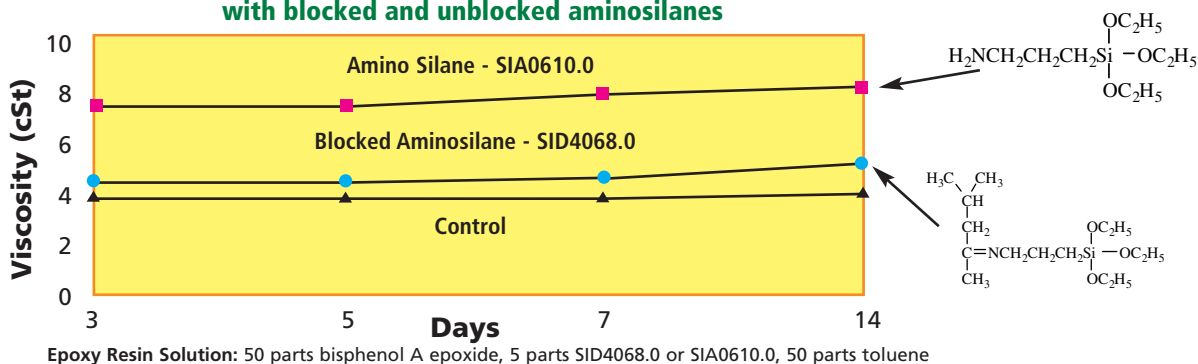
Humidity Resistance vs. Flexural Strength of Epoxy Molding Compounds



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



Primer coatings for metal substrates utilize dipodal silanes to improve wet adhesion. Comparative results for the addition of a non-functional dipodal silane (SIB1817.0bis(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.

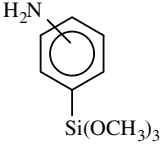
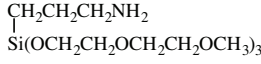
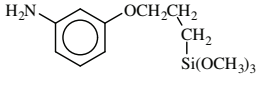
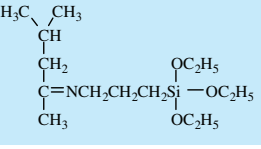
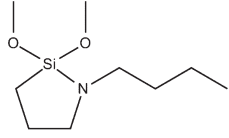
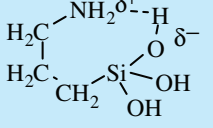
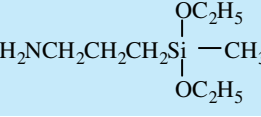
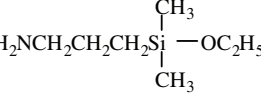
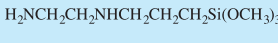
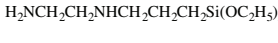
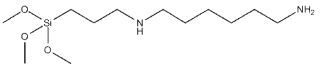
Effect of dipodal -SiCH₂CH₂Si- on the bond strength of a crosslinkable ethylene-vinyl acetate primer formulation

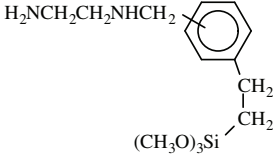
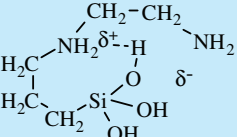
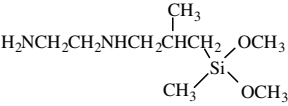
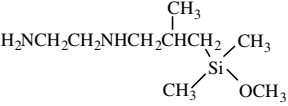
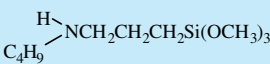
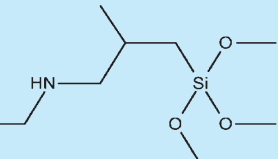
Primer on metal 10% in <i>i</i> -PrOH	Wet adhesion to metals (N/cm)*	
	Titanium	Cold-rolled steel
No silane	Nil	Nil
Methacryloxypropylsilane	0.25	7.0
Methacryloxypropylsilane + 10% dipodal	10.75	28.0
		(cohesive failure)

*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

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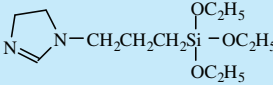
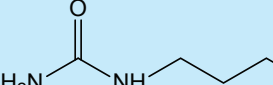
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
	SIA0599.2 AMINOPHENYLTRIMETHOXYSILANE, mixed isomers typically 60-70% para, 30-40% meta C ₉ H ₁₅ NO ₃ Si for pure isomers, see SIA0559.0, SIA0559.1- coupling agent for polyimides used in electronics [33976-43-1] HMIS: 3-1-1-X	213.31	110-4°/0.6	1.19	
	SIA0614.0 3-AMINOPROPYLTRIS(METHOXYETHOXY- 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
	SIA0598.0 3-(m-AMINOPHENOXY)PROPYLTRIMETHOXY- SILANE, tech-95 amber liquid C ₁₂ H ₂₁ NO ₄ Si [55648-29-8] TSCA HMIS: 3-1-1-X	271.39	125-135°/0.5	1.02	1.495
Blocked Monoamine Functional Silanes - Alkoxy					
	SID4068.0 3-(1,3-DIMETHYLBUTYLIDENE)AMINO- PROPYLTRIETHOXYSILANE C ₁₅ H ₃₃ NO ₃ Si coupling agent for epoxy coatings blocked amine - moisture deblocked [116229-43-7] TSCA HMIS: 2-2-1-X	303.52	134°/5 flashpoint: 131°C (268°F)	0.93	1.437 ²⁵
	SIB1932.4 N-n-BUTYL-AZA-2,2-DIMETHOXYSILA- CYCLOPENTANE C ₉ H ₂₁ NO ₂ Si [618914-44-6] TSCA HMIS: 3-2-1-X	203.36	69-71°/3 flashpoint: 85°C (185°F)	0.941	1.438
Monoamine Functional Silanes - Water-borne					
	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	
Monoamine Functional Silanes - Dialkoxy					
	SIA0605.0 3-AMINOPROPYLMETHYLDIETHOXYSILANE C ₈ H ₂₁ NO ₂ Si coupling agent for foundry resins [3179-76-8] TSCA HMIS: 3-2-1-X	191.34	85-8°/8 TOXICITY- oral rat, LD50: 4760mg/kg flashpoint: 85°C(185°F)	0.916	1.4272
Monoamine Functional Silanes - Monoalkoxy					
	SIA0603.0 3-AMINOPROPYLDIMETHYLETHOXYSILANE C ₇ H ₁₉ NOSi Δ Hform: 147.6 kcal/mole [18306-79-1] TSCA HMIS: 3-2-1-X	161.32	78-9°/24 flashpoint: 73°C (163°F)	0.857 ²⁵	1.427 ²⁵
Diamine Functional Silanes - Trialkoxy					
	SIA0591.0 N-(2-AMINOETHYL)-3-AMINOPROPYLTRI- METHOXYSILANE N-[3-(TRIMETHOXY-SILYL)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	140°/15	1.019 ²⁵	1.450 ²⁵
	SIA0590.5 N-(2-AMINOETHYL)-3-AMINOPROPYLTRI- ETHOXYSILANE, 95% C ₁₁ H ₂₈ N ₂ O ₃ Si [5089-72-5] TSCA HMIS: 3-1-1-X	264.55	156°/15 flashpoint: 148°C (298°F)	0.994	1.4367 ²⁵
	SIA0594.0 N-(6-AMINOHEXYL)AMINOPROPYLTRIMETHOXYSILANE, 95% C ₁₂ H ₃₀ N ₂ O ₃ Si [51895-58-0] HMIS: 3-1-1-X	278.47	160-5°/0.15 flashpoint: 110°C (230°F)	1.11	1.4501

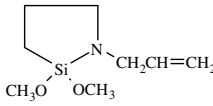
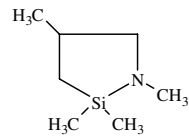
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
$\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}(\text{CH}_2)_{11}\text{Si}(\text{OCH}_3)_3$	SIA0595.0 N-(2-AMINOETHYL)-11-AMINOUNDECYL- TRIMETHOXYSILANE $\text{C}_{16}\text{H}_{38}\text{N}_2\text{O}_3\text{Si}$ coupling agent with extended spacer-group for remote substrate binding HMIS: 3-1-1-X	334.57	155-9°/0.4	0.873 ²⁵	1.4515
	SIA0588.0 (AMINOETHYLAMINOMETHYL)PHENETHYL- TRIMETHOXYSILANE, 90% mixed m,p isomers $\text{C}_{14}\text{H}_{26}\text{N}_2\text{O}_3\text{Si}$ coupling agent for polyimides [74113-77-2] TSCA HMIS: 3-1-1-X	298.46	126-30°/0.2 flashpoint: > 110°C(>230°F)	1.02	1.5083
$\text{H}_2\text{N}(\text{CH}_2\text{CHO})_2\text{CH}_2\text{CHNHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$	SIA0599.4 N-3-[(AMINO(POLYPROPYLENOXY))AMINO- PROPYLTRIMETHOXYSILANE, 60-65% coupling agent with film-forming- capability HMIS: 2-2-1-X	337-435	3-4 propyleneoxy units	0.984	1.4508
Diamine Functional Silanes - Water-borne					
	SIA0590.0 N-(2-AMINOETHYL)-3-AMINOPROPYL- SILANETRIOL, 25% in water mainly oligomers $\text{C}_5\text{H}_{17}\text{N}_2\text{O}_3\text{Si}$ internal hydrogen bonding stabilizes solution [68400-09-9] TSCA HMIS: 2-0-0-X	180.28	flashpoint: >110°C(230°F) pH: 10.0-10.5	1.00	
$\text{H}_2\text{NCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$	SIA0589.0 N-(2-AMINOETHYL)-3-AMINOPROPYLMETHYL- DIMETHOXYSILANE $\text{C}_8\text{H}_{22}\text{N}_2\text{O}_2\text{Si}$ [3069-29-2] TSCA HMIS: 3-1-1-X	206.36	265° flashpoint: 90°C(194°F) auto-ignition temp: 280°C specific wetting surface: 380 m²/g	0.975 ²⁵	1.4447 ²⁵
	SIA0587.5 N-(2-AMINOETHYL)-3-AMINOISOBUTYL- METHYLDIMETHOXYSILANE, 95% $\text{C}_9\text{H}_{24}\text{N}_2\text{O}_2\text{Si}$ [23410-40-4] TSCA HMIS: 3-2-1-X	220.39	131°/15 flashpoint: 96°C(205°F)	0.960	1.4518
	SIA0587.2 (AMINOETHYLAMINO)-3-ISOBUTYLDI- METHYLMETHOXYSILANE, 95% $\text{C}_9\text{H}_{24}\text{N}_2\text{O}_2\text{Si}$ [31024-49-4] HMIS: 3-2-1-X	204.39	85-9°/2	0.900 ²⁵	1.4513 ²⁵
Triamine Functional Silanes					
$\text{H}_2\text{NCH}_2\text{CH}_2\text{HNCH}_2\text{CH}_2\text{NH}_2$	SIT8398.0 (3-TRIMETHOXYSILYL)PROPYL)DIETHYLENE- TRIAMINE, 95% $\text{C}_{10}\text{H}_{27}\text{N}_3\text{O}_3\text{Si}$ hardener, coupling agent for epoxies [35141-30-1] TSCA HMIS: 3-1-1-X	265.43	114-8°/2 flashpoint: 137°C(279°F) γ of treated surface: 37.5 dynes/cm	1.030	1.4590
	SIB1932.2 n-BUTYLAMINOPROPYLTRIMETHOXYSILANE $\text{C}_{10}\text{H}_{25}\text{NO}_3\text{Si}$ coupling agent for urethane coatings [31024-56-3] TSCA HMIS: 2-2-1-X	235.40	102°/3.5 flashpoint: 110°C (230°F)	0.947	1.4246 ²⁵
	SIE4886.0 N-ETHYLAMINOISOBUTYLTRIMETHOXYSILANE $\text{C}_9\text{H}_{23}\text{NO}_3\text{Si}$ adhesion promoter for polyurethane coatings [227085-51-0] TSCA HMIS: 3-2-1-X	221.37	95°/10 flashpoint: 91°C(196°F)	0.952 ²⁵	1.4234

Commercial

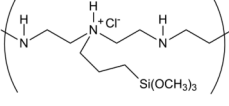
Commercial

	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 flashpoint: 82°C(179°F) γc of treated surface: 31 dynes/cm	106°/30	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 flashpoint: 165°C(329°F) specific wetting surface: 307m ² /g	132-5°/0.3	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] TSCA HMIS: 3-2-1-X	219.36 flashpoint: 88°C(190°F)	106-9°/25	0.989 ²⁵	1.4990 ²⁵	
	SIP6723.7 N-PHENYLAMINOMETHYLTRIETHOXY-SILANE 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-DIMETHOXY-SILANE C ₇ H ₁₉ NO ₂ Si [31024-35-8] HMIS: 3-2-1-X	177.32 flashpoint: 80°C(176°F)	93°/25	0.9173 ²⁵	1.4224 ²⁵	
Dipodal Amine Functional Silanes						
	SIB1833.0 BIS(TRIMETHOXSILYLPROPYL)AMINE, 95% C ₁₂ H ₃₁ NO ₆ Si ₂ dipodal coupling agent [82985-35-1] TSCA HMIS: 3-1-1-X	341.56 flashpoint: 113°C (235°)	152°/4	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(TRIETHOXSILYLPROPYL)AMINE, 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 flashpoint: >140°C (284°F)	160°/0.6	0.97		
	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(METHYLDIETHOXSILYLPROPYL)AMINE 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	
	SIA0587.6 1-[3-(2-AMINOETHYL)-3-AMINOISOBUTYL]-1,1,3,3,3-PENTAETHOXY-1,3-DISILAPROPANE, 95% C ₁₇ H ₄₂ N ₂ O ₅ Si ₂ [1621184-23-3] HMIS: 3-1-1-X	410.70	130-140°/0.5	0.990		

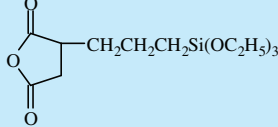
	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	Specialty Amine Functional Silanes					
	SIT8187.5 N-(3-TRIETHOXSILYLPROPYL)- 4,5-DIHYDROIMIDAZOLE 3-(2-IMIDAZOLIN-1-YL)PROPYLTRIETHOXSILANE C ₁₂ H ₂₆ N ₂ O ₃ Si coupling agent for elevated temperature cure epoxy resins. [58068-97-6] TSCA HMIS: 2-1-1-X	274.43 flashpoint: >110°C (>230°F)	134°/2	1.005	1.452	Commercial
	SIU9055.0 UREIDOPROPYLTRIETHOXSILANE, 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: 2-4-1-X	264.40 flashpoint: 14°C (58°F)	(-97°)mp	0.92	1.386	
	SIU9058.0 UREIDOPROPYLTRIMETHOXSILANE C ₇ H ₁₈ N ₂ O ₄ Si [23843-64-3] TSCA HMIS: 2-3-1-X	222.32 flashpoint: 99°C (210°F)	217-225°	1.150	1.386 ²⁵	

	Cyclic Azasilanes					
	SIA0415.0 N-ALLYL-AZA-2,2-DIMETHOXSILACYCLOPENTANE C ₈ H ₁₇ NO ₂ Si HMIS: 3-3-1-X	187.31	52-4°/3			
	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	
	SIB1932.4 N-n-BUTYL-AZA-2,2-DIMETHOXSILACYCLOPENTANE C ₉ H ₂₁ NO ₂ Si [618914-44-6] TSCA HMIS: 3-2-1-X	203.36 flashpoint: 85°C (185°F)	69-71°/3	0.941	1.438	
	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			
	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 flashpoint: 14°C (58°F)	137°	0.813	1.4308	

Polyamine Silanes

	SSP-060 TRIMETHOXSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol viscosity: 125-175 cSt. ~20% of nitrogens substituted [136856-91-2]/[37251-86-8] TSCA HMIS: 2-4-1-X	0.92 flashpoint: 12°C (54°F)				
	SSP-065 DIMETHOXSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol viscosity: 100-200 cSt. ~20% of nitrogens substituted [125441-88-5] TSCA HMIS: 2-4-1-X	0.92 flashpoint: 12°C (54°F)				

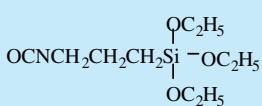
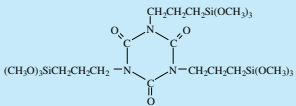
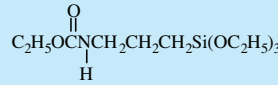
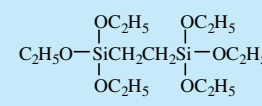
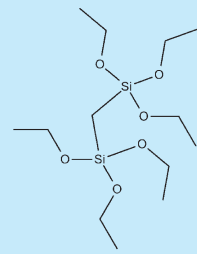
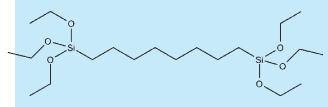
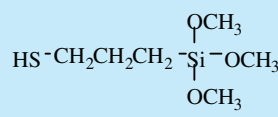
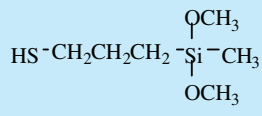
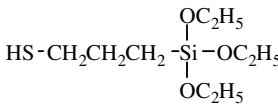
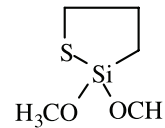
Anhydride Functional Silane

	Anhydride Functional Silane					
	SIT8192.6 3-(TRIETHOXSILYL)PROPYLSUCCINIC ANHYDRIDE, 95% 3-(TRIETHOXSILYLPROPYL)DIHYDRO-3,5-FURANDIONE C ₁₃ H ₂₄ O ₆ Si hardener, coupling agent for epoxy resins acetic acid-catalyzed hydrolysis yields succinic acid derivative. [93642-68-3] TSCA HMIS: 2-1-1-X	304.41 flashpoint: >100°C (>212°F)	135°/0.2	1.070	1.4405	Commercial

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 flashpoint: 104°C(220°F)	114-7°/0.4	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.	246.38 flashpoint: 146°C(295°F) γc of treated surface: 39.5 dynes/cm specific wetting surface: 317 m ² /g	95-7°/0.25	1.065	1.449	
	[3388-04-3] TSCA HMIS: 3-1-1-X	100g	2.0kg	18kg		
	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 flashpoint: 120°/2 (<-70°)mp TOXICITY- oral rat, LD50: 8,400 mg/kg	120°/2 (<-70°)mp	1.070	1.4290	
	SIG5839.0 (3-GLYCIDOXYPROPYL)TRIETHOXSILANE C ₁₂ H ₂₆ O ₅ Si viscosity: 3 cSt [2602-34-8] TSCA HMIS:3-2-1-X	278.42 flashpoint: 144°C(291°F)	124°/3	1.00	1.425	
		25g	100g	2kg		
	SIE4675.0 5,6-EPOXYHEXYLTRIETHOXSILANE C ₁₂ H ₂₆ O ₄ Si [86138-01-4] HMIS: 3-2-1-X	262.42 flashpoint: 99°C(210°F)	115-9°/1.5	0.960 ²⁵	1.4254 ²⁵	Commercial
	SIG5810.0 8-GLYCIDOXYOCTYLTRIMETHOXSILANE, 95% C ₁₄ H ₃₀ O ₅ Si viscosity: 6-7 cSt [1239602-38-0] HMIS:3-2-1-X	306.47 Adhesion promoter with improved slubility in acrylic resins				
Epoxy Functional Silanes - Dialkoxy						
	SIG5832.0 (3-GLYCIDOXYPROPYL)METHYLDIETHOXY-SILANE C ₁₁ H ₂₄ O ₄ Si viscosity: 3.0 cSt [2897-60-1] TSCA HMIS: 2-1-1-X	248.39 flashpoint: 122°C(252°F)	122-6°/5	0.978 ²⁵	1.431	Commercial
	SIG5836.0 (3-GLYCIDOXYPROPYL)METHYLDIMETHOXSILANE 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 flashpoint: 105°C (221°F)	100°/4	1.02	1.431 ²⁵	
	SIE4666.0 2-(3,4-EPOXYCYCLOHEXYL)ETHYLMETHYLDIEHOXSILANE C ₁₃ H ₂₆ O ₃ Si UV polymerizeable monomer [148-35-3] HMIS: 2-2-1-X	258.43	114-7°/1	0.976 ²⁵	1.4248 ²⁵	Commercial
	Epoxy Functional Silanes - Monoalkoxy					
	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 flashpoint: 87°C(189°F)	100°/3	0.950	1.4337 ²⁵	
		10g		50g		
Dipodal Epoxy Functional Silanes						
	SIG5837.0 1-(3-GLYCIDOXYPROPYL)-1,1,3,3,3-PENTAETHOXY-1,3-DISILAPROPANE, 95% C ₁₇ H ₃₈ O ₇ Si ₂ Forms hydrolysis resistant films [1621184-20-0] HMIS: 3-2-1-X	410.65	125-9°/0.1	1.003		Commercial
			2.5g			

Isocyanate and Masked Isocyanate Functional Silanes

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰	
	Isocyanate Functional Silanes - Trialkoxy					
	SII6455.0 3-ISOCYANATOPROPYLTRIETHOXYSIANE, 95% C ₁₀ H ₂₁ NO ₄ Si coupling agent for urethanes, polyols, amines. [24801-88-5] TSCA HMIS: 3-2-1-X	247.37 flashpoint: 80°C(176°F)	130°/20	0.99	1.419	
	25g	100g	2.0kg			
	Masked Isocyanate Silanes					
	SIT8717.0 TRIS(3-TRIMETHOXSILYLPROPYL)ISOCYANURATE, 95% C ₂₁ H ₄₅ N ₃ O ₁₂ Si ₃ [26115-70-8] TSCA HMIS: 2-1-1-X	615.86 flashpoint: 102°C(216°F)		1.170	1.4610	
	25g/	100g	2.0kg			
	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 flashpoint: 95°C(203°F)	124-6°/0.5	1.015	1.4321	
	25g	100g	2kg			
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/primer 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. [16068-37-4] TSCA-S HMIS: 3-1-1-X	354.59 flashpoint: 107°C(225°F) vapor pressure, 150°: 10mm TOXICITY - oral rat, LD50: 161mg/kg	96°/0.3	0.957	1.4052	
	25g	100g	2.0kg			
	SIB1821.0 BIS(TRIETHOXSILYL)METHANE 4,4,6,6-TETRAETHOXY-3,7-DIOXA-4,6-DISILANONANE C ₁₃ H ₃₂ O ₆ Si ₂ Intermediate for sol-gel coatings, hybrid inorganic-organic polymers Forms methylene-bridged mesoporous structures. ¹ Forms modified silica membranes that separate propylene/propane mixtures. ² 1. Zhang, W et al. Chem. Mater. 2005, 17, 6407. 2. Kanezashi, M. et al. J. Membr. Sci. 2012, 415-416, 478. [118418-72-9] TSCA-L HMIS: 3-2-1-X	340.56	114-5°/3.5	0.9741	1.4098	
	25g	100g				
	SIB1824.0 1,8-BIS(TRIETHOXSILYL)OCTANE C ₂₀ H ₄₆ O ₆ Si ₂ Employed in sol-gel synthesis of mesoporous structures Crosslinker for moisture-cure silicone RTVs with improved environmental resistance Sol-gels of α,ω-bis(trialkoxysilyl)alkanes reported. ¹ 1. Loy, D.A. et al. J. Am. Chem. Soc. 1999, 121, 5413. [52217-60-4] TSCA HMIS: 2-2-1-X	438.76	172-5°/0.75	0.926	1.4240	
	25g	100g				
Sulfur Functional Silanes						
	SIM6476.0 3-MERCAPTOPROPYLTRIMETHOXYSIANE 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 [4420-74-0] TSCA HMIS: 3-2-1-X	196.34 TOXICITY- oral rat, LD50: 2380mg/kg flashpoint: 96°C(205°F) primary irritation index: 0.19	93°/40	1.051 ²⁵	1.4502 ²⁵	
	100g	2kg	18kg			
	SIM6474.0 3-MERCAPTOPROPYLMETHYLDIMETHOXYSIANE C ₆ H ₁₆ O ₃ SSi intermediate for silicones in thiol-ene UV cure systems [31001-77-1] TSCA HMIS: 3-2-1-X	180.34 flashpoint: 93°C (199°F)	96°/30	1.00	1.4502	
	100g	2kg	18kg			
	SIM6475.0 3-MERCAPTOPROPYLTRIETHOXYSIANE, 95% C ₉ H ₂₂ O ₃ SSi TOXICITY- oral rat, LD50: > 2000mg/kg [14814-09-6] TSCA HMIS: 2-2-1-X	238.42 flashpoint: 88°C(190°F)	210°	0.9325	1.4331	
	25g	100g	2kg			
	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 [26903-85-5] HMIS: 3-3-1-X	164.29	57-8°/7	1.094		
	25g					

Commercial

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 epoxycyclohexyl 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.

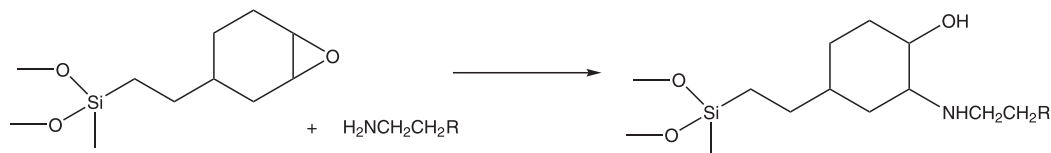
The compatibility of epoxy functional silicones with conventional epoxies varies. In simple unfilled systems, total solubility is required. For filled systems, it is often desirable to consider systems that are miscible but have only limited solubility since microphase separation can allow a mechanism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

Epoxysilicones 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	Epoxy Type		
	Bisphenol	Polyglycol	Cycloaliphatic
SIB 1092.0	miscible	soluble	soluble
SIB 1110.0	soluble	soluble	soluble
SIB 1115.0	soluble	soluble	soluble
SIG5820.0	insoluble	insoluble	soluble
MCR-E11	insoluble	insoluble	insoluble
MCS-E15	insoluble	insoluble	insoluble
DMS-E09	soluble	soluble	soluble
DMS-E11	insoluble	miscible	miscible
PMS-E11	soluble	soluble	soluble
ECMS-127	insoluble	insoluble	insoluble
EMS-622	insoluble	miscible	insoluble

(10% silicone 90% epoxy)

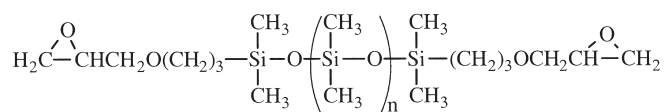


A UV initiator for cycloaliphatic epoxides is OMBO037 described in the Catalyst Section (p. 14). Epoxy functional siloxane copolymers with polyalkyleneoxide functionality provide hydrophilic textile finishes.

Difunctional Low MW 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 TOXICITY- oral rat, LD50: >2000mg/kg flashpoint: 200°C (392°F)	(-34°)mp	0.998	1.4758	
		25g		100g		
	SIB1110.0 1,5-BIS(2-(GLYCIDOXYPROPYL)-3-PHENYL- 1,1,3,3,5-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			
	SIB1115.0 1,3-BIS(2-(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 flashpoint: 110°C (230°F) viscosity: 10-12 cSt.	184-7°/2 (-46 to -50°)mp	0.996	1.452	Commercial
		25g	100g	2kg		

Difunctional Polymeric Siloxanes



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		
DMS-E11	12-18	500-600	1.9-2.2	0.98	1.419		
DMS-E12	20-35	1000-1400	1.6-1.9	0.98	1.417		
DMS-E21	100-140	4500-5500	0.45-3.5	0.98	1.408		

Epoxycyclohexylethyl Terminated PolyDimethylsiloxanes

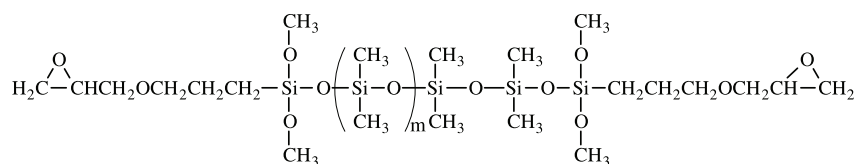
[102782-98-9] TSCA

DMS-EC13	25-35	900-1100	1.9-2.0	0.99	1.433		
DMS-EC17	60-80	3200-3600	0.5-0.7	0.98	1.412		

Epoxypropoxypropyl Terminated PolyPhenylMethylsiloxanes

[102782-98-9] TSCA

PMS-E11	15-30	500-600	3.6-4.0	1.01	1.475		
PMS-E15	30-50	1200-1500	1.0-1.7	1.01	1.490		

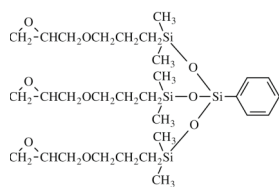


Epoxypropoxypropyl)dimethoxysilyl Terminated PolyDimethylsiloxanes

[188958-73-8] TSCA

DMS-EX21	80-120	3500-4000	0.48-0.5	0.98	1.408		
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Multifunctional Low MW Siloxanes



name

SIT8715.6
TRIS(GLYCIDOPROPYLDIMETHYLSILOXY)-
PHENYLSILANE, 95% amber liquid
C₃₀H₅₆O₉Si₄
[90393-83-2] HMIS: 2-1-0-X

MW

673.11
viscosity: 30-35 cSt.

bp/mm (mp)

(-73°)mp

D₄²⁰

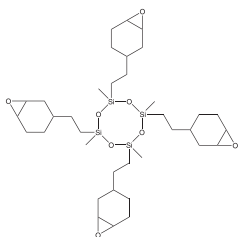
1.05

n_D²⁰

1.4742²⁵

25g

100g



SIT7281.5

TETRAKIS[(EPOXYCYCLOHEXYL)ETHYL]TETRAMETHYL-
CYCLOTETRASILOXANE tech-95

C₃₆H₆₄O₈Si₄
Polymerized by cationic photoinitiators or anhydrides
[121225-98-7] HMIS: 2-2-1-X

737.23

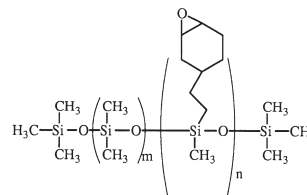
viscosity: 300 cSt.

1.14

1.487

25g

Multifunctional Polymeric Siloxanes



(Epoxy cyclohexylethylMethylsiloxane) Dimethylsiloxane Copolymers

CAS: [6772-95-2] TSCA

Code	Viscosity	Molecular Weight	Mole % (Epoxy cyclohexylethylMethylSiloxane)	Specific Gravity	Refractive Index	Price 100g	Price 1 kg	Price 10 kg
ECMS-127	500-1200	18,000-15,000	1-2	0.98	1.407			
ECMS-227	650-800	18,000-20,000	2-3	0.98	1.407			
ECMS-327	650-850	18,000-20,000	3-4	0.99	1.409			
ECMS-924	300-450	10,000-12,000	8-10	0.97	1.421			

(EpoxypropoxypropylMethylsiloxane)-(Dimethylsiloxane) Copolymers

CAS: [68440-71-1] TSCA

EMS-622	200-300	7,000-9,000	5-7	0.99	1.412			
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(2-3% Epoxy cyclohexylethylMethylsiloxane)(10-15% MethoxypolyalkyleneoxyMethylSiloxane)-(Dimethylsiloxane) Terpolymer

CAS: [69669-36-9] TSCA

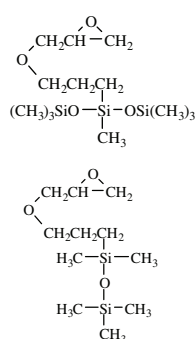
EBP-234	4000-5000	25,000-36,000	0.75-0.80	1.03	1.445			
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Silicone Resin Modifiers - Monofunctional Silicones

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 preregs 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 Low MW Siloxanes



name

SIG5820.0
(3-GLYCIDOXYPROPYL)BIS(TRIMETHYL-SILOXY)METHYLSILANE
C₁₃H₃₂O₄Si₃
[7422-52-8] TSCA HMIS: 3-1-1-X

MW

336.65

bp/mm (mp)

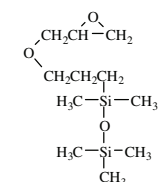
96°/0.5
flashpoint: >110°C (>230°F)

D₄²⁰

0.910

n_D²⁰

1.4206



name

SIG5838.0
(3-GLYCIDOXYPROPYL)PENTAMETHYL-DISILOXANE
C₁₁H₂₆O₃Si₂
[18044-44-5] HMIS: 3-2-0-X

MW

262.50

81°/1.5
flashpoint: 83°C (181°F)

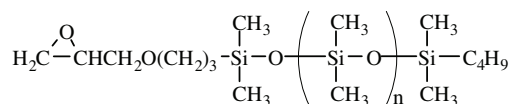
D₄²⁰

0.915²⁵

1.4267

5.0g

Monofunctional Polymeric Siloxanes (Macromers)



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

CAS: [127947-26-6] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g
MCR-E11	10-15	1000	1.420	0.96	
MCR-E21	100-120	5000	1.408	0.97	

Mono-(2,3-Epoxy)Propylether Functional PolyDimethylsiloxanes-symmetric

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
MCS-E15	45-55	800-900	1.398	1.09		

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 <chem>C20H38O3Si2</chem> viscosity: 40cSt. UV-initiated polymerization with weak acid donors [18724-32-8 TSCA HMIS: 2-1-1-X]	382.69 TOXICITY- oral rat, LD50: >2000mg/kg flashpoint: 200°C (392°F)	(-34°)mp	0.998	1.4758
	25g		100g	

Epoxycyclohexylethyl Terminated PolyDimethylsiloxanes

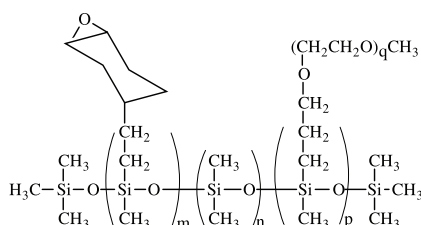
Code	Viscosity	M.W.	Epoxy - Eq/kg	Specific Gravity	Refractive Index	Price/ 100g
DMS-EC13	25-35	900-1100	1.9-2.0	0.99	1.433	
DMS-EC17	60-80	3200-3600	0.5-0.7	0.98	1.412	
DMS-EC31	800-1200	40,000	0.04-0.06	0.98	1.410	

Multifunctional Siloxanes

(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-127	500-1200	12,000-15,000	1-2	0.98	1.407			
ECMS-227	650-800	18,000-20,000	2-3	0.98	1.407			
ECMS-327	650-850	18,000-20,000	3-4	0.99	1.409			
ECMS-924	300-450	10,000-12,000	8-10	0.97	1.421			



(2-3% EpoxycyclohexylethylMethylsiloxane)(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			

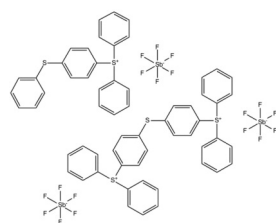
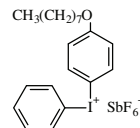
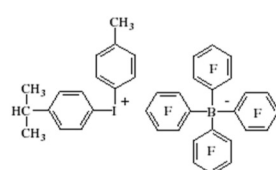
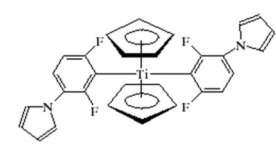
(EpoxypropoxypropylMethylsiloxane)-(Dimethylsiloxane) Copolymers

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		

Photoinitiators

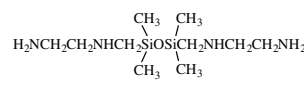
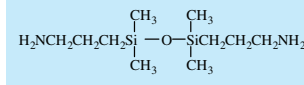
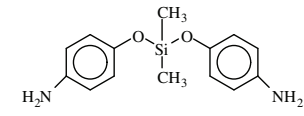
Gelest offers cationic and long-wavelength UV initiators that are hydrophobic and soluble in silicone systems.

	name	MW	bp/mm (mp)	D ₄ ²⁰	n _D ²⁰
	OMAN076 (THOPHENOXYPHENYL)DIPHENYLSULFONIUMHEXAFLUOROANTIMONATE-BIS(BIS(DIP[HENYSULFONIUM]DIPHENYLTHIO)ETHER HEXAFLUOROANTIMONATE BLEND, 50% in propylene carbonate C ₂₄ H ₁₉ F ₆ S ₂ SB AMBER LIQUID UV initiator for cationic polymerizations, e.g. cycloaliphatic epoxides [71449-78-0]/[89452-37-9] TSCA HMIS: 3-1-1-X	607.28	(145°)Cfp	1.40	
	OMAN071 p-(OCTYLOXYPHENYL)PHENYL IODONIUM- HEXAFLUOROANTIMONATE C ₂₀ H ₂₆ F ₆ IOSb [121239-74-5] TSCA 3-1-1-X	645.07	(57-8°)mp		
	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		
	OMTI014 BIS(2,6-DIFLUORO-3-(1-HYDROXYRROL-1-YL)- PHENYL)TITANOCENE 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°	534.4	(160-170°)mp color: orange-yellow		
					

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)	D ₄ ²⁰	n _D ²⁰
	SIB1021.5 1,3-BIS(2-AMINOETHYLAMINOMETHYL)- TETRAMETHYLDISILOXANE C ₁₀ H ₃₀ N ₄ OSi ₂ curing agent for epoxies [83936-41-8] HMIS: 3-2-0-X	278.55	140-5°/2	0.941	
	SIB1024.0 BIS(3-AMINOPROPYL)TETRAMETHYL- DISILOXANE C ₁₀ H ₂₈ N ₂ OSi 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	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)		
					

Commercial

CAS: [106214-84-0] TSCA

Reduced Volatility Grade

*total volatiles, 4 hours @ 150°C: 2.0 wt% maximum



CAS: [254891-17-3] TSCA

Multifunctional Siloxane Curing Agents

CAS: [99363-37-8] TSCA

CAS: [71750-79-3] TSCA

CAS: [106842-44-8] TSCA
$$\text{O}=\text{C}(\text{O})\text{C}(\text{O})\text{CH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{CH}_3)_2\text{O}\left(\text{Si}(\text{CH}_3)_2\text{O}\right)_n\text{Si}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C}(\text{O})\text{C}(\text{O})\text{O}$$

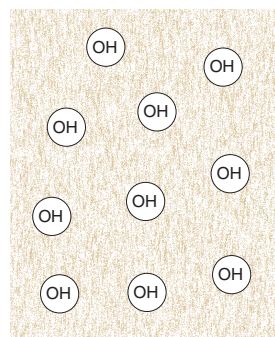
Anhydride functional silicones offer outstanding color stability as curing agents for epoxy resins.

Code	Viscosity	Molecular Weight		Specific Gravity	Refractive Index	Price/25g	Price/100g
DMS-Z21	75-100	600-800		1.06	1.436		

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

interactions 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

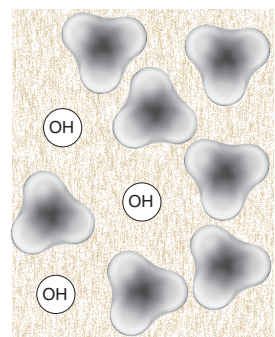
bp/mm (mp)

D₄²⁰

n_D²⁰

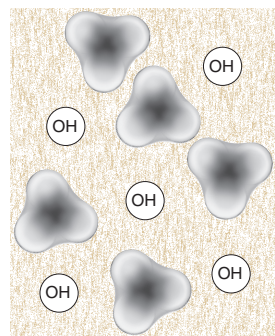
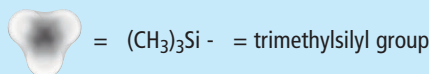
SIS6960.0
SILICON DIOXIDE, amorphous
fumed silica
SiO₂
surface area, 200m²/g
isoelectric point: 2.2
[112945-52-5] TSCA HMIS: 2-0-0-X

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 2kg



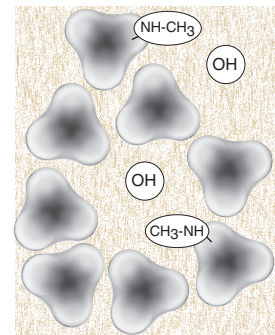
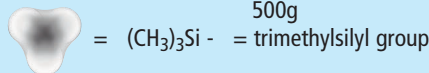
SIS6962.0
SILICON DIOXIDE, amorphous
HEXAMETHYLDISILAZANE TREATED
fumed silica, HMDZ TREATED
SiO₂
carbon content: 3%
approximate ratio: (CH₃)₃Si/HO-Si: 2/1
[68909-20-6] TSCA HMIS: 2-0-0-X

60.09 (>1600°)mp 2.2 1.46
surface area, 150-200m²/g
ultimate particle size: 0.02μ
500g 2kg



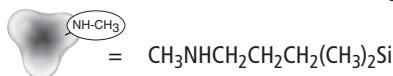
SIS6962.1M30
SILICON DIOXIDE, amorphous
HEXAMETHYLDISILAZANE TREATED
fumed silica, HMDZ TREATED
SiO₂
carbon content: 2-3%
calculated ratio: (CH₃)₃Si/HO-Si: 1/1
[68909-20-6] TSCA HMIS: 2-0-0-X

60.09 (>1600°)mp 2.2 1.46
surface area, 150-200m²/g
ultimate particle size: 0.02μ
500g 2kg



SIS6962.1N30
SILICON DIOXIDE, amorphous
CYCLIC AZASILANE/HEXAMETHYLDISILAZANE TREATED
fumed silica, N-Methylaminopropylfunctional
SiO₂
carbon content: 4-7%
calculated ratio: CH₃NHCH₂CH₂CH₂Si/(CH₃)₃Si:HO-Si:1/2/1
[68909-20-6] TSCA HMIS: 2-0-0-X

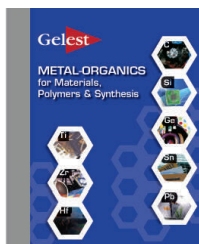
60.09 (>1600°)mp 2.2 1.46
surface area, 150-200m²/g
ultimate particle size: 0.02μ
500g



Commercial

Gelest provides custom surface treatment services. We can handle a wide range of materials with special process considerations including: inert atmospheres, highly flammable and corrosive treatments, as well as thermal and vacuum drying.

Related Gelest Product Literature



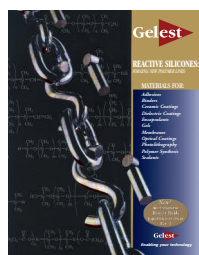
Metal-Organics for Material & Polymer Technology

The latest Gelest handbook provides many new compounds with applications on optical, microelectronic, diagnostic and materials applications. Highly referenced listings and device applications are presented.



Silicon Compounds: Silanes and Silicones

Detailed chemical properties and reference articles for compounds. The Handbook of silane and silicone chemistry includes scholarly reviews as well as detailed information on various applications.



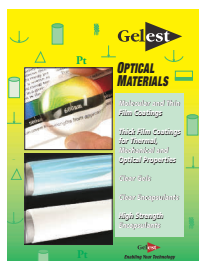
Reactive Silicones: Forging New Polymer Links

The brochure describes reactive silicones that can be formulated into coatings, membranes, cured rubbers and adhesives for mechanical, optical, electronic and ceramic applications. Information on reactions and cures of silicones as well as physical properties shortens product development time for chemists and engineers.



Silicone Fluids - Stable, Inert Media

Design and Engineering properties for conventional silicone fluids as well as thermal, fluorosilicone, hydrophilic and low temperature grades are presented in selection guide. The brochure provides data on thermal, rheological, electrical, mechanical and optical properties for silicones. Silicone fluids are available in viscosities ranging from 0.65 to 2,500,000 cSt.



Optical Materials: Optical Materials

This brochure showcases a wide range of optical materials. Product offerings include optical grade silicone encapsulants with refractive indices ranging from 1.39 to 1.50, optical grade hard resin coatings with refractive indices ranging from 1.55-1.64, refractive index matching fluids, and UV-active/Fluorescent molecular coatings.



Silane Coupling Agents

Silane coupling agents enhance adhesion, increase mechanical properties of composites, improve dispersion of pigments and fillers and immobilize catalysts and biomaterials. This brochure describes chemistry, techniques, applications and physical properties of silane coupling agents.



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Enabling Your Technology

