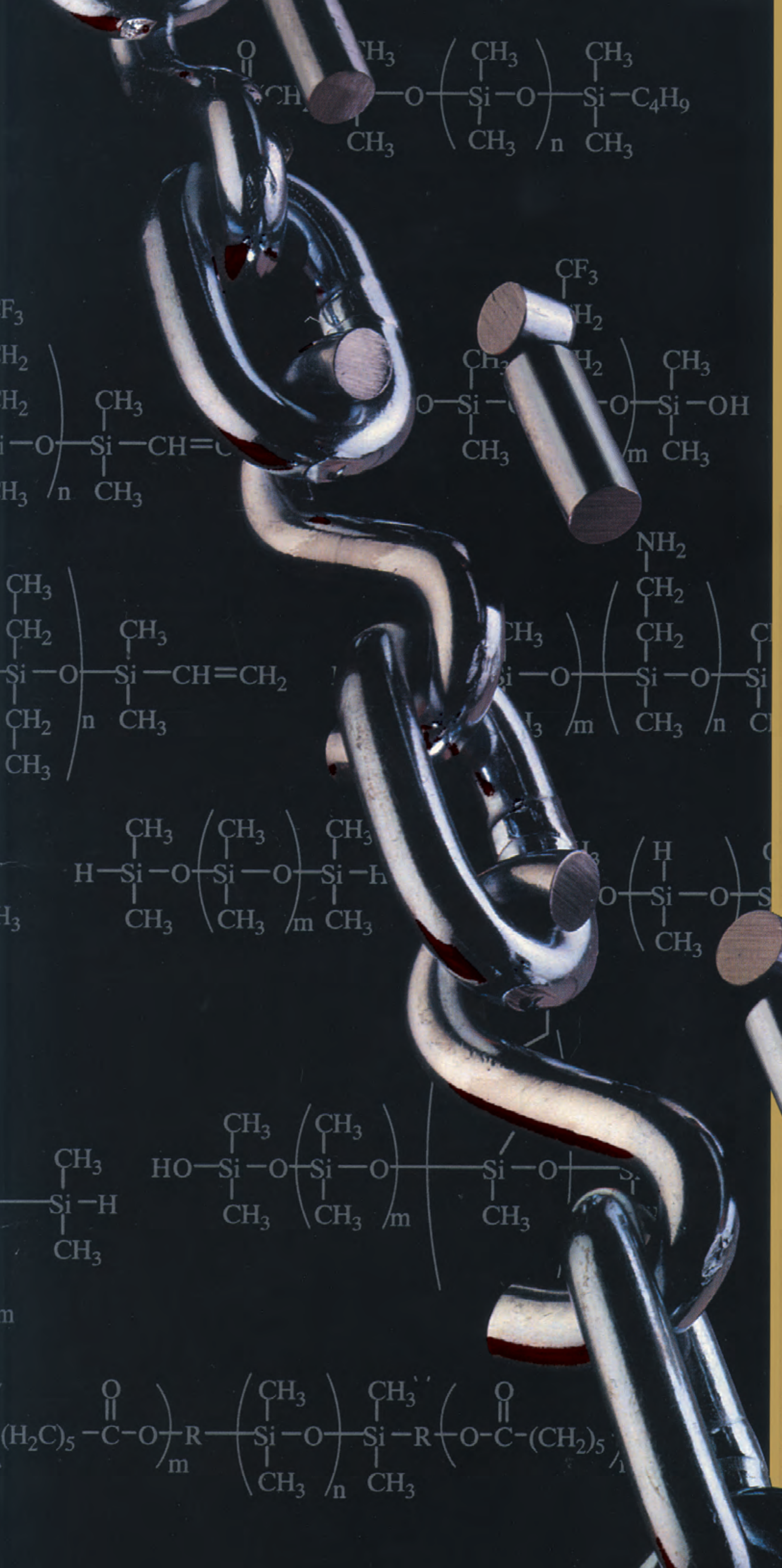

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Gelest Inc.
11 East Steel Rd.
Morrisville, PA 19067 USA
Phone (United States): (215) 547-1015
Phone (United Kingdom): 44(0)1622 741115
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Reactive Silicones: Forging New Polymer Links
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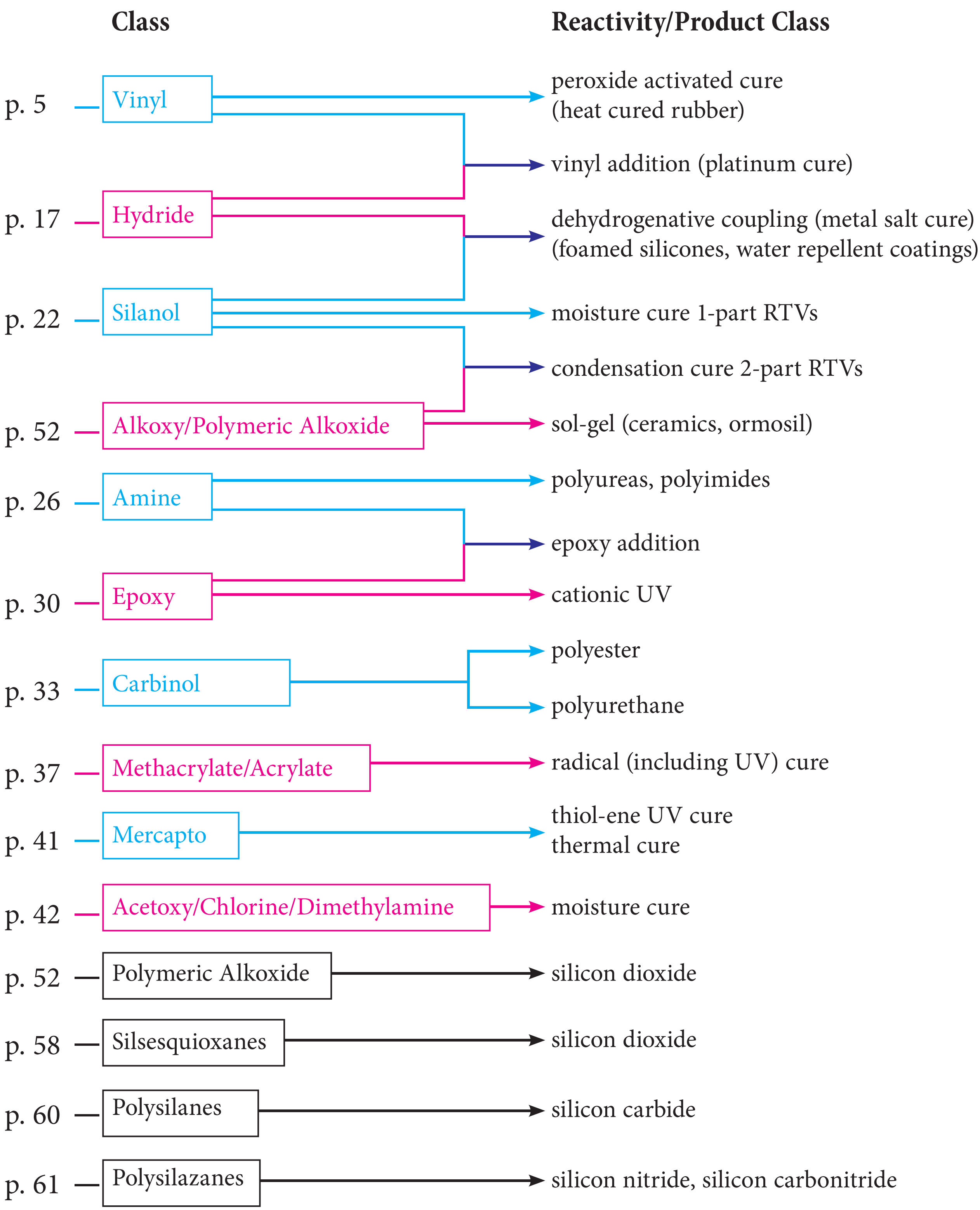
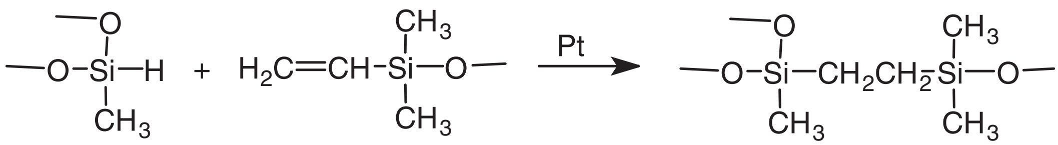
Functional Silicone Reactivity Guide



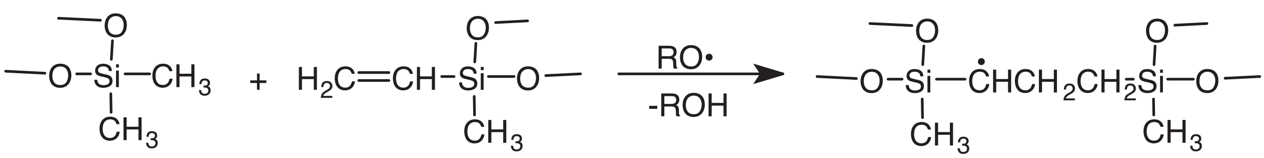
$$Si{-}CH{=}CH_2$$

Vinyl Functional Polymers

The reactivity of vinyl functional polymers is utilized in two major regimes.[1] Vinyl terminated polymers are employed in addition cure systems. The bond forming chemistry is the platinum catalyzed hydrosilylation reaction which proceeds according to the following equation:



Vinylmethylsiloxane copolymers and vinyl T-structure fluids are mostly employed in peroxide activated cure systems, which involve peroxide-induced free radical coupling between vinyl and methyl groups. Concomitant and subsequent reactions take place among methyl groups and between crosslink sites and methyl groups. The initial crosslinking reaction is depicted in the following equation:



Mechanical Properties of Silicone Rubbers Formulated with Vinyl Silicones

Silicone Type	Tensile Strength, Mpa	Elongation, %	Tear Strength, kN/m
HCR-High Consistency Silicone Rubber	4-13	100-1100	9-45
LSR-Liquid Silicone Rubber	4-12	200-900	10-50
RTV-2-Room Temperature Vulcanizing Silicone	5-10	100-700	8-10
FSR Fluorosilicone Rubber	9-12	150-700	18-46

Addition Cure (Platinum Cure)

Addition cure chemistry provides an extremely flexible basis for formulating silicone elastomers. An important feature of the cure system is that no byproducts are formed, allowing fabrication of parts with good dimensional stability. Cures below 50°C, Room Temperature Vulcanizing (RTV), cures between 50° and 130°C, Low Temperature Vulcanizing (LTV), and cures above 130°C, High Temperature Vulcanizing (HTV), are all readily achieved by addition cure. The rheology of the systems can also be varied widely, ranging from dip-cures to liquid injection molding (LIM) and conventional heat-cure rubber (HCR) processing. Vinyl-terminated polydimethylsiloxanes with viscosities greater than 200 cSt generally have less than 2% volatiles and form the base polymers for these systems. More typically, base polymers range from 1000 to 60,000 cSt. The crosslinking polymer is generally a methylhydrosiloxane-dimethylsiloxane copolymer with 15-50 mole % methylhydrosiloxane. The catalyst is usually a complex of platinum in alcohol, xylene, divinylsiloxanes or cyclic vinylsiloxanes. The system is usually prepared in two parts. By convention, the A part typically contains the vinyl-containing silicone and the platinum catalyst at a level of 5-10ppm, and the B part usually contains the hydride functional siloxane.

[1] Arkles, B., CHEMTECH, **1983**, *13*, 542.

Platinum Catalysts- see p. 65
Addition Cure Modifiers- see p. 66

Formulation of addition cure silicones must address the following issues:

Strength- Unfilled silicones have extremely poor mechanical properties and will literally crumble under pressure from a fingernail. The most effective reinforcing filler is hexamethyldisilazane treated fumed silica. Alternatively, if clarity must be maintained, vinyl "Q" reinforcing resins are employed.

Hardness- Higher crosslink density provides higher durometer elastomers. Gels are weakly crosslinked systems and even contain substantial quantities of "free" fluids. In principal, molar equivalents of hydrides react with vinyls. See the section on hydride functional fluids for further information. Also, polymers with vinyl pendant on the chain rather than at chain ends are utilized to modify hardness and compression set.

Consistency- The viscosity of the base polymer and a variety of low surface area fillers ranging from calcium carbonate to precipitated silica are used to control the flow characteristics of silicone elastomers.

Temperature of Cure- Selection of platinum catalysts generally controls the preferred temperature of cure.[1] Platinum in vinyldisiloxanes is usually used in room temperature cures. Platinum in cyclic vinylsiloxanes is usually used in high temperature cures. See the Platinum listings in the catalyst section. **(p. 65)**

Work Time (Speed of Cure)- Apart from temperature, moderators (sometimes called retarders) and inhibitors are used to control work time. Moderators slow, but do not stop platinum catalysts. A typical moderator is tetravinyltetramethylcyclotetrasiloxane. Inhibitors stop or "shut-down" platinum catalysts and therefore are fugitive, i.e volatile or decomposed by heat or light (UV). Acetylenic alcohols such as methylisobutynol are volatile inhibitors. Patent literature shows that t-butylhydroperoxide is an effective inhibitor that breaks down at temperatures above 130°.

Low Temperature Properties, Optical Properties- The introduction of vinyl polymers with phenyl groups alters physical properties of elastomers. At levels of 3-4 mole %, phenyl groups improve low temperature properties. At higher levels, they are used to alter refractive index of elastomers, ranging from matching fillers for transparency to optical fiber applications. Unfortunately, increased phenyl substitution lowers mechanical properties of elastomers.

Shelf Life- A fully compounded elastomer is a complex system. Shelf-life can be affected by moisture, differential adsorption of reactive components by fillers and inhibitory effects of trace impurities. Empirical adjustments of catalyst and hydride levels are made to compensate for these effects.

Compounding- All but the lowest consistency elastomers are typically compounded in sigma-blade mixers, planetary mixers, two-roll mills or, for large scale production, twin-screw extruders.

Quick Start Formulation Transfer and Impression Molding Elastomer

This low strength formulation is useful as a reproductive molding compound. It is presented here because it can be prepared without special equipment and is an instructive starting point for addition cure silicone elastomers.

DMS-V31	1000 cSt vinyl-terminated polydimethylsiloxane	100 parts
SIS6962.0	hexamethyldisilazane treated silica	50 parts
HMS-301	methylhydrosiloxane-dimethylsiloxane copolymer	3-4 parts
SIP6830.3	platinum complex solution	150-200ppm

In small portions, work the DMS-V31 into the silica with a spatula. After a uniform dispersion is produced, work in the HMS-301. The blend may be stored in this form. Just prior to use add the platinum solution with an eyedropper and work it in rapidly. Working time is 5-10 minutes. The rate of cure can be retarded by adding tetravinyltetramethylcyclotetrasiloxane (SIT7900.0).

[1] Lewis, L. et al. *J. Mol. Cat. A: Chem.* **1996**, *104*, 293.; Lewis, L. et al. *J. Inorg. Organomet. Polym.* **1996**, 6, 123.

Peroxide Activated Cure

Activated cure silicone elastomers are processed by methods consistent with conventional rubbers. These silicone products are referred to as HCRs (heat cured rubbers). The base stocks are high molecular weight linear polydiorganosiloxanes that can be converted from a highly viscous plastic state into a predominantly elastic state by crosslinking. Vinylmethylsiloxane-dimethylsiloxane copolymers of extremely high molecular weights are the typical base stocks for activated cure silicone elastomers. The base stocks are commonly referred to as gums. Gums typically have molecular weights from 500,000 to 900,000 with viscosities exceeding 2,000,000 cSt. The silicone rubbers derived from the gums by compounding reinforcing aents extenders and additives are devided into three main classes: VMQ (Dimethyl Silicone/Regular Silicone), PVMQ (Diphenyl Dimethyl Silicone/Low Termperature Silicone) & FVMQ (Fluorosilicone/Fuel Resistant Silicone).

Free radical coupling (cure) of vinyl and methyl groups is usually initiated by peroxides at process temperatures of 140°-160°. Generally, peroxide loading is 0.2-1.0%. Following the cure, a post-cure at 25-30° higher temperature removes volatile peroxide decomposition products and stabilizes polymer properties. The most widely used peroxides include dibenzoylperoxide (often as a 50% concentrate in silicone oil), dicumylperoxide (often 40% on calcium carbonate), 2,5-dimethyl-2,5-di-t-butylperoxyhexane and bis(dichlorobenzoyl)peroxide[1,2]. The last peroxide is particularly recommended for aromatic-containing siloxanes. Terpolymer gums containing low levels of phenyl are used in low temperature applications. At increased phenyl concentrations, they are used in high temperature and radiation resistant applications and are typically compounded with stabilizing fillers such as iron oxide. Phenyl groups reduce cross-linking efficiency of peroxide systems and result in rubbers with lower elasticity. Fluorosilicone materials offer solvent resistance. Lower molecular weight vinylsiloxanes are frequently added to modify processability of base stocks.

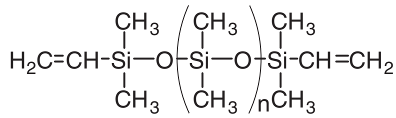
Peroxide and Peroxyketal Curing Agents for HTV Silicone Rubbers

Peroxide	Cure Temperature, °C	10 minute Half-Life Temperature, °C	Application
Dicumyl peroxide	160-200°	157°	Fast cure, calendering
Di(t-butylperoxy)diisopropylbenzene	160-200°	157°	Low odor
2,5-Dimethyl-2,5-di(t-butylperoxy)hexane	160-200°	157°	Commonly used for vinyl base stocks, FDA listed
2,5-Dimethyl-2,5-di(t-butylperoxy)hexyne	190-220°	169°	Systems requiring high temperature cure
2,4-Dichlorobenzoyl peroxide	110-125°	89°	Extrusion, Phenyl Copolymers, not Vinyl specific
1,2-Bis(t-butylperoxy)3,3,5-trimethylcyclohexane	135-185°	131°	Fast-cure at lower temperatures without bloom
n-Butyl-4,4-di(t-butylperoxy)valerate	135-185°	150°	High vinyl content cures

While the use of peroxide activated cure chemistry for vinylmethylsiloxanes is well established for gum rubber stocks, its to use is growing in new applications that are comparable to some peroxide cure acrylic systems. Relatively low viscosity vinylmethylsiloxanes and vinyl T-fluids are employed as grafting additives to EPDM elastomers in the wire and cable industry to improve electrical properties. They also form reactive internal lubricants for vulcanizeable rubber formulations. At low levels they are copolymerized with vinyl monomers to form surfactants for organosols.

[1]Lynch, W., “Handbook of Silicone Rubber Fabrication”, Van Nostrand Reichold, 1978.
[2]Brassard, D.M., “The Silicone Elastomer Handbook”, Silicone Solutions, 2010.

Peroxide Catalysts- see p. 69



Vinyl Terminated PolyDimethylsiloxanes

CAS: [68083-19-2] TSCA

Code	Viscosity	Molecular Weight	Wgt % Vinyl	Vinyl - Eq/kg	Density	Price/100g	Price/3kg	Price/16kg
DMS-V00	0.7	186	29	10.9	0.81			
DMS-V03	2-3	500	10-12	3.6-4.3	0.92			
DMS-V05	4-8	800	7-9	2.4-2.9	0.93			
DMS-V21	100	6,000	0.8-1.2	0.33-0.37	0.97			
DMS-V22	200	9,400	0.4-0.6	0.21-0.24	0.97			
DMS-V25	500	17,200	0.37-0.43	0.11-0.13	0.97			
DMS-V31	1,000	28,000	0.18-0.26	0.07-0.10	0.97			
DMS-V33	3,500	43,000	0.12-0.15	0.05-0.06	0.97			
DMS-V34	4,000	45,000	0.11-0.14	0.045-0.055	0.97			
DMS-V35	5000	49,500	0.10-0.13	0.04-0.05	0.97			
DMS-V41	10,000	62,700	0.08-0.12	0.03-0.04	0.97			
DMS-V42	20,000	72,000	0.07-0.09	0.025-0.030	0.98			
DMS-V43	30,000	92,000	0.06-0.08	0.022-0.026	0.98			
DMS-V46	60,000	117,000	0.04-0.06	0.018-0.020	0.98			
DMS-V51	100,000	140,000	0.03-0.05	0.016-0.018	0.98			
DMS-V52	165,000	155,000	0.03-0.04	0.013-0.016	0.98			

These materials are most often employed in 2-part addition cure silicone elastomers.

Monodisperse Vinyl Terminated PolyDimethylsiloxane

DMS-Vm31	1000	28,000	0.18-0.26	0.07-0.10	0.97			
DMS-Vm35	5000	49,500	0.10-0.13	0.04-0.05	0.97			
DMS-Vm41	10,000	62,700	0.08-0.12	0.03-0.04	0.97			

Monodisperse telechelic silicone fluids offer advantages over traditional telechelic fluids. These materials contain little or no low molecular weight non-functional components which can plasticize and migrate out of cured elastomers, reducing or eliminating migratory contamination issues.

Reduced Volatility Grades*

DMS-V25R	500	17,200	0.37-0.43	0.11-0.13	0.97			
DMS-V35R	5000	49,500	0.10-0.13	0.04-0.05	0.97			

*total volatiles, 4 hours @ 150°C: 0.2% maximum

Fumed Silica Reinforced Vinyl Terminated PolyDimethylsiloxane

Code	Viscosity	Base Fluid Viscosity	wt % Silica	Vinyl - Eq/Kg	Density	Price/100g	Price/3kg	Price/16kg
DMS-V31S15	3000	1000	15-18	0.06	1.1			

Precompounded base materials provide access to low durometer formulations without the need for special compounding equipment required to mix fumed silica. The following is a starting-point formulation.

Part A

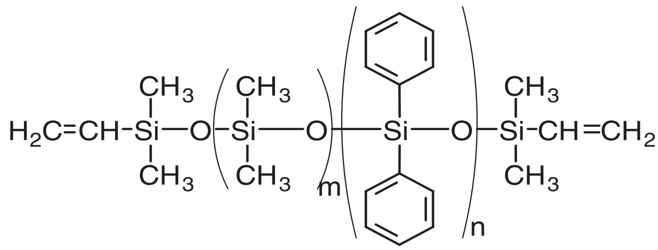
DMS-V31S15	Base	99.85%
SIP6831.2	Catalyst	0.15%

Part B

DMS-V31	Vinyl Silicone	90.0%
HMS-301	Crosslinker	10.0%

Prepare Part A and Part B separately. When ready to cure mix 3 parts A to 1 part B. The mix will cure over 4 hours at room temperature to give the following properties.

Hardness:	20-30 Shore A	Tensile Strength	3.5MPa (500psi)
Elongation	400-450%	Tear Strength	16N/mm (91ppi)



Vinyl Terminated Diphenylsiloxane-Dimethylsiloxane Copolymers

CAS: [68951-96-2] TSCA

Code	Mole % Diphenylsiloxane	Viscosity	Molecular Weight	Vinyl - Eq/Kg	Refractive Index	Price/100g	Price /3kg
PDV-0131	1.0-1.2	1,000	27,000	0.065-0.11	1.411		
PDV-0325	3.0-3.5	500	15,500	0.10-0.16	1.420		
PDV-0331	3.0-3.5	1,000	27,000	0.065-0.11	1.420		
PDV-0341	3.0-3.5	10,000	62,000	0.027-0.037	1.420		
PDV-0346	3.0-3.5	60,000	78,000	0.017-0.021	1.420		
PDV-0525	4-6	500	14,000	0.12-0.16	1.430		
PDV-0535	4-6	5,000	47,500	0.03-0.06	1.430		
PDV-0541	4-6	10,000	60,000	0.027-0.038	1.430		
PDV-1625	15-17	500	9,500	0.19-0.23	1.465		
PDV-1631	15-17	1,000	19,000	0.09-0.12	1.465		
PDV-1635	15-17	5,000	35,300	0.052-0.060	1.465		
PDV-1641	15-17	10,000	55,000	0.033-0.040	1.465		
PDV-2331	22-25	1,000-1,500	12,500	0.13-0.19	1.493		
PDV-2335	22-25	4,000-5,000	23,000	0.07-0.10	1.493		

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Vinyl Terminated polyPhenylMethylsiloxane

CAS: [225927-21-9] TSCA-L

Code	Mole % PhenylMethylsiloxane	Viscosity	Molecular Weight	Vinyl– Eq/Kg	Refractive Index	Density	Price/100g
PMV-9925	99-100	300-600	2000-3000	0.5-1.2	1.537	1.11	

These materials are most often employed in 2-part addition cure silicone elastomers where special thermal or optical properties are required

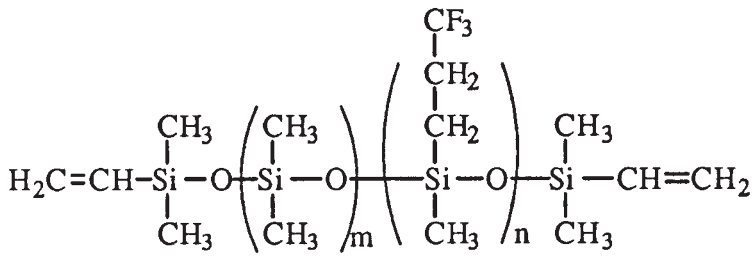
VinylPhenylMethyl Terminated VinylPhenylsiloxane - PhenylMethylsiloxane Copolymer

CAS: [68037-82-1] TSCA

Code	Mole % PhenylMethylsiloxane	Viscosity	Molecular Weight	Vinyl– Eq/Kg	Refractive Index	Density	Price/100g
PVV-3522	30-40	80-150	800-1500	6.0-7.5	1.530	1.10	

Crosslinks with dicumyl peroxide.

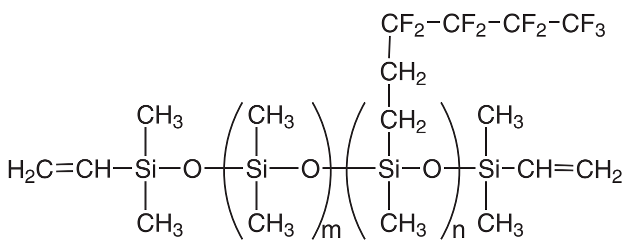
Vinyl Functional Fluorosilicones



Vinyl Terminated TrifluoropropylMethylsiloxane - Dimethylsiloxane Copolymer CAS: [68951-98-4] TSCA

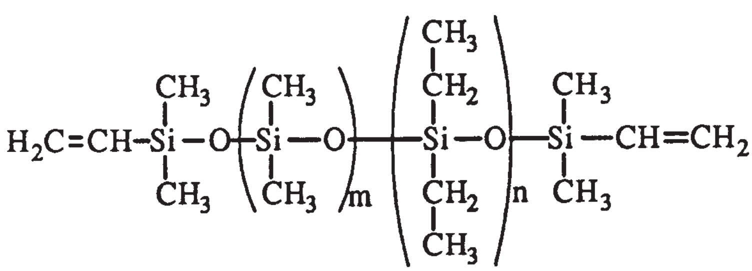
Code	Mole % $CF_3CH_2CH_2MeSiO$	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
FMV-4035	35-45	4,000-6,000	6,000-9,000	1.388	1.13		
FMV-4042	35-45	14,000-18,000	25,000-35,000	1.388	1.13		

Trifluoropropylmethylsiloxane copolymers offer greater solvent resistance (lower hydrocarbon solubility) and lower refractive index than analogous dimethylsiloxane homopolymers.



Vinyl Terminated Nonafluorohexylmethylsiloxane – Dimethylsiloxane Copolymer CAS:[609768-44-7]

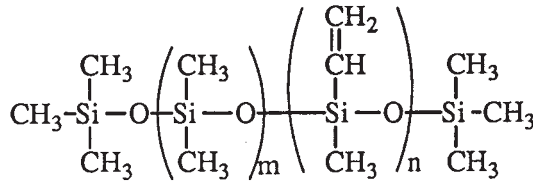
Code	Mole % Nonafluorohexyl	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
FNV-3031	30-35	800-1400	8,000-10,000	1.365	1.22		



Vinyl Terminated Diethylsiloxane - Dimethylsiloxane Copolymers

Code	Mole % Diethylsiloxane	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
EDV-2022	18-22	150-300	8000-12,000	1.413	0.953	

Diethylsiloxane copolymers offer better hydrocarbon compatibility (greater solubility) and higher refractive index than analogous dimethylsiloxane homopolymers.



Vinylmethylsiloxane - Dimethylsiloxane Copolymers, trimethylsiloxy terminated CAS: [67762-94-1] TSCA

Code	Mole % Vinylmethylsiloxane	Viscosity, cSt.	Molecular Weight	Vinyl - Eq/kg	Specific Gravity	Price/100 g	Price/1kg
VDT-123	0.8-1.2	250-350	12,000	0.11-0.15	0.97		
VDT-127	0.8-1.2	700-800	23,000	0.11-0.15	0.97		
VDT-131	0.8-1.2	800-1,200	28,000	0.11-0.15	0.97		
VDT-163	0.3-0.7	2,000,000-4,000,000	425,000	0.04-0.08	0.98		
VDT-431	4.0-5.0	800-1,200	28,000	0.5-0.7	0.97		
VDT-731	7.0-8.0	800-1,200	28,000	0.9-1.1	0.96		
VDT-954	11.0-13.0	300,000-500,000	225,000	1.1-1.4	0.98		
VDT-5035	48-52	4,500-5,500	50,000	6.0-6.5	0.98		

Vinyl containing copolymers are used as crosslinkers in Pt and peroxide cure elastomer. High vinyl content copolymers form elastomers used in high accuracy soft lithography[1,2,3].

[1]Choi, D. et al. *Mat. Sci. Eng. C.* **2004**, *24*, 213.

[2]Infuehr, R. et al. *Appl. Surf. Sci.* **2003**, *254*, 836.

[3]Schmid, H.; Michel. B. *Macromolecules* **2000**, *33*, 3042.

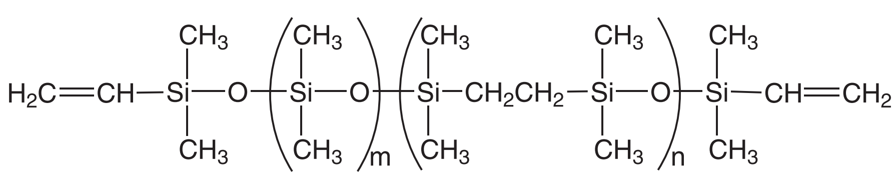
Vinylmethylsiloxane - Dimethylsiloxane Copolymers, silanol terminated, 4-6% OH CAS: [67923-19-7] TSCA

VDS-1013	10-15	25-40	550-650	0.9-1.4	0.99		

Vinylmethylsiloxane - Dimethylsiloxane Copolymers, vinyl terminated CAS: [68083-18-1] TSCA

VDV-0131	0.3-0.4	800-1200	28,000	0.04-0.055	0.97		

These materials are modifiers for addition cure and activated cure elastomers.



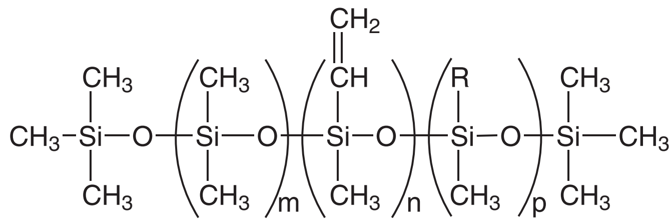
Vinyl Terminated Ethylene-Siloxane Copolymer Fluids

CAS: [26710-23-6]

Code	Viscosity	Mole % Siloxane	Specific Gravity	Refractive Index	Molecular Weight	Price/100g	Price/1kg
DCE-V7512	150-250	70-80	0.907	1.429	>2000		

Ethylene-siloxane copolymer polymers exhibit reversion resistant behavior.

See also MCS-V212 - p. 14



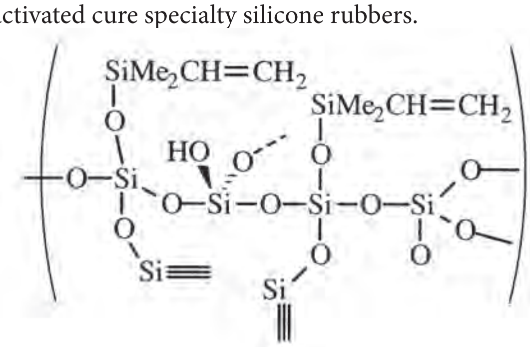
Vinyl Gums (balance dimethylsiloxane unless otherwise specified) TSCA

Code	Mole % Vinylmethylsiloxane	Comonomer %	Specific Gravity	Price/100 g	Price/1kg
VGM-021**	0.2-0.3		0.98		
VGP-061***	0.1-0.2	6-7% Diphenylsiloxane	0.99		
VGF-991 ‡	1.0-2.0%	98-9% Trifluoropropylmethylsiloxane	1.35		
DGM-000*	0.0	100% dimethylsiloxane	0.98		

* This gum is listed here for convenience. It contains no vinyl functionality. It may be cured with dichlorobenzoylperoxide.

CAS: *[9016-00-6], **[67762-94-1], ***[68951-96-2], ‡[68952-02-2]

These materials are base polymers for activated cure specialty silicone rubbers.

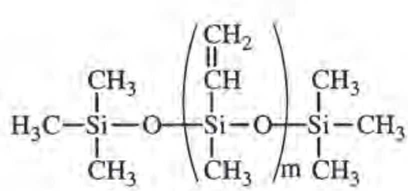


Vinyl Q Resins Dispersions CAS: [68584-83-8] TSCA

Code	Base	Viscosity	Vinyl Eq/kg	Refractive Index	Density	Price/100g	Price/3kg
VQM-135*	DMS-V41	4,500-7000	0.2-0.3	1.405	1.02		
VQM-146*	DMS-V46	50,000-60,000	0.18-0.23	1.406	1.02		
VQX-221	50% in xylene	-	0.4-0.6	-	1.05		

*20-25% Q-resin

Vinyl Q resins are clear reinforcing additives for addition cure elastomers.



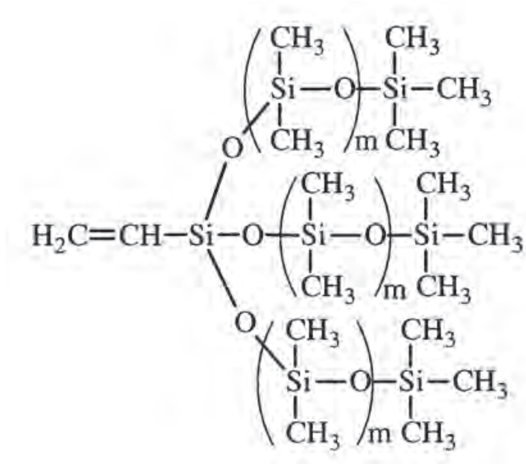
Vinylmethylsiloxane Homopolymers TSCA

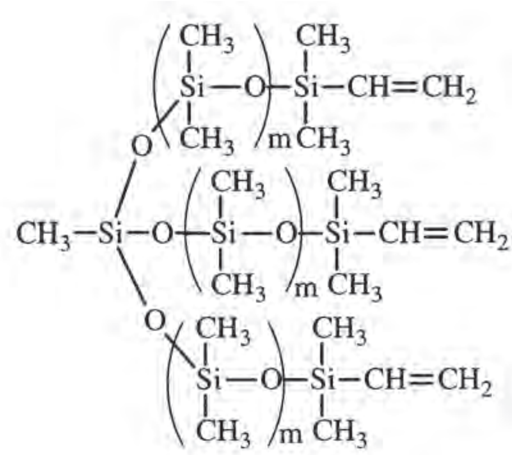
Code	Description	Molecular Weight	Viscosity	Density	Price/100g	Price/3kg
VMS-005	cyclics	258-431	3-7	0.99		
VMS-T11*	linear	1000-1500	7-15	0.96		

*CAS: [68037-87-6]

Low molecular weight vinylmethylsiloxanes are primarily used as moderators (cure-rate retarders) for vinyl-addition cure silicones. They also are reactive intermediates and monomers.

See also Hydride Q resins - p. 20





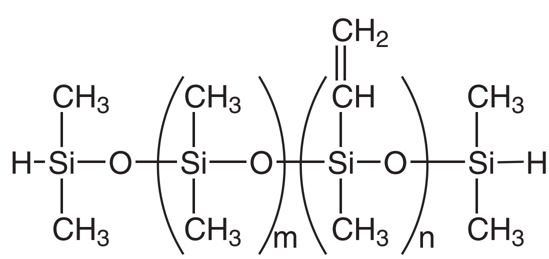
Vinyl T-structure Polymers

Code	Branch Point	Branch Terminus	Vinyl - Eq/Kg	Viscosity	Density	Refractive Index	Price/100g	Price/3kg
VTT-106*	Vinyl	Methyl	2-4	5-8	0.90	-		
MTV-112**	Methyl	Vinyl	3-6	15-30	0.96	1.407		

*CAS: [126581-51-9] TSCA **CAS: [21714-00-0]

T-structure polymers contain multiple branch points.

These materials are additives and modifiers for addition cure and activated cure elastomers.



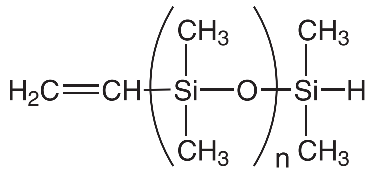
VinylMethylsiloxane – Dimethylsiloxane copolymer, hydride terminated

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Vinyl- Eq/Kg	Price/100g	Price/1kg
VDH-422	150-250	8000-10,000	1.404	0.97	0.3-0.5		

Vinyl Functional Macromers

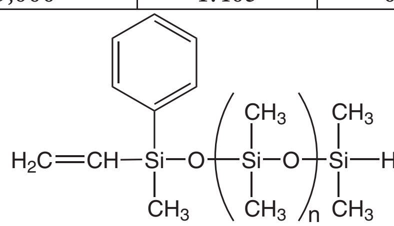
Hetero bi-functional silicone fluids contain little or no low molecular weight components. They can be used as additives into traditional RTV-2 silicone formulations or undergo a stepgrowth process when catalyzed by platinum, resulting in high elongation elastomer.[1,2]

1. Goff, J. et al, Polymer Preprints **2012**, *53(1)*, 487.
2. Goff, J. et al, Advanced Materials, **2016**, *28(12)*, 2393, doi 10.1002/adma, 201503320



α-MonoVinyl-Ω-MonoHydride Terminated PolyDimethylsiloxane CAS: [104780-63-4] TSCA

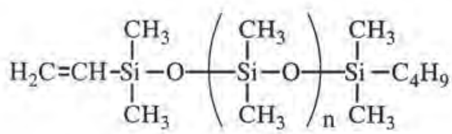
Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
DMS-HV15	40-60	2,000-3,000	1.404	0.96		
DMS-HV22	150-250	10,000	1.403	0.97		
DMS-HV31	600-1,000	25,000	1.403	0.97		



α-MonoVinyl-MonoPhenyl-Ω-MonoHydride Terminated PolyDimethylsiloxane CAS: [1422279-25-1]

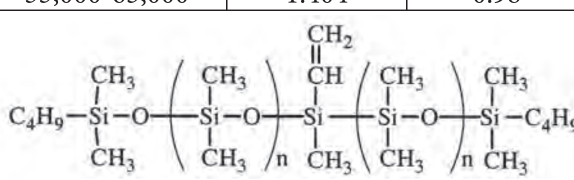
Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
PMM-HV12	20	2,000	1.4135	0.97		

Mono-vinyl functional silicone fluids can be used as components in silicone gels and modifiers in release coatings.



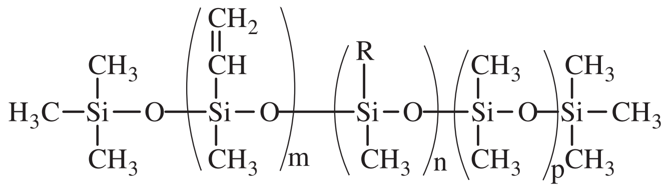
MonoVinyl Functional PolyDimethylsiloxane - symmetric CAS: [689252-00-1]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-V21	80-120	5,500-6,500	1.403	0.97		
MCR-V25	400-600	15,000-20,000	1.403	0.97		
MCR-V41	8000-12000	55,000-65,000	1.404	0.98		



MonoVinyl Functional PolyDimethylsiloxane - symmetric CAS: [689252-00-1]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCS-V212	16-24	1,200-1,400	1.419	0.95		



VinylMethylsiloxane Terpolymers

(3-5% Vinylmethylsiloxane)-(35-40% Octylmethylsiloxane)-(Dimethylsiloxane) terpolymer CAS: [597543-32-3] TSCA

Code	Viscosity	Molecular Weight	Density	Refractive Index	Vinyl-Eq/Kg	Price/100g	Price/1kg
VAT-4326	500-700	10,000-12,000	0.93	1.437	0.20-0.24		

Vinyl-alkyl terpolymers are used in hybrid organic polymer-silicone applications.

Employed as a matrix polymer in vapor sensor films.[1]

[1] Blok, E. et al, US Patent 7,138,090, **2006.**

(3-5% Vinylmethylsiloxane)-(35-40% Phenylmethylsiloxane)-(Dimethylsiloxane) terpolymer

Code	Viscosity	Molecular Weight	Density	Refractive Index	Vinyl-Eq/Kg	Price/100g	Price/1kg
VPT-1323	250-350	2500-3000	1.03	1.467	0.25-0.29		

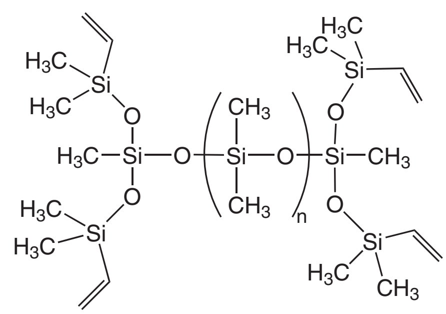
Vinyl-phenyl terpolymers are used in refractive index match applications.

Dimethylsiloxane-vinylmethylsiloxane – (Propylene Oxide – Ethylene Oxide) Block Copolymers

Code	Viscosity	Molecular Weight	Density	Refractive Index	Vinyl-Eq/Kg	Price/100g	Price/1kg
DBP-V102	800-1000	9,000-12,000	0.99	1.415	0.15-0.20		
DBP-V052	500-600	8,000-10,000	0.99	1.418	0.03-0.05		

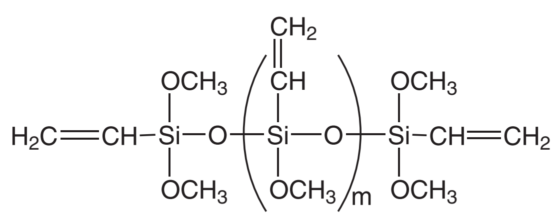
Vinyl functional glycol-silicone copolymers are used as hydrophilic additives in silicone RTV-2 formulations.

Multi-functional Vinyl Siloxanes



Polydimethylsiloxane, Bis(Divinyl) terminated

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Vinyl-Eq/Kg	Price/100g	Price/1kg
DMS-VD11	8-15	700-800	0.92	-	5.0-5.5		



Vinylmethoxysiloxane Homopolymer

CAS: [131298-48-1] TSCA

Code	Description	Viscosity	Density	Price/100g	Price/1kg
VMM-010*	oligomer	8 - 12	1.10		

*R.I.: 1.428; 22-3 wgt% vinyl

Vinylethoxysiloxane Homopolymer

CAS: [29434-25-1] TSCA

Code	Description	Viscosity	Density	Price/100g	Price/1kg
VEE-005*	oligomer	4 - 7	1.02		

*19-22 wgt% vinyl

Vinylethoxysiloxane-Propylethoxysiloxane Copolymer

CAS: [201615-10-3] TSCA

Code	Description	Viscosity	Density	Price/100g	Price/1kg
VPE-005*	oligomer	3 - 7	1.02		

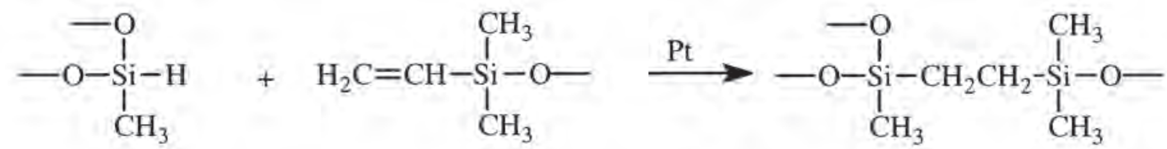
*9-11 wgt% vinyl

These materials are employed as adhesion promoters for vinyl-addition cure RTVs, as crosslinking agents for neutral cure RTVs, and as coupling agents in polyethylene for wire and cable applications.

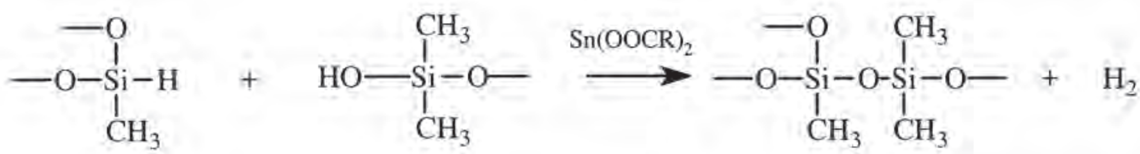
Hydride Functional Polymers

Hydride functional siloxanes undergo three main classes of reactivity: hydrosilylation, dehydrogenative coupling and hydride transfer.

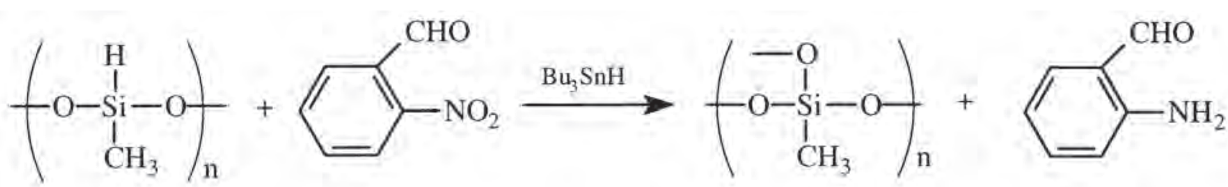
Hydrosilylation



Dehydrogenative Coupling



Reduction



Hydrosilylation - Addition Cure

The hydrosilylation of vinyl functional siloxanes by hydride functional siloxanes is the basis of addition cure chemistry used in 2-part RTVs and LTVs.[1,2] The most widely used materials for these applications are methylhydrosiloxane-dimethylsiloxane copolymers which have more readily controlled reactivity than the homopolymers and result in tougher polymers with lower cross-link density. The preferred catalysts for the reactions are platinum complexes such as SIP6830.3 and SIP6832.2. In principle, the reaction of hydride functional siloxanes with vinyl functional siloxanes takes place at 1:1 stoichiometry. For filled systems, the ratio of hydride to vinyl is much higher, ranging from 1.3:1 to 4.5:1. The optimum cure ratio is usually determined by measuring the hardness of cured elastomers at different ratios. Phenyl substituted hydrosiloxanes are used to crosslink phenylsiloxanes because of their greater solubility and closer refractive index match. The following chart gives some examples of starting ratios for common polymers and crosslinkers calculated at 1.5 Hydride to Vinyl ratio.

1. Warrick, E. et al. *Rubber Chem. Tech.* **1979**, *52*, 437.
2. Dolgov, O. et al. *Organosilicon Liquid Rubbers, Int'l Poly. Sci. & Tech.* Monograph *#1*, RAPRA, **1975**.

Starting Ratios of Hydride Functional Siloxanes (parts) to 100 parts of Vinylsiloxane*

Hydrosiloxane Vinylsiloxane	HMS-013	HMS-151	HMS-301
DMS-V31	80.8	4.2	2.1
DMS-V41	11.5	1.8	0.9
PDV-0341	11.9	1.9	0.9

* formulation is based on 1.5 Si-H to 1 CH_2=CH-Si; filled formulations may require up to 3x the amount listed

The hydrosilylation of olefins is utilized to generate alkyl- and arylalkyl-substituted siloxanes, which form the basis of organic compatible silicone fluids. The hydrosilylation of functional olefins provides the basis for formation of silicone block polymers.

Dehydrogenative Coupling - Water Repellency, Foamed Silicones

Hydroxyl functional materials react with hydride functional siloxanes in the presence bis(2-ethylhexanoate)tin, dibutyldilauryltin, zinc octoate, iron octoate or a variety of other metal salt catalysts. The reaction with hydroxylic surface groups is widely used to impart water-repellency to glass, leather, paper and fabric surfaces and powders. A recent application is in the production of water-resistant gypsum board. Application is generally from dilute (0.5-2.0%) solution in hydrocarbons or as an emulsion. The coatings are generally cured at 110-150°C. Polymethylhydrosiloxane is most commonly employed.

Silanol terminated polydimethylsiloxanes react with hydride functional siloxanes to produce foamed silicone materials. In addition to the formal chemistry described above, the presence of oxygen and moisture also influences cross-link density and foam structure.

Reductions[3]

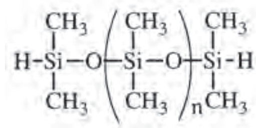
Polymethylhydrosiloxane is a versatile low cost hydride transfer reagent. It has a hydride equivalent weight of 60. Reactions are catalyzed by Pd^0 or dibutyltin oxide. The choice of reaction conditions leads to chemoselective reduction, e.g. allyl reductions in the presence of ketones and aldehydes.[4,5,6] Esters are reduced to primary alcohols in the presence of $Ti(OiPr)_4$[7].

See brochure "Silicon-Based Reducing Agents".

Physical Properties

Polymethylhydrosiloxanes exhibit the highest compressibility of the silicone fluids, 9.32% at 20,000 psi and the lowest viscosity temperature coefficient, 0.50.

3. Larson, G. L., Fry, J. L., "*Ionic and Organometallic-Catalyzed Organosilane Reductions*", in *Organic Reactions* S. E. Denmark, Ed. Volume 71, John Wiley and Sons, pp 1-771, **2008**.
4. Lipowitz, J. et al. *J. Org. Chem.* **1973**, *38*, 162.
5. Keinan, E. et al. *Israel J. Chem.* **1984**, *24*, 82. and *J. Org. Chem.* **1983**, *48*, 3545
6. Mukaiyama, T. et al. *Chem. Lett.* **1983**, 1727.
7. Reding, M. et al. *J. Org. Chem.* **1995**, *60*, 7884.



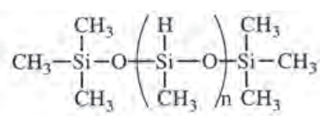
Hydride Terminated PolyDimethylsiloxanes CAS: [70900-21-9] TSCA

Code	Viscosity	Molecular Weight	wt% H	Equilvalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-H03	2 - 3	400-500	0.5	225	0.90	1.395		
DMS-H05	4 - 6	600-700	0.3	325	0.91	1.397		
DMS-H11	7-10	1000-1100	0.2	550	0.93	1.399		
DMS-H21	100	4000-5000	0.04	3,000	0.97	1.403		
DMS-H25	500	17,200	0.01	8,600	0.97	1.403		
DMS-H31	1000	28,000	0.007	14,000	0.97	1.403		
DMS-H41	10,000	62,700	0.003	31,350	0.97	1.403		

Hydride terminated silicones are chain extenders for vinyl-addition silicones, enabling low viscosity, high elongation formulations. They are also intermediates for functionally terminated silicones.

Monodisperse Hydride Terminated PolyDimethylsiloxane

Code	Viscosity	Molecular Weight	wt% H	Equilvalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-Hm15	50	3000-3500	0.07	1,625	0.96	1.403		
DMS-Hm21	100	5500	0.04	2,750	0.96	1.403		
DMS-Hm25	500	17,200	0.01	8,600	0.97	1.403		

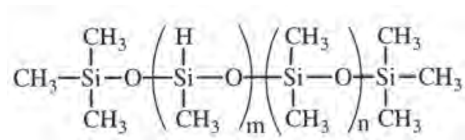


polyMethylHydrosiloxanes, Trimethylsiloxy terminated CAS: [63148-57-2] TSCA

Code	Viscosity	Molecular Weight	Mole% MeHSiO	Equivalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/3kg
HMS-991	15-25	1400-1800	100	67	0.98	1.395		
HMS-992	20-35	1800-2100	100	65	0.99	1.396		
HMS-993	30-45	2100-2400	100	64	0.99	1.396		

Tg: -119° V.T.C: 0.50

MethylHydrosiloxane homopolymers are used as water-proofing agents, reducing agents and as components in some foamed silicone systems.



MethylHydrosiloxane - Dimethylsiloxane Copolymers, Trimethylsiloxy terminated CAS: [68037-59-2] TSCA

Code	Viscosity	Molecular Weight	Mole% MeHSiO	Equivalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/3kg
HMS-013	5000-8000	45,000-60,000	0.5-1.5	10,000	0.97	1.404		
HMS-031	25-35	1900-2000	3-4	1600	0.97	1.401		
HMS-053	750-1000	20,000-25,000	4-6	1475	0.97	1.403		
HMS-064	6000-9000	50,000-60,000	4-8	1240	0.97	1.403		
HMS-071	25-35	1900-2000	6-7	1000	0.97	1.401		
HMS-082	110-150	5500-6500	7-9	925	0.97	1.403		
HMS-151	25-35	1900-2000	15-18	490	0.97	1.400		
HMS-301*	25-35	1900-2000	25-35	245	0.98	1.399		
HMS-501	10-15	900-1200	45-55	135	0.96	1.394		

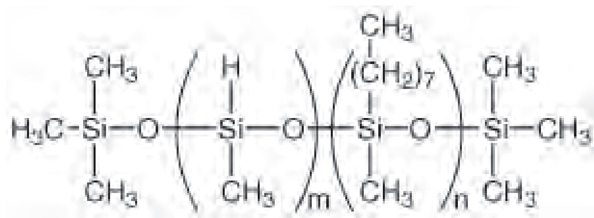
*available in reduced volatility grade

Specialty Hydrosiloxanes

MethylHydrosiloxane - Dimethylsiloxane Copolymers, Hydride terminated CAS: [69013-23-6] TSCA

Code	Viscosity	Molecular Weight	Mole % (MeHSiO)	Equivalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/3kg
HMS-H271	24-60	2000-2600	25-30	200	0.96	1.402		
HMS-HM271*	30-70	2000-3000	25-30	200	0.96	1.402		

*mixed methyl, hydride terminated.
MethylHydrosiloxane copolymers are the primary crosslinkers for vinyl-addition silicones and intermediates for functional copolymers.



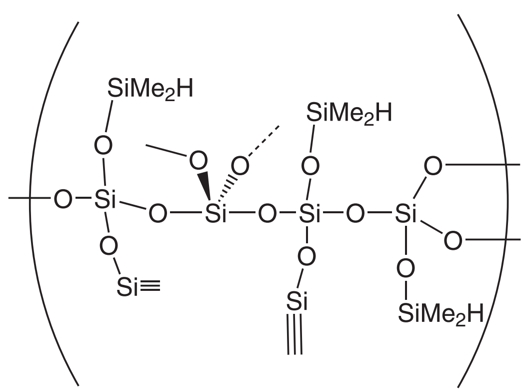
MethylHydrosiloxane - OctylMethylsiloxane copolymers and terpolymers

Code	Viscosity	Mole % (MeHSiO)	Equivalent Weight	Specific Gravity	Refractive Index	Price/25g	Price/100g
HAM-301*	30-80	25-30	440-480	0.91	1.442		
HAM-3012**	20-60	25-30	280-320	0.93	1.425		

*CAS: [68554-69-8] TSCA ** contains, 30-35% $C_8H_{17}MeSiO$, 35-40% Me2SiO

PolyTrifluoropropylmethylsiloxane, Hydride terminated

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Vinyl- Eq/Kg	Price/100g	Price/1kg
FMS-H31	500 - 1000	3500 - 5000	1.28	1.380	5.0-5.5		

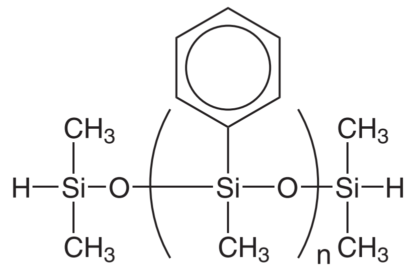


Hydride Q Resin CAS: [68988-57-8] TSCA

Code	Viscosity	Hydride Eq/kg	Equivalent Weight	Specific Gravity	Refractive Index	Price/25g	Price/100g
HQM-105	3-5	7.8-9.2	110-130	0.94	1.410		
HQM-107	6-8	7.5-9.0	115-135	0.95	1.410		

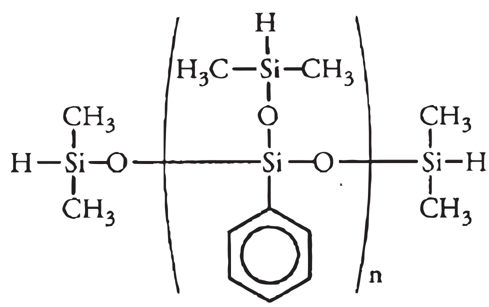
see also SST-3MH1.1 - p. 57; SST-H8HS8 - p. 59

Phenyl Functional Hydrosiloxanes



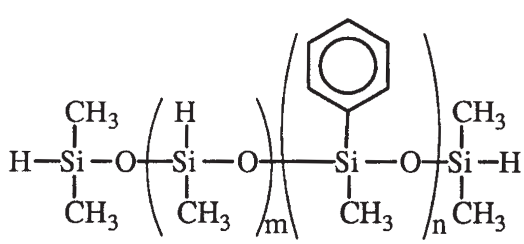
polyPhenylMethylsiloxane, Hydride Terminated*

Code	Viscosity	Mole % $[(HMe_2SiO)(C_6H_5Si)O]$	Equivalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/1 kg
PMS-H03	2 - 5	300-500	200	0.93	1.453		
PMS-H11	8 - 12	900-1100	500	0.93	1.500		



polyPhenyl - (DiMethylHydrosiloxy)siloxane, hydride terminated CAS: [925454-54-2] / [68952-30-7]

Code	Viscosity	Mole % $[(HMe_2SiO)(C_6H_5Si)O]$	Equivalent Weight	Specific Gravity	Refractive Index	Price/25g	Price/100g	Price/1kg
HDP-111	50-80	99-100	150-155	1.01	1.463			



MethylHydrosiloxane - PhenylMethylsiloxane copolymer, hydride terminated CAS: [115487-49-5] TSCA

Code	Viscosity	Mole % (MeHSiO)	Equivalent Weight	Specific Gravity	Refractive Index	Price/25g	Price/100g	Price/1kg
HPM-502*	75-110	45-50	160-170	1.08	1.500			

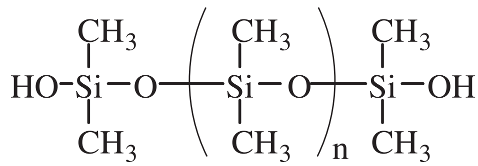
*unit MW: 200

Component in flexible optical waveguides.[1]

[1]Bichler, S. et al, *Optical Materials*, **2012**, 34, 772.

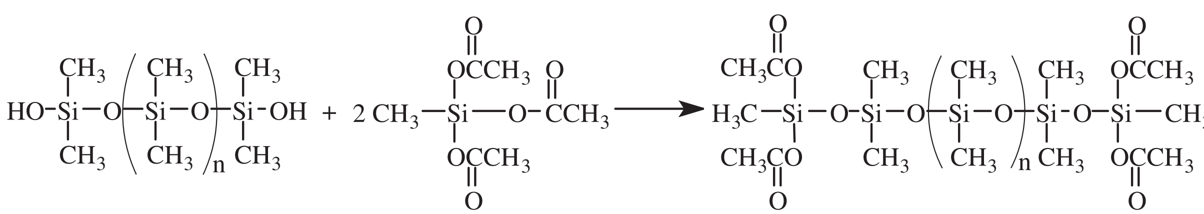
$\equiv Si-OH$

Silanol Functional Polymers

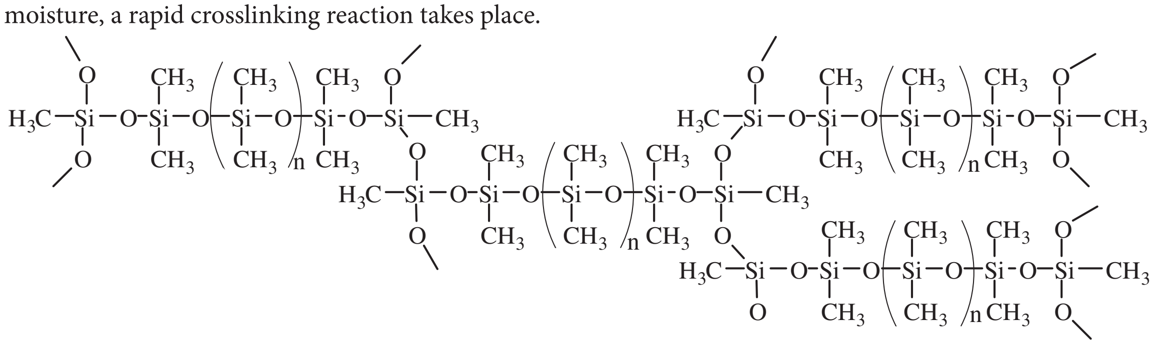


Terminal silanol groups render polydimethylsiloxanes susceptible to condensation under both mild acid and base conditions. They are intermediates for most room temperature vulcanizeable (RTV) silicones. Low molecular weight silanol fluids are generally produced by kinetically controlled hydrolysis of chlorosilanes. Higher molecular weight fluids can be prepared by equilibrating low molecular weight silanol fluids with cyclics, equilibrium polymerization of cyclics with water under pressure or methods of polymerization that involve hydrolyzeable end caps such as methoxy groups. Low molecular weight silanol fluids can be condensed to higher molecular weight silanol fluids by utilization of chlorophosphazene ($PNCl_2$) catalysts.

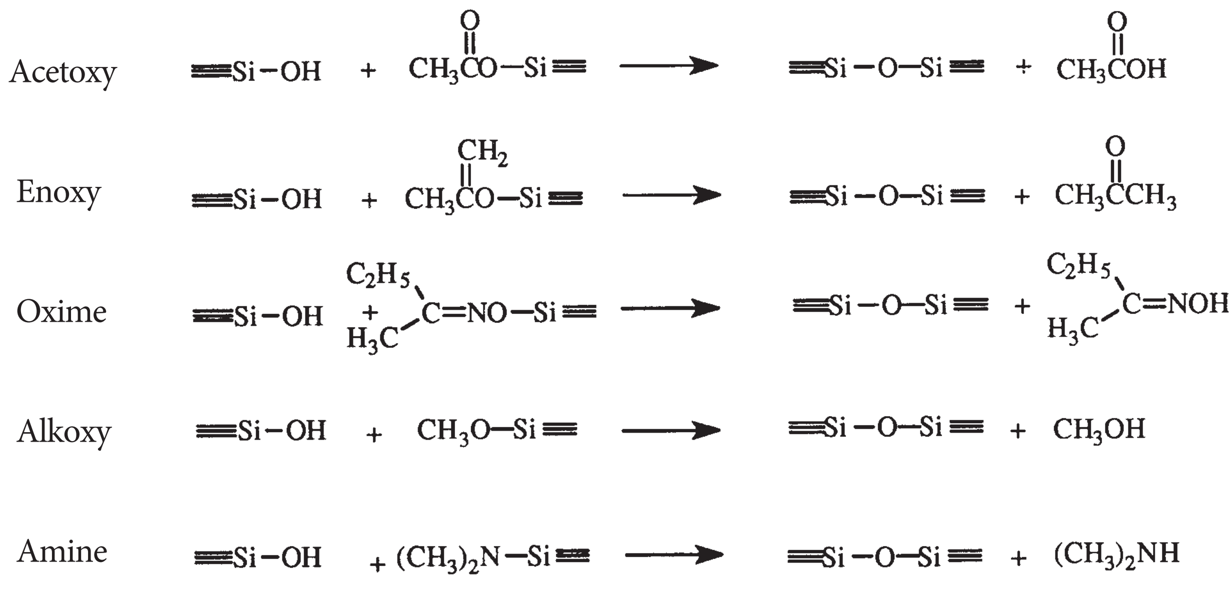
Condensation cure one-part and two-part RTV systems are formulated from silanol terminated polymers with molecular weights ranging from 15,000 to 150,000. One-part systems are the most widely used. One-part systems are crosslinked with moisture-sensitive multi-functional silanes in a two stage reaction. In the first stage, after compounding with fillers, the silanol is reacted with an excess of multi-functional silane. The silanol is in essence displaced by the silane. This is depicted below for an acetoxy system.



The silicone now has two groups at each end that are extremely susceptible to hydrolysis. The silicone is stored in this form and protected from moisture until ready for use. The second stage of the reaction takes place upon use. When the end groups are exposed to moisture, a rapid crosslinking reaction takes place.



The most common moisture cure systems are:



The crosslinking reaction of alkoxy systems are catalyzed by titanates, frequently in combination with tin compounds and other metal-organics. Acetoxy one-part systems usually rely solely on tin catalysts. The tin level in one-part RTV systems is minimally about 50ppm with a ratio of ~2500:1 for Si-OR to Sn, but typical formulations have up to ten times the minimum. Other specialty crosslinking systems include benzamido and mixed alkoxyamino. The organic (non-hydrolyzeable) substituents on the crosslinkers influence the speed of cure. Among the widely used crosslinkers vinyl substituted is the fastest: vinyl > methyl > ethyl >> phenyl.

Two-part condensation cure silanol systems employ ethylsilicates (polydiethoxysiloxanes) such as PSI-021 as crosslinkers and dialkyltincarboxylates as accelerators. Tin levels in these systems are minimally 500ppm, but typical formulations have up to ten times the minimum. Two-part systems are inexpensive, require less sophisticated compounding equipment, and are not subject to inhibition.

The following is a starting point formulation for a two-part RTV.[1]

10:1 ratio of A to B.

Part A			**Part B**		
DMS-S45	silanol fluid	70%	DMS-T21	100 cSt. silicone fluid	50%
SIS6964.0	silica powder	28%	SIS6964.0	silica powder	45%
PSI-021	ethylsilicate	2%	SND3260	DBTL tin catalyst	5%

This low tear strength formulation can be improved by substituting fumed silica for silica powder.

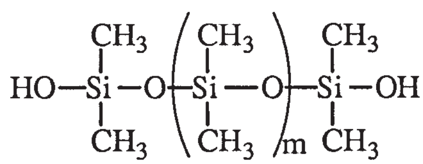
Incorporation of hydride functional (Si-H) siloxanes into silanol elastomer formulations results in foamed structures. The blowing agent is hydrogen which forms as a result of silanol condensation with hydrosiloxanes. Foam systems are usually two components which are compounded separately and mixed shortly before use.

[1] Flackett, D., "One Part Silicone Sealents in Silicon Compounds: Silanes and Silicones", 433-439, 2004

Condensation Cure Catalysts- see p. 68
Condensation Cure Crosslinkers- see p. 67

Silanol terminated diphenylsiloxane copolymers are employed to modify low temperature properties or optical properties of silicone RTVs. They are also utilized as flow control agents in polyester coatings. Diphenylsiloxane homopolymers are glassy materials with softening points >120°C that are used to formulate coatings and impregnants for electrical and nuclear applications.

The reactivity of silanol fluids is utilized in applications other than RTVs. Low viscosity silanol fluids are employed as filler treatments and structure control additives in silicone rubber compounding. Intermediate viscosity, 1000-10,000 cSt. fluids can be applied to textiles as durable fabric softeners. High viscosity silanol terminated fluids form the matrix component in tackifiers and pressure sensitive adhesives.

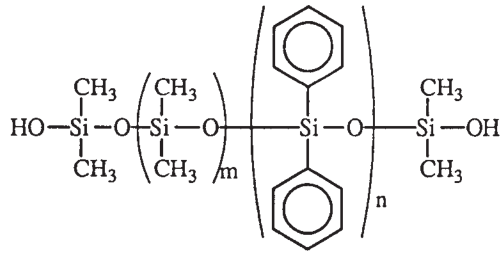


Silanol Terminated PolyDimethylsiloxanes

CAS: [70131-67-8] TSCA

Code	Viscosity	Molecular-Weight	wt% (OH)	(OH) Eq/kg	Specific Gravity	Refractive Index	Price/100g	Price/3kg	Price/16kg
DMS-S12	16-32	400-700	4.5-7.5	2.3-3.5	0.95	1.401			
DMS-S14	35-45	700-1500	3.0-4.0	1.7-2.3	0.96	1.402			
DMS-S15	45-85	2000-3500	0.9-1.2	0.53-0.70	0.96	1.402			
DMS-S21	90-120	4200	0.8-0.9	0.47-0.53	0.97	1.402			
DMS-S27	700-800	18,000	0.2	0.11-0.13	0.97	1.403			
DMS-S31	1000	26,000	0.1	0.055-0.060	0.98	1.403			
DMS-S32	2000	36,000	0.09	0.050-0.055	0.98	1.403			
DMS-S33*	3500	43,500	0.08	0.045-0.050	0.98	1.403			
DMS-S35	5000	49,000	0.07	0.039-0.043	0.98	1.403			
DMS-S42	18,000	77,000	0.04	0.023-0.025	0.98	1.403			
DMS-S45	50,000	110,000	0.03	0.015-0.017	0.98	1.403			
DMS-S51	90,000-150,000	139,000	0.02	0.010-0.015	0.98	1.403			

***also available as an emulsion (see DMS-S33M50 - p. 51)**



Silanol Terminated Diphenylsiloxane - Dimethylsiloxane Copolymers

TSCA

Code	Viscosity	Mole % Diphenylsiloxane	Molecular Weight	Refractive Index	wt% (OH)	Price/100g	Price/3kg
PDS-0338*	6000-8000	2.5-3.5	50,000	1.420	0.4-0.7		
PDS-1615**	50-60	14-18	900-1000	1.473	3.4-4.8		

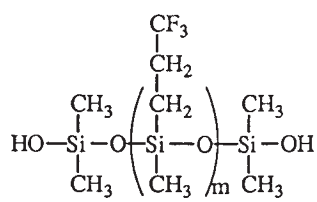
*CAS: [68083-14-7]   **CAS: [68951-93-9]

Employed as gloss enhancing additive for organic coatings and color stabilizers in sintered PTFE composites.

Silanol Terminated PolyDiphenylsiloxane

Tm: 142-155°; contains cyclics   CAS: [63148-59-4] TSCA

Code	Viscosity	Mole % Diphenylsiloxane	Molecular Weight	Refractive Index	wt% (OH)	Price/100g	Price/1kg
PDS-9931	glassy solid	100	1000-1400	1.610	2.4-3.4		



Silanol Terminated PolyTrifluoropropylMethylsiloxane

CAS: [68607-77-2] TSCA

Code	Viscosity	Mole % $CF_3CH_2CH_2MeSiO$	Molecular Weight	Refractive Index	wt% (OH)	Specific Gravity	Price/100g
FMS-9921	50-160	100	550-800	1.379	4-7%	1.28	
FMS-9922	150-250	100	800-1200	1.379	3-5%	1.28	

Silanol-Trimethylsilyl Modified Q Resins

CAS: [56275-01-5] TSCA

Code	Wgt % Q resin	Molecular Weight	wt%(OH)	Base Resin	solvent	Price/100g	Price/3kg
SQO-299	100	3000-4000	1.7-2.0	-	-		-
SQD-255	50	3000-4000	-	-	50% D5		
SQT-221	60	3000-4000	-	-	40% toluene		
SQS-261	35-40	3000-4000	-	DMS-S61*	40% toluene		

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*300,000-400,000 MW silanol terminated polydimethylsiloxane

Silanol-Trimethylsilyl-modified Q resins are often referred to as MQ resins. They serve as reinforcing resins in silicone elastomers and tackifying components in pressure sensitive adhesives.

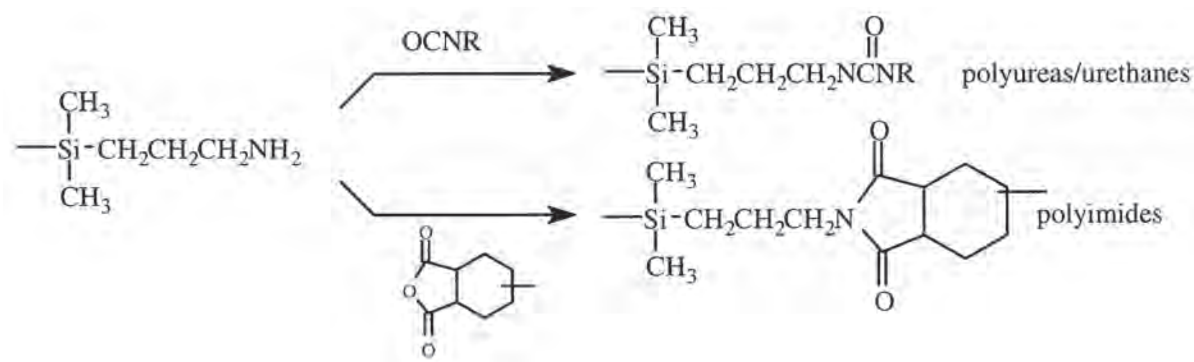
Silanol terminated vinylmethylsiloxane copolymers -
see Vinylmethylsiloxane Dimethylsiloxane Copolymers, silanol terminated - p. 11

$\equiv SiCH_2CH_2CH_2NH_2$

Amino Functional Silicones

Aminoalkylfunctional silicones have a broad array of applications as a result of their chemical reactivity, their ability to form hydrogen bonds and, particularly in the case of diamines, their chelating ability. Additional reactivity can be built into aminoalkyl groups in the form of alkoxy groups. Aminoalkylsiloxanes are available in the three classes of structures typical for silicone polymers: terminated, pendant group and T-structure.

Aminopropyl terminated polydimethylsiloxanes react to form a variety of polymers including polyimides, polyureas[1] and polyurethanes. Block polymers based on these materials are becoming increasingly important in microelectronic (passivation layer) and electrical (low-smoke generation insulation) applications. They are also employed in specialty lubricant and surfactant applications. Phosphorylcholine derivatives have been utilized as coatings for extended wear contact lens[2].



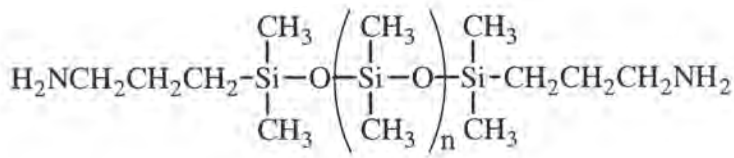
Amino functionality pendant from the siloxane backbone is available in two forms: (aminopropyl)-methylsiloxane-dimethylsiloxane copolymers and (aminoethylaminopropyl)-methylsiloxane-dimethylsiloxane copolymers. They are frequently used in modification of polymers such as epoxies and urethanes, internal mold releases for nylons and as lubricants, release agents and components in coatings for textiles and polishes.

Aminoalkyl T-structure silicones are primarily used as surface treatments for textiles and finished metal polishes (e.g. automotive car polishes). The resistance to wash-off of these silicones is frequently enhanced by the incorporation of alkoxy groups which slowly hydrolyze and form crosslink or reactive sites under the influence of the amine. The same systems can be reacted with perfluorocarboxylic acids to form low surface energy (<7 dynes/cm) films.[3]

[1]Riess, C. *Monatshefte Chem.* **2006**, *137*, 1434.

[2]Willis, S. et al *Biomaterials*, **2001**, *22*, 3261.

[3]Thürman, A. *J. Mater. Chem.* **2001**, *11*, 381.



Aminopropyl Terminated PolyDimethylsiloxanes Tg: -123° CAS: [106214-84-0] TSCA

Code	Viscosity	Molecular Weight	wt% Amine (NH_2)	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-A11	10-15	850-900	3.2-3.8	0.98	1.412		
DMS-A12	20-30	900-1000	3.0-3.2	0.98	1.411		
DMS-A15	50-60	3000	1.0-1.2	0.97	1.408		
DMS-A21	100-120	5000	0.6-0.7	0.98	1.407		
DMS-A31	900-1100	25,000	0.11-0.12	0.98	1.407		
DMS-A32	1800-2200	30,000	0.08-0.09	0.98	1.404		
DMS-A35	4000-6000	50,000	0.05-0.06	0.98	1.404		

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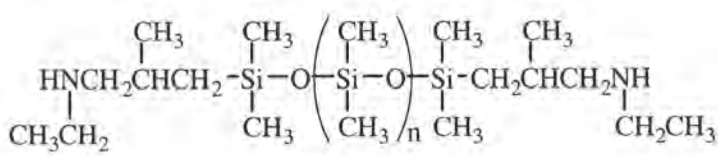
Reduced Volatility Grades

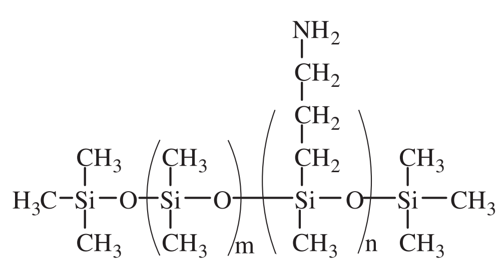
DMS-A32R*	1900-2300	30,000	0.08-0.09	0.98	1.404		

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



N-EthylAminoisobutyl Terminated PolyDimethylsiloxane CAS: [254891-17-3] TSCA

Code	Viscosity	Molecular Weight	% Amine (NH)	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-A211	8-12	800-1000	2.8-3.2	0.93	1.422		
DMS-A214	32-40	2500-3000	1.0-1.4	0.96	1.411		



AminopropylMethylsiloxane - Dimethylsiloxane Copolymers CAS: [99363-37-8] TSCA

Code	Viscosity	Molecular Weight	Mole % (Aminopropyl) MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/3kg
AMS-132	80-120	4500-6000	2-3	0.96	1.404		
AMS-152	100-300	7000-9000	4-5	0.97	1.408		
AMS-162	64-200	4000-5000	6-7	0.97	1.410		
AMS-163	1800-2200	50,000	6-7	0.97	1.411		
AMS-191	40-60	2000-3000	9-11	0.97	1.412		
AMS-1203	900-1100	20,000	20-25	0.98	1.426		

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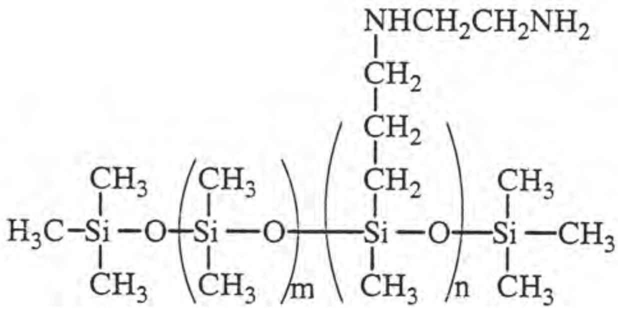


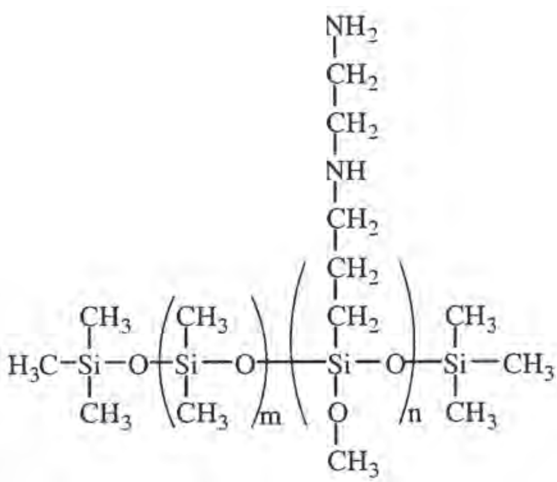
AminoethylaminopropylMethylsiloxane - Dimethylsiloxane Copolymers CAS: [71750-79-3] TSCA

Code	Viscosity	Molecular Weight	Mole % (Diamino-propyl)MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/3kg
AMS-233	900-1200	-	2 - 4	0.98	1.407		
AMS-2202	300-500	-	18-24	0.98	1.41		

AminoethylaminoisobutylMethylsiloxane - Dimethylsiloxane Copolymers CAS: [106842-44-8] TSCA

Code	Viscosity	Molecular Weight	Mole % (Diamino-isobutyl)MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/3kg
AMS-242	120-150	-	3-5	0.97	1.404		

Amine Functional Siloxanes with Alkoxy Groups



AminoethylaminopropylMethoxysiloxane - Dimethylsiloxane Copolymers with branch structure CAS: [67923-07-3] TSCA

Code	Viscosity	Molecular Weight	Mole % (Diamino-propyl)MethoxySiloxane	Specific Gravity	Base Equiv. meq/g	Price/100g	Price/3 kg
ATM-1112	100-200	5000-6500	0.5-1.5	0.97	0.55		
ATM-1322*	200-300	-	2 - 4	0.97	-		

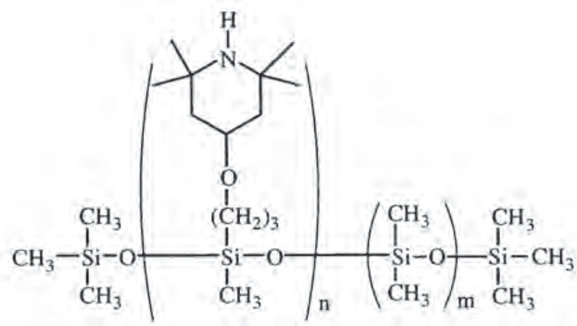
*also available as an emulsion

Diaminoalkoxysiloxanes cure to form durable films on metal substrates.

See ATM-1322M50- p.51
See water-borne silsesquioxanes- p. 51

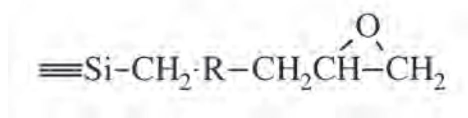
Hindered Amine Functional Siloxanes

Hindered Amine Light Stabilizers (HALS) may be incorporated into polysiloxane structures affording an ultraviolet light stabilizer system that is compatible with other stabilizers such as hindered phenolics and organophosphites and is strongly resistant to water extraction.



(Tetramethylpiperidinyloxy)propylMethylsiloxane-Dimethylsiloxane copolymer CAS: [182635-99-0] TSCA

Code	Viscosity	mole % HALS functional MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
UBS-0541	10000	4-6	1.00	1.408		
UBS-0822	250	7-9	0.98	1.409		



Epoxy Functional Silicones

Difunctional and multifunctional epoxy silicones 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 cellulosics of polyacrylate resins.

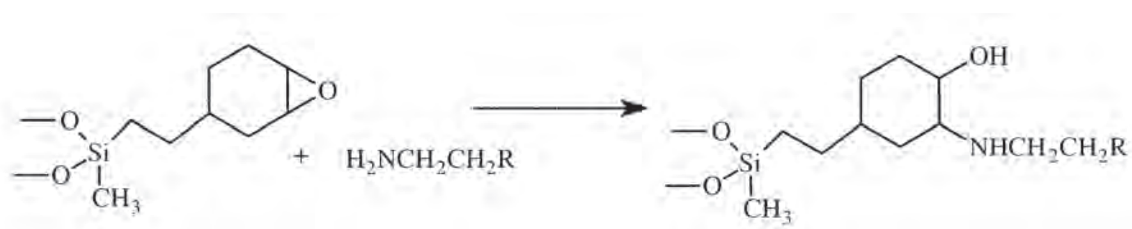
The compatibility of epoxy functional silicones with conventional epoxies varies. In simple unfilled systems, total solubility is required. For filled systems, it is often desireable to consider systems that are miscible but have only limited solubility since microphase separation can allow a mechanism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

	Epoxy Type		
Gelest Product	Bisphenol	Polyglycol	Cycloaliphatic
SIB1092.0	miscible	soluble	soluble
PMS-E11	soluble	soluble	soluble
DMS-E09	soluble	soluble	soluble
DMS-E11	insoluble	miscible	miscible
EMS-622	insoluble	miscible	insoluble

(10% silicone 90% epoxy)



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

Epoxypropoxypropyl Terminated PolyDimethylsiloxanes

CAS: [102782-97-8] TSCA

Code	Viscosity	Molecular Weight	Epoxy-Eq/kg	Specific Gravity	Refractive Index	Price/100g	Price/1 kg
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	0.45-0.35	0.98	1.408		

Used in preparation of photocurable silicone for soft lithography[1].

[1]Choi, D. et al, *JACS*, **2003**, *125*, 4060

Used in preparation of photocurable silicone for soft lithography[1].

(Epoxypropoxypropyl Methylsiloxane)-(Dimethylsiloxane) Copolymers

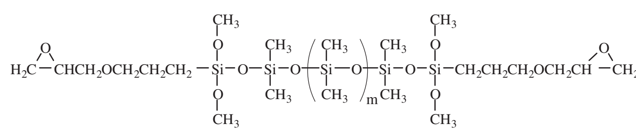
CAS: [68440-71-7] TSCA

EMS-622	200-300	7,000-9,000	5-7	0.99	1.412		

Epoxypropoxypropyl Terminated PolyPhenylMethylsiloxanes

CAS: [102782-98-9] TSCA

PMS-E11	15-30	500-600	3.0-3.6	1.01	1.475		
PMS-E15	30-50	1200-1500	1.0-1.7	1.01	1.490		

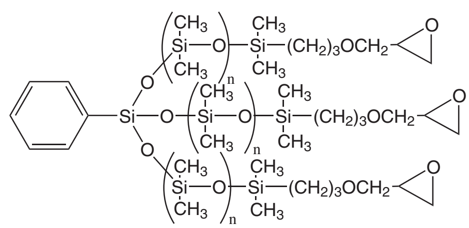


(Epoxypropoxypropyl)dimethoxysilyl Terminated PolyDimethylsiloxanes

CAS: [188958-73-8] TSCA

DMS-EX21	80-120	3500-4000	0.48-0.5	0.98	1.408		

Multifunctional Siloxanes

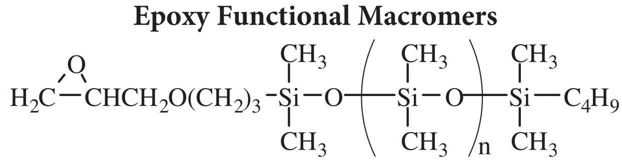


MonoPhenyl functional Tris(Epoxy Terminated PolyDimethylsiloxane)

CAS: [90393-83-2] TSCA

Code	Viscosity	Molecular Weight	Epoxy–Eq/Kg	Melting Point	Specific Gravity	Refractive Index	Price/25g
MCT-EP13	30-35	500-750	4-6	-73°	1.05	1.4742	

Epoxy Functional Macromers



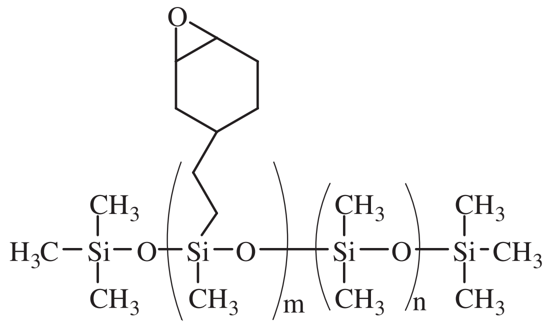
Mono-(2,3-Epoxy)Propylether Terminated PolyDimethylsiloxane

CAS: [127947-26-6]

Code	Viscosity	Molecular Weight	Epoxy–Eq/Kg	Specific Gravity	Refractive Index	Price/100g	Price/1 kg
MCR-E11	10-15	1000	0.8-1.2	0.96	1.410		
MCR-E21	100-120	5000	0.1-0.3	0.97	1.408		

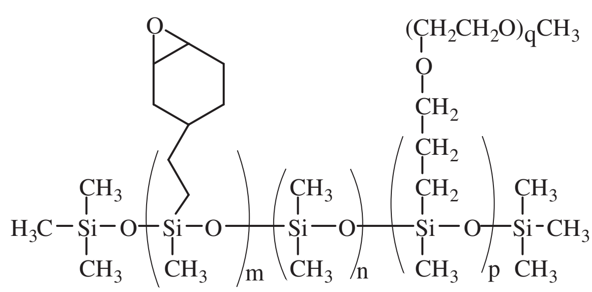
Cycloaliphatic Epoxy Silicones

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.



(EpoxycyclohexylethylMethylsiloxane) - Dimethylsiloxane Copolymers **CAS: [67762-95-2] TSCA**

Code	Viscosity	Molecular Weight	Mole % (Epoxycyclohexyl)-ethylMethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/1 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) Terpolymers

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			

CAS: [69669-36-9] TSCA

Epoxycyclohexylethyl Terminated PolyDimethylsiloxanes **CAS: [102782-98-9] TSCA**

Code	Viscosity	Molecular Weight	Epoxy-Eq/Kg	Specific Gravity	Refractive Index	Price/100g	Price/1kg
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		

see also SIB1092.0 p.30

$$\equiv Si{-}CH_2{-}R{-}(OCH_2CH_2)_nOH$$

Carbinol Functional Silicones

Carbinol (Hydroxy) Functional Siloxanes

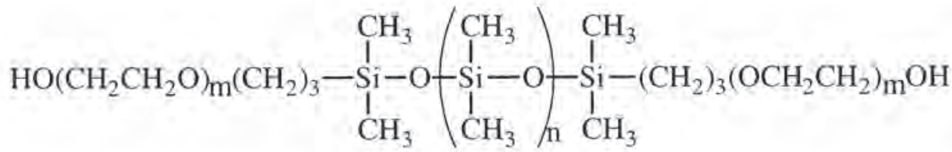
The term carbinol refers to a hydroxyl group bound to carbon (C-OH) and is frequently used in silicone chemistry to differentiate them from hydroxyl groups bound to silicon (Si-OH) which are referred to as silanols. Carbinol terminated siloxanes contain primary hydroxyl groups which are linked to the siloxane backbone by non-hydrolyzeable transition groups. Frequently a transition block of ethylene oxide or propylene oxide is used. Carbinol functional polydimethylsiloxanes may be reacted into polyurethanes, epoxies, polyesters and phenolics.

Applications include additives for urethane leather finishes and as reactive internal lubricants for polyester fiber melt spinning. They are also utilized as surfactants and processing aids for dispersion of particles in silicone formulations.

Polyethyleneoxide transition blocks are more polar than polypropyleneoxide blocks and maintain a broad range of liquid behavior. Carbinol terminated siloxanes with caprolactone transition blocks offer a highly polar component which enables compatibility in a variety of thermoplastic resins.

Mono(dicarbinol) terminated polydimethylsiloxanes are macromers with diol termination on one end of a polydimethylsiloxane chain. In contrast with telechelic carbinol terminated polydimethylsiloxanes, they have the unique ability to react with isocyanates to form urethanes with pendant silicone groups. In this configuration the mechanical strength of the polyurethane is maintained while properties such as hydrophobicity, release and low dynamic coefficient of friction are achieved. For example, a 2 wgt % incorporation of MCR-C61 or MCR-C62 into an aromatic urethane formulation increases water contact angle from 78° to 98°. The reduction of coefficient of friction and increased release of urethanes formulated with diol terminated macromers has led to their acceptance as additives in synthetic leather.

Carbinol functional Macromers - see Macromers p. 45



Carbinol (Hydroxyl) Terminated PolyDimethylsiloxanes

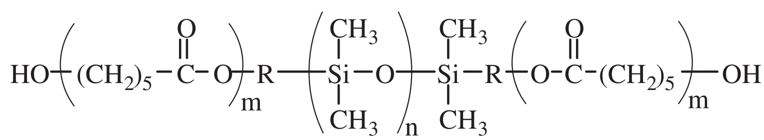
Code	Viscosity	Molecular Weight	Weight % Non-Siloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-C15	30-50	1000	20	0.98	1.417		
DMS-C16	50-65	600-850	-	0.97	1.416		
DMS-C21	110-140	4500-5500	4	0.98	1.407		
DMS-C23	300-350	10,000	-	0.98	1.406		
DBE-C25*	400-450	3500-4500	60	1.07	1.450		
DBP-C22**	200-300	2500-3200	45-55	0.99	1.434		

COMMERCIAL

note: for DMS-C15, DMS-C21, DMS-C23 m=1 CAS: [156327-07-0]; for DMS-C16 m=0 CAS: [104780-66-7] TSCA

*A-B-A ethylene oxide - dimethylsiloxane - ethylene oxide block polymer CAS: [68937-54-2]

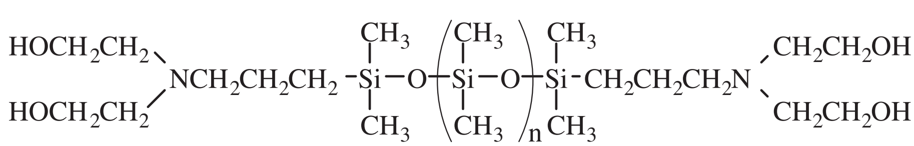
**A-B-A propylene oxide - dimethylsiloxane - propylene oxide block copolymer m=12-16 CAS: [161755-53-9]



Carbinol (Hydroxyl) Terminated PolyDimethylsiloxanes

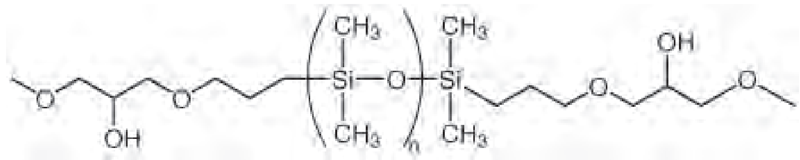
Code	Melting Point	Molecular Weight	Weight % Non-Siloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DBL-C31*	52-6°	5700-6900	50	1.05	-		
DBL-C32**	80-85°	7000-8000	25-30	1.05	-		

A-B-A caprolactone - dimethylsiloxane - caprolactone block polymer, *m=15-20; **m=7-10 CAS: [120359-07-1]



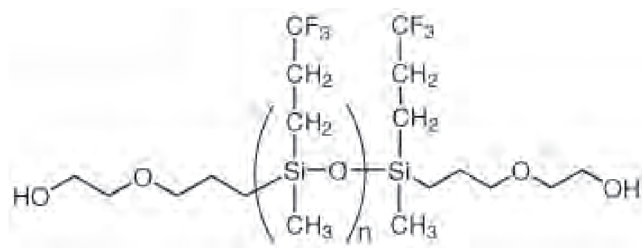
[Bis(Hydroxyethyl)Amine] Terminated PolyDimethylsiloxanes

Code	Viscosity	Molecular Weight	Weight % Non-Siloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-CA21	120-160	3000	10	0.97	1.414		



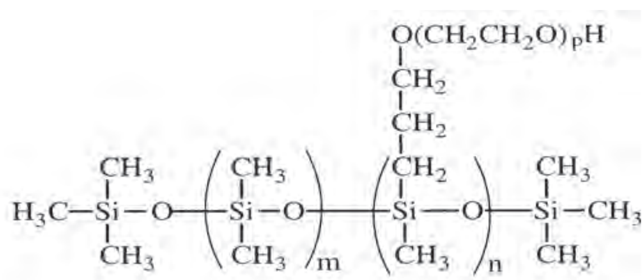
(2-Hydroxy-3-methoxypropoxy)propyl Terminated PolyDimethylsiloxane

Code	Viscosity	Molecular Weight	Weight % Non-siloxane	Specific Gravity	Refractive Index	Price/100g
DMS-CS26	50-70	1500-2000	15-20	0.98	1.414	



Carbinol (Hydroxyl) Terminated PolyTrifuoropropylmethylsiloxane

Code	Viscosity	Molecular Weight	Weight % Non-siloxane	Specific Gravity	Refractive Index	Price/100g
FMS-C32	1500-2000	3500-5000	4-5	1.28	1.380	

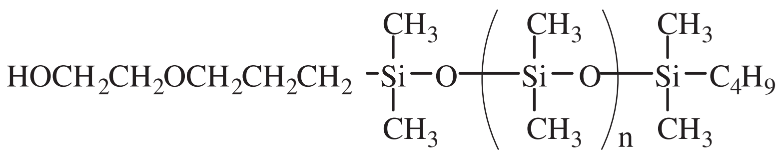


(Carbinol functional)Methylsiloxane-Dimethylsiloxane Copolymers

Code	wt% Non-Siloxane	OH Content (meq/g)	Glycol chains/mol	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	CAS	Price 100g	Price 1kg
CMS-221	20-25	0.7-0.9	3-4	125-150	4000	1.00	1.419	68937-54-2		
CMS-222	20	0.4-0.6	2-3	150-200	5500-6500	0.98	1.411	68957-00-6		
CMS-832*	50-60	0.2-0.3	-	1000-2000	2000-5000	1.09	1.505	200443-93-2		
CMS-626	65	0.3-0.5	1-3	550-650	4500-5500	1.09	1.458	68937-54-2		

*(Hydroxypolyethyleneoxypropyl)methylsiloxane-(3,4-Dimethoxyphenylpropyl)methylsiloxane-Dimethylsiloxane terpolymer

Carbinol Functional Macromers

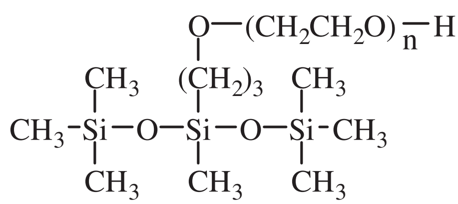


MonoCarbinol Terminated PolyDimethylsiloxane CAS: [207308-30-3] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-C12	15-20	1000	1.409	0.96		
MCR-C18	60-140	5000	1.405	0.97		
MCR-C22	250	10,000	1.404	0.98		

Dispersants for particles, including quantum dots, in silicone elastomers.[1]

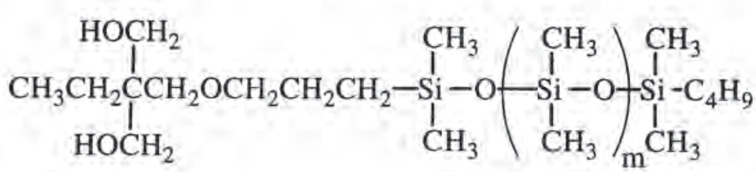
1. Tag, P. et al, J. Mater. Chem. C, **2013**, 1, 86



MonoCarbinol Terminated Functional PolyDimethylsiloxanes - symmetric CAS: [67674-67-3] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCS-C11*	5-15	280-380	1.413	0.905		
MCS-C13**	35-40	550-650	1.446	1.02		

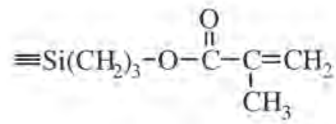
* n=0, CAS [17962-67-3] **n=6-9, CAS[67674-67-3]



MonoDiCarbinol Terminated PolyDimethylsiloxane CAS: [218131-11-4]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-C61	50-60	1000	1.417	0.97		
MCR-C62	100-125	5000	1.409	0.97		
MCR-C63	200-250	15,000	1.406	0.97		

Diol terminated silicones improve electrical and release properties of polyurethanes and can be components in synthetic leather.

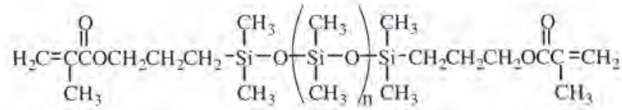


Methacrylate and Acrylate Functional Siloxanes

Methacrylate and Acrylate functional siloxanes undergo the same reactions generally associated with methacrylates and acrylates, the most conspicuous being radical induced polymerization. Unlike vinylsiloxanes which are sluggish compared to their organic counterparts, methacrylate and acrylate siloxanes have similar reactivity to their organic counterparts. The principal applications of methacrylate functional siloxanes are as modifiers to organic systems. Upon radical induced polymerization, methacryloxypropyl terminated siloxanes by themselves only increase in viscosity. Copolymers with greater than 5 mole % methacrylate substitution crosslink to give non-flowable resins. Acrylate functional siloxanes cure at greater than ten times as fast as methacrylate functional siloxanes on exposure to UV in the presence of a photoinitiator such as ethylbenzoin. They form permeable membranes for fiber-optic oxygen and glucose sensors.[1]

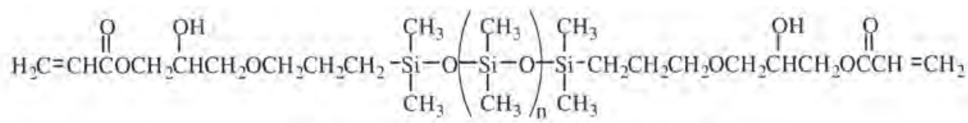
Oxygen is an inhibitor for methacrylate polymerization in general. The high oxygen permeability of siloxanes usually makes it necessary to blanket these materials with nitrogen or argon in order to obtain reasonable cures.

[1]Li, L. et al. *Analyt. Chem.* **1995**, *67*, 3746.



Methacryloxypropyl Terminated PolyDimethylsiloxanes CAS: [58130-03-3]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
DMS-R05	4 - 6	380-550	1.448	0.97		
DMS-R11	8-14	900-1200	1.422	0.98		
DMS-R18	50-90	4500-5500	1.409	0.98		
DMS-R22	125-250	10,000	1.405	0.98		
DMS-R31	1000	25,000	1.404	0.98		



(3-Acryloxy-2-hydroxypropoxypropyl) Terminated PolyDimethylsiloxanes CAS: [128754-61-0]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
DMS-U21	60-140	600-900	1.426	0.99		

Acryloxy Terminated Ethyleneoxide - Dimethylsiloxane-Ethyleneoxide ABA Block Copolymers CAS: [117440-21-8] TSCA

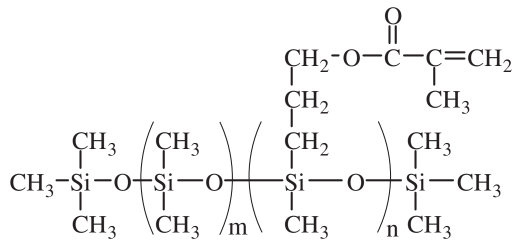
Code	Viscosity	Molecular Weight	MW PDMS block	Refractive Index	Specific Gravity	Price/100g	Price/1kg
DBE-U12*	80-120	1500-1600	700-800	1.450	1.03		
DBE-U22**	110-150	1700-1800	1000-1200	1.445	1.03		

* 45-55 wgt% CH_2CH_2O **30-35 wgt% CH_2CH_2O

Methacryloxypropyl Terminated Branched PolyDimethylsiloxanes CAS: [80722-63-0]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
SIB1400.0	14-18	683	1.432	0.99		

See also- methacrylate functional macromers- p. 48



(Methacryloxypropyl)methylsiloxane - Dimethylsiloxane Copolymers CAS: [104780-61-2] TSCA

Code	Viscosity	Specific Gravity	Mole% (Methacryloxypropyl) Methylsiloxane	Refractive Index	Price/100g
RMS-044	8000-10,000	0.98	4 - 6	1.410	
RMS-033	1000-2000	0.98	2 - 4	1.410	
RMS-083	2000-3000	0.99	7 - 9	1.418	
RMS-992*	75-125	0.99	99-100	1.465	

(Acryloxypropyl)methylsiloxane - Dimethylsiloxane Copolymers CAS: 158061-40-6

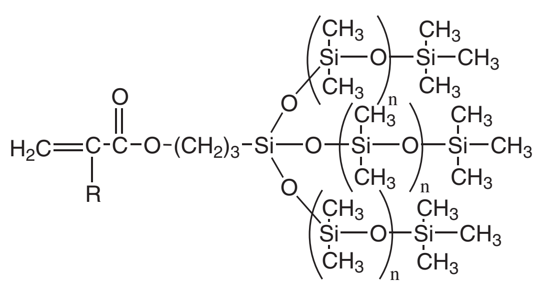
Code	Viscosity	Specific Gravity	Mole% (Acryloxypropyl) Methylsiloxane	Refractive Index	Price/100g
UMS-182	80-120	1.01	15-20	1.427	
UMS-992*	50-125	1.10	99-100	1.469	

*homopolymer

(3-Acryloxy-2-Hydroxypropoxypropyl)Methylsiloxane-Dimethylsiloxane Copolymer

Code	Viscosity	Molecular Weight	Mole% (Acryloxyfunctional) Methylsiloxane	Price/100g
UCS-052	500-1,500	7500-8500	4-6	

amber liquid



Methacryloxypropyl T-structure Siloxanes CAS: [67923-18-6] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g
RTT-1011	10 - 20	570-620	0.95	1.422	

contains multiple branch points (>2 methacrylate groups)

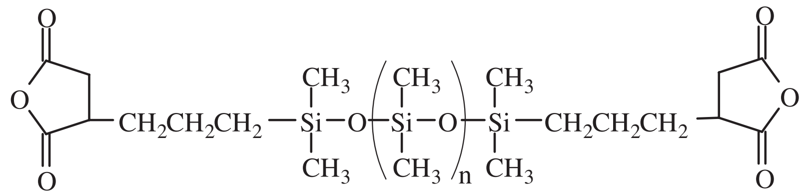
Acryloxypropyl T-structure Siloxanes

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g
UTT-1012	10 - 30	500-900	0.96	1.421	

contains multiple branch points (>2 acrylate groups)

Methacrylate functional macromers- see p. 48

Anhydride, Bicycloheptenyl, and Carboxylate functional Silicones



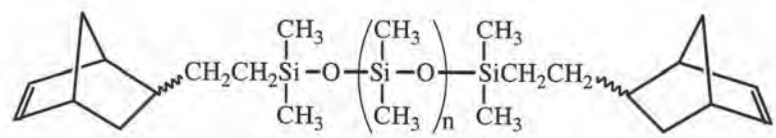
Anhydride functional Silicones

Anhydride functional siloxanes can be reacted directly with amines and epoxides or hydrolyzed to give dicarboxylic acid terminated siloxanes.

Succinic Anhydride Terminated PolyDimethylsiloxane

CAS: [161208-23-8]

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



Bicycloheptenyl functional Silicones

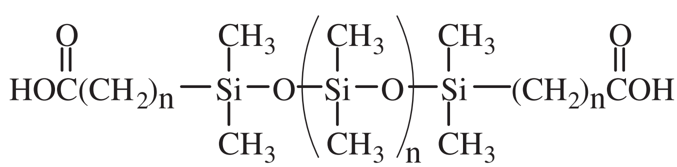
Bicycloheptenyl terminated silicones undergo ring-opening metathesis polymerization (ROMP) reactions.[1,2]

[1] Finkelstein, E. 10th Int'l Organosilicone Symp. Proc, **1993**, P-120.
[2] Angeletakis, C. et al, US Pat. 6,455,029, **2002.**

(Bicycloheptenyl)ethyl Terminated PolyDimethylsiloxane

CAS: [945244-93-9]

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/25g	Price/100g
DMS-NB25	400-600	12,000-16,000	0.98	1.406		
DMS-NB32	1300-1800	16,000-20,000	0.96	1.406		



Carboxylate functional Silicones

Carboxylic acid functional siloxanes are excellent rheology and wetting modifiers for polyesters. When reacted with inorganic bases or amines, they perform as anti-static surfactants and lubricants.

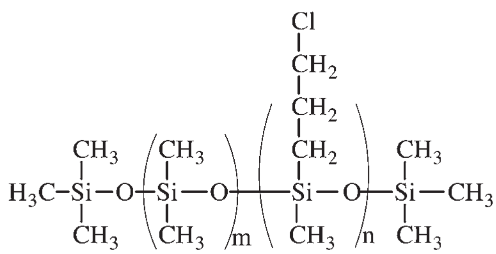
(Carboxyalkyl) Terminated PolyDimethylsiloxane

Code	Viscosity	Molecular Weight	Termination	Specific Gravity	Refractive Index	Price/25g	Price/100g
DMS-B12*	15-30	1000	Carboxydecyl	0.96	1.421		
DMS-B25*	450-550	10,000	Carboxydecyl	0.97	1.403		
DMS-B31**	800-1200	28,000	Carboxypropyl	0.98	-		

*CAS: [58130-04-4] ** [158465-59-9]

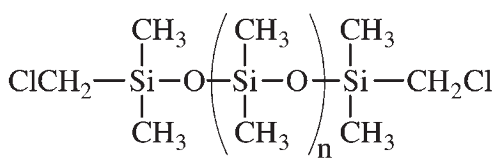
Chloroalkyl Functional Silicones

Chlororopropyl-functional silicones are moderately stable fluids which are reactive with polysulfides and durable press fabrics. They behave as internal lubricants and plasticizers for a variety of resins where low volatility and flammability resistance is a factor. Chloromethyl and chloromethylphenethyl terminated polydimethylsiloxanes offer access to block copolymers through various polymerization chemistries such as ATRP & RAFT.



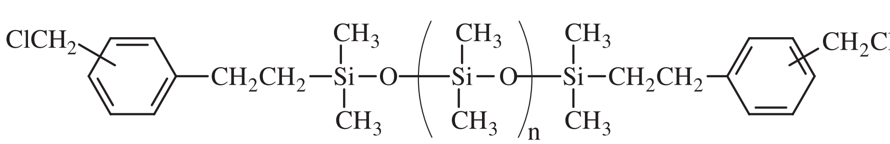
(Chloropropyl)Methylsiloxane - Dimethylsiloxane Copolymers CAS: [70900-20-8] TSCA

Code	Viscosity	Molecular Weight	Mole % (Chloro-propyl)MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
LMS-152	300-450	7500-10,000	14 - 16	1.01	1.420		



Chloromethyl terminated PolyDimethylsiloxane CAS: [158465-60-2]

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-L21	100-150	6000-8000	0.98	1.406		



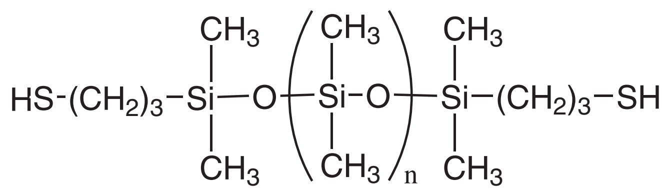
Chloromethylphenethyl terminated PolyDimethylsiloxane

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-LP21	100-150	5000	0.98	1.420		

Mercapto-functional Silicones

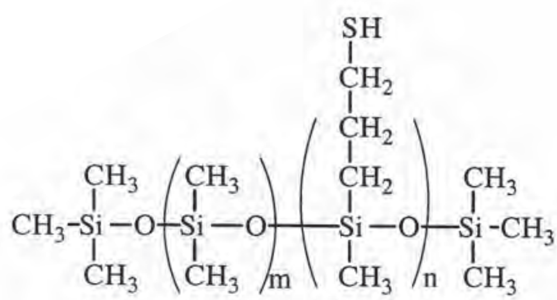
Mercapto-functional siloxanes strongly adsorb onto fibers and metal surfaces. High performance toner fluids for reprographic applications are formulated from mercapto-fluids. As components in automotive polishes they are effective rust inhibitors. They act as internal mold release agents for rubber and semi-permanent lubricants for automotive weather stripping. Mercapto-fluids are valuable additives in cosmetic and hair care products. They also undergo radical initiated (including UV) addition to unsaturated resins. Homopolymers are used as crosslinkers for vinylsiloxanes in rapid UV cure fiber optic coatings[1] and soft lithography stamps.[2]

[1] Mueller, U. et al. *J. Macromol. Sci. Pure Appl. Chem.* **1996**, *A43*, 439.
[2] Campos, L. et al. *Chem. Mater.* **2009**, *21*, 531.



Mercaptopropyl terminated PolyDimethylsiloxane CAS: [308072-58-4]

Code	Viscosity	Molecular Weight	Specific Gravity	Refractive Index	Price/100g
DMS-SM21	80-120	10000	0.97	1.412	



(Mercaptopropyl)Methylsiloxane - Dimethylsiloxane Copolymers CAS: [102783-03-9] TSCA

Code	Viscosity	Molecular Weight	Mole % (Mercapto-propyl) MethylSiloxane	Specific Gravity	Refractive Index	Price/100g	Price/1kg
SMS-022	120-250	6000-8000	2 - 3	0.97	1.406		
SMS-042	120-170	6000-8000	4 - 6	0.98	1.408		
SMS-142	100-200	3000-4000	13 - 17	0.98	1.410		
SMS-992*	75-150	4000-7000	99-100	0.97	1.496		

*homopolymer, contains cyclics

Polydimethylsiloxanes with Hydrolyzable Functionality

Polydimethylsiloxanes with hydrolyzable functionality react with water to produce silanol terminated fluids of equivalent or higher degrees of polymerization. Polymers with this category of reactivity are almost never directly hydrolyzed. Chlorine and dimethylamine terminated fluids are usually employed in ordered chain extension and block polymer synthesis, particularly urethanes and polycarbonates. Acetoxy and dimethylamine terminated fluids can also be used as unfilled bases for rapid cure RTVs.

Chlorine Terminated PolyDimethylsiloxanes

CAS: [67923-13-1] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-K05	3-8	425-650	1.00		
DMS-K13	20-50	2000-4000	0.99		
DMS-K26	500-800	15,000-20,000	0.99		

Chlorine Terminated Nonafluorohexylmethylsiloxane – Dimethylsiloxane Copolymers

CAS: [908858-79-7] TSCA-L

Code	Viscosity	Molecular Weight	Specific Gravity	Price/25g	Price/1kg
FMS-K11	5-15	500-1000	1.46		

Diacetoxymethyl Terminated PolyDimethylsiloxanes

CAS: [158465-54-4] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-D33	2000-4000	36,000	0.99		

Dimethylamino Terminated PolyDimethylsiloxanes

CAS: [67762-92-9] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-N05	3 - 8	450-600	0.93		
DMS-N12	15 - 30	1550-2000	0.95		

hazy liquids

Ethoxy Terminated PolyDimethylsiloxanes

CAS: [70851-25-1] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-XE11	5-10	800-900	0.94		

TriEthoxysilylethyl Terminated PolyDimethylsiloxanes

CAS: [195158-81-7] / [210548-76-8]

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-XT11	8-12	600-900	0.96		

Methoxy Terminated PolyDimethylsiloxanes

CAS: [68951-97-3] TSCA

Code	Viscosity	Molecular Weight	Specific Gravity	Price/100g	Price/1kg
DMS-XM11	5-12	900-1000	0.94		

MethoxyMethylsiloxane-Dimethylsiloxane copolymer

methoxy terminated with branch structure

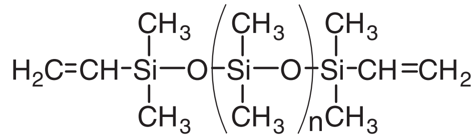
CAS: [68440-84-6] TSCA

Code	Viscosity	Mole % MethoxyMethylsiloxane	Specific Gravity	Price/100g	Price/1kg
XMS-5025.2*	2-5	10-20	0.83		

*20% in isopropanol

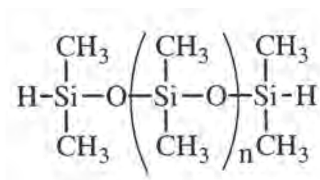
Monodisperse Reactive Silicones via Anionic Living Polymerization

Monodisperse silicones offer certain advantages over standard telechelic silicones. They have a discrete molecular weight and no low molecular weight non-functional cyclic siloxanes that can migrate out of the fluid or materials produced with them. Higher molecular weight vinyl functional materials can be used as base silicones for 2-part RTVs.



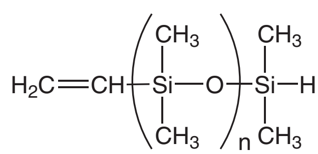
Vinyl Terminated PolyDimethylsiloxane, monodisperse

Code	Viscosity	Molecular Weight	Wgt % Vinyl	Vinyl - Eq/kg	Density	Price/100g	Price/3kg
DMS-Vm31	1000	28,000	0.18-0.26	0.07-0.10	0.97		
DMS-Vm35	5000	49,500	0.10-0.13	0.04-0.05	0.97		
DMS-Vm41	10,000	62,700	0.08-0.12	0.03-0.04	0.97		



Hydride Terminated PolyDimethylsiloxane, monodisperse

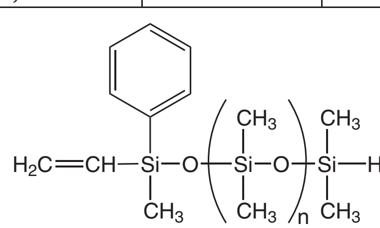
Code	Viscosity	Molecular Weight	wt% H	Equilvalent Weight	Specific Gravity	Refractive Index	Price/100g	Price/1kg
DMS-Hm15	50	3000-3500	0.07	1,625	0.96	1.403		
DMS-Hm21	100	5500	0.04	2,750	0.96	1.403		
DMS-Hm25	500	17,200	0.01	8,600	0.97	1.403		



α-MonoVinyl-Ω-MonoHydride Terminated PolyDimethylsiloxane

CAS: [104780-63-4] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
DMS-HV15	40-60	2,000-3,000	1.404	0.96		
DMS-HV22	150-250	10,000	1.403	0.97		
DMS-HV31	600-1,000	25,000	1.403	0.97		



α-MonoVinyl-MonoPhenyl-Ω-MonoHydride-Terminated PolyDimethylsiloxane

CAS: [1422279-25-1]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
PMM-HV12	20	2000	1.4135	0.97		

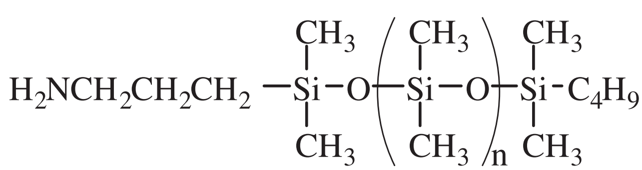
Macromers and Monofunctional Silicones

Macromers are relatively high molecular weight species with a single functional polymerizeable group which, although used as monomers, have high enough molecular weight or internal monomer units to be considered polymers. A macromer has one end-group which enables it to act as a monomer molecule, contributing only a single monomeric unit to a chain of the final macromolecule. The term macromer is a contraction of the word macromonomer. Copolymerization of macromers with traditional monomers offers a route to polymers that are usually associated with grafting. Macromers provide a mechanism for introducing pendant groups onto a polymer backbone with conditions consistent with radical, condensation or step-growth polymerization but result in pendant groups that are usually associated with significantly different polymerization conditions and significantly different physical properties than the main polymer chain. Siloxane macromers afford a mechanism for introducing a variety of desirable properties without disrupting the main chain integrity of an organic polymer.

Two general classes of siloxane macromers are available: asymmetric and symmetric. Asymmetric macromers have been the most widely used, but symmetric monomers, which open a path for hyper-branched polymers, are anticipated to have increased commercial utilization. Macromers are primarily defined by the functional group anticipated to be the reactive functionality in a polymerization. Other modifications usually effect a greater degree of compatibility with the proposed bulk polymer. These include modifying or replacing the most widely used siloxane building block, dimethylsiloxane, with other siloxanes, typically trifluoropropylmethylsiloxane.

MonoAminopropyl Terminated PolyDimethylsiloxanes

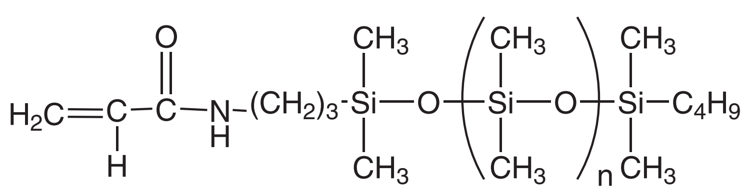
MonoAminopropyl Terminated PolyDimethylsiloxanes are most widely used as intermediates for acrylamide functional macromers or as terminating groups for polyamides and polyimides.



MonoAminopropyl Terminated PolyDimethylsiloxanes - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
MCR-A11	8-12	800-1000	1.411	0.92	
MCR-A12	18-25	2000	1.411	0.97	

Mono Acrylamidopropyl Terminated PolyDimethylsiloxanes

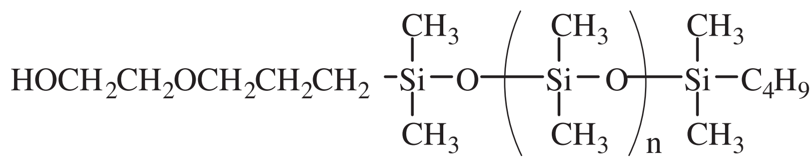


MonoAcrylamidopropyl Terminated PolyDimethylsiloxane

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
MCR-W15	50-70	1000-1500	1.418	0.96	

MonoCarbinol Terminated PolyDimethylsiloxanes

Monocarbinol terminated silicones are pigment dispersants and compatibilizers for a variety of resin systems including epoxies, urethanes and silicones. The action of these materials has been likened to surfactants for non-aqueous systems.



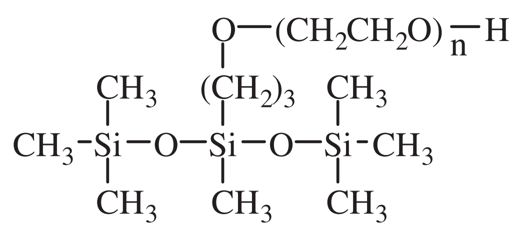
MonoCarbinol Terminated PolyDimethylsiloxanes - asymmetric CAS: [207308-30-3] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-C12	15-20	1000	1.409	0.96		
MCR-C18	80-90	5000	1.405	0.97		
MCR-C22	250	10000	1.404	0.98		

hydroxyethoxypropyl terminated

Dispersants for particles, including quantum dots, in silicone elastomers.[1]

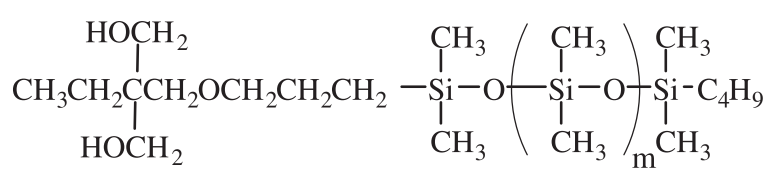
1. Tag, P. et al, J. Mater. Chem. C, **2013**, 1, 86



MonoCarbinol Terminated Functional PolyDimethylsiloxanes - symmetric CAS: [67674-67-3] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCS-C11*	5-15	280-380	1.413	0.905		
MCS-C13**	35-40	550-650	1.446	1.02		

* n=0, CAS: [17962-67-3] **n=6-9, CAS: [67674-67-3]



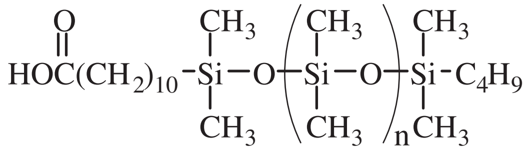
MonoDiCarbinol Terminated PolyDimethylsiloxanes - asymmetric CAS: [218131-11-4]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-C61	50-60	1000	1.417	0.97		
MCR-C62	100-125	5000	1.409	0.97		
MCR-C63	200-250	15,000	1.406	0.97		

Diol terminated silicones improve electrical and release properties of polyurethanes and can be components in synthetic leather.

MonoCarboxy Terminated PolyDimethylsiloxanes

Carboxylic acid terminated silicones form esters. They also behave as surfactants.

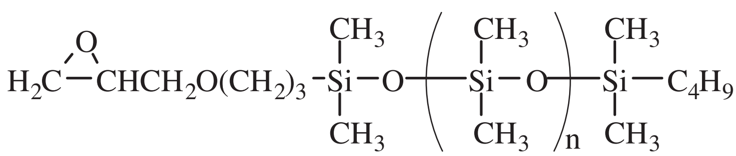


MonoCarboxydecyl Terminated PolyDimethylsiloxanes - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-B12	20	1500	1.415	0.94		

MonoEpoxyTerminated PolyDimethylsiloxanes

Monofunctional epoxy terminated silicones have been utilized as modifiers for aliphatic epoxy systems. They have been used as thermal stress reduction additives to epoxies employed in electronic applications. They have also been acrylated to form UV curable macromers.



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

CAS:[1108731-31-2]/ [127947-26-6] TSCA

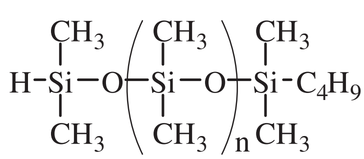
Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-E11	10-15	1000	1.410	0.96		
MCR-E21	120	5000	1.408	0.97		

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

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

MonoHydrideTerminated PolyDimethylsiloxanes

Hydride functional macromer can be derivatized or reacted with a variety of olefins by hydrosilylation. They are also modifiers for platinum-cure silicone elastomers.



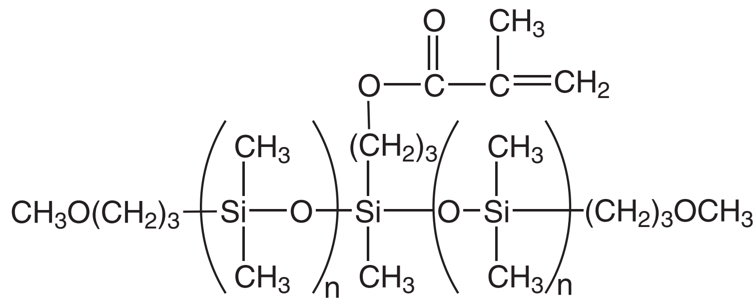
MonoHydride Terminated PolyDimethylsiloxanes - asymmetric

CAS:[1038821-58-7] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-H07	5-8	800-900	1.404	0.96		
MCR-H11	8-12	900-1100	1.407	0.96		
MCR-H21	80-120	4500-5000	1.411	0.96		
MCR-H22	150-250	10,000	1.411	0.98		

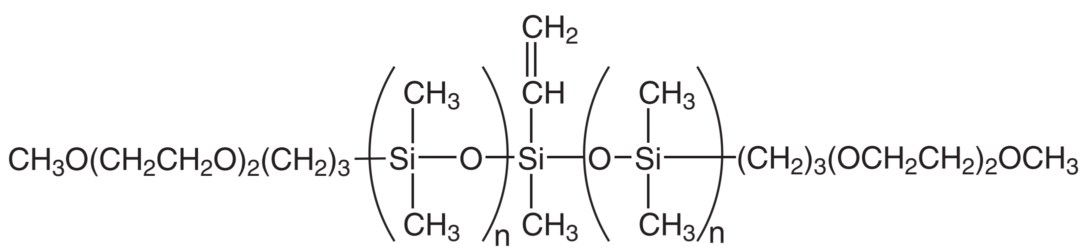
Polar Endcapped Symmetric Macromers

Macromers with polar terminations can be used as additives into more polar organic resins to add silicone characteristics with reduced likelihood of phase separation.



MonoMethacryloxypropyl Functional PolyDimethylsiloxanes, methoxypropyl terminated - symmetric

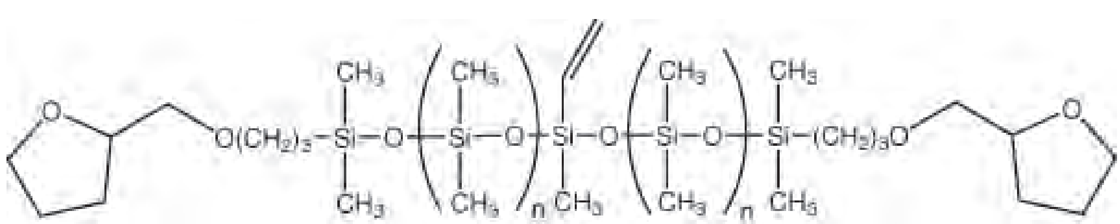
Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
MCS-MX11	8-12	1000	1.430	0.96	



CAS:[1586018-77-0]

MonoVinyl Functional PolyDimethylsiloxanes, methoxy(diethyleneoxide)propyl terminated - symmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
MCS-VX15	40-60	5000	1.412	0.96	



CAS:[1581252-46-1]

MonoVinyl Functional PolyDiMethylsiloxanes, Tetrahydrofurfuryloxypropyl terminated - symmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
MCS-VF14	35-45	2,000-3,000	1.414	.097	

MonoMethacrylate Terminated PolyDimethylsiloxanes

The most widely employed silicone macromers are methacrylate functional. Applications have been reported for hair spray[1], contact lens[2], pigment dispersion[3] and adhesive release[4]. The materials copolymerize smoothly with other acrylate and styrenic monomers as indicated by their reactivity ratios.

1. US Pats 5166276, 5480634; 2. JP-A-230115/90, US Pat 6,943,203; 3. US Pat 6,991,884; 4. US Pat 4,728,571

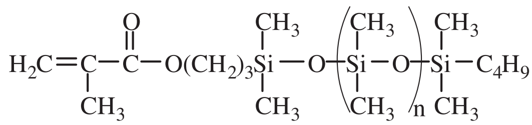
Reactivity Ratios

Monomers	r1:r2*
MCR-M11:methylmethacrylate	nm**:1.60
MCR-M22:methylmethacrylate	nm**:2.10
MCR-M11:styrene	0.26:1.07
MCR-M11:acrylonitrile	5.4:0.89

*M1M1°/M1M2°:M2M2°/M2M1°; **no meaningful results

Solubility of Macromers in Polar Monomers

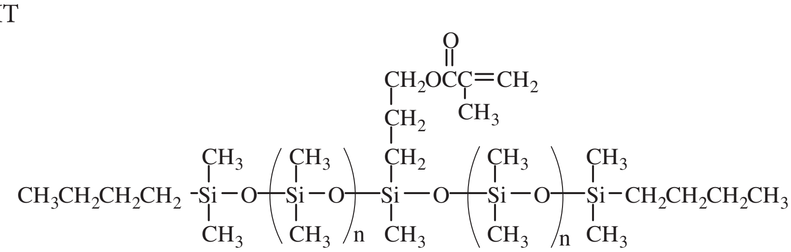
Macromer	Solubility (wt%) in Dimethylacrylamide	Solubility (wt%) in Hydroxyethylmethacrylate
MCR-M11	4	1
MCS-M11	8	2
MFR-M15	100 (miscible)	2



MonoMethacryloxypropyl Terminated PolyDimethylsiloxanes - asymmetric CAS: [146632-07-7] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-M07	6-9	600-800	1.416	0.96		
MCR-M11	10	800-1000	1.411	0.96		
MCR-M17	70-80	5000	1.406	0.97		
MCR-M22	150-200	10000	1.405	0.97		

inhibited with BHT



MonoMethacryloxypropyl Functional PolyDimethylsiloxanes - symmetric CAS: [868684-55-3] / [104780-61-2] TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCS-M11	7-9	800-1000	1.417	0.93		

inhibited with BHT

MonoMethacryloxypropyl Terminated PolyTrifluoropropylmethylsiloxanes - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MFR-M15	50-70	800-1000	1.398	1.09		

inhibited with BHT

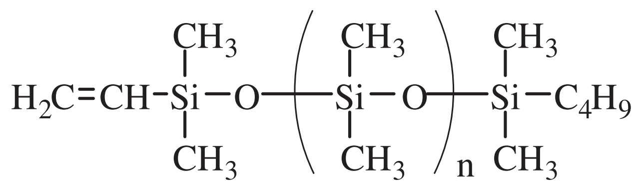
MonoMethacryloxypropyl Functional PolyTrifluoropropylMethylsiloxanes - symmetric CAS: [1072456-00-8]

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MFS-M15	40-60	800-1000	1.398	1.09		

inhibited with BHT

MonoVinyl Terminated PolyDimethylsiloxanes

Monovinyl functional siloxanes are utilized to control modulus and tack in silicone gels, elastomers and coatings.



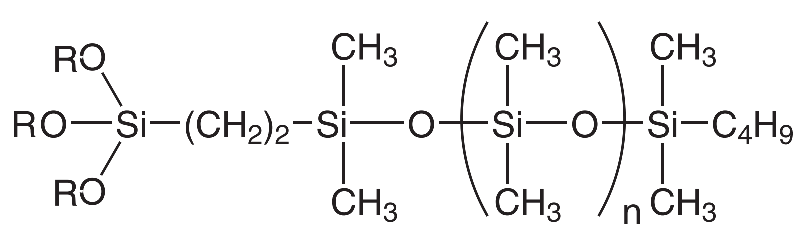
MonoVinyl Terminated PolyDimethylsiloxanes - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCR-V21	80-120	5500-6500	1.403	0.97		
MCR-V25	400-600	15,000-20,000	1.403	0.97		
MCR-V41	8000-12000	55000-65000	1.404	0.98		

MonoVinyl Functional PolyDimethylsiloxanes - symmetric TSCA

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g	Price/1kg
MCS-V212	16-24	1200-1400	1.419	0.97		

MonoTrialkoxysilyl Terminated PolyDimethylsiloxanes

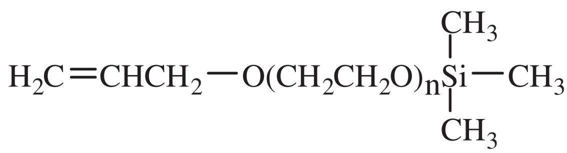


MonoTriEthoxysilylethyl Terminated PolyDimethylsiloxanes - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
MCR-XT11	16-24	500-1000	1.412	0.97		

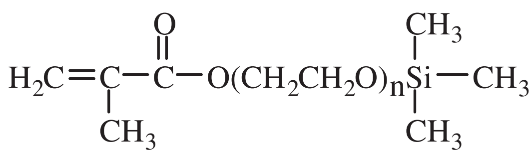
Silylated Organic Macromers

Silylated macromers provide a route to incorporation of polar monomers into mixtures of non-polar monomers. Subsequent to polymerization, the trimethylsilyl group is removed by hydrolysis.



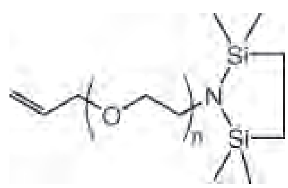
MonoAllyl-Mono Trimethylsiloxy Terminated Polyethylene Oxide - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
SIA0479.0	20-25	500	1.456	1.04		



MonoMethacryloxy-Mono Trimethylsiloxy Terminated Polyethylene Oxide - asymmetric

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/25g	Price/100g
SIM6485.9	-	400	-	1.02		



Poly(Ethylene Oxide) MonoAllyl, Mono Amine Terminated, Silylated

Code	Viscosity	Molecular Weight	Refractive Index	Specific Gravity	Price/100g
ENEP3712	4-5	400-600	-	-	

Reactive Silicone Emulsions

Emulsions of reactive silicones are playing an increasing role in formulation technology for water-borne systems. Primary applications for silicone emulsions are in textile finishes, release coatings and automotive polishes. Silanol fluids are stable under neutral conditions and have non-ionic emulsifiers. Aminoalkylalkoxysiloxanes are offered with cationic emulsifiers.

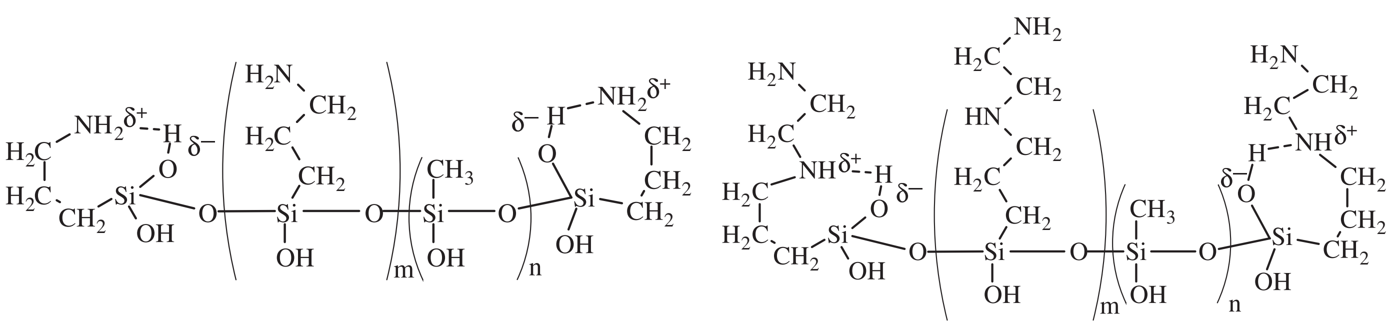
Reactive Silicone Emulsions

emulsifier content: 3-6% TSCA

Code	silicone class	base fluid viscosity	wt% solids	emulsion type	Price/100 g	Price/3kg	Price/18kg
DMS-S33M50	silanol	3500	50	nonionic			
ATM-1322M50*	diamino/alkoxy	200-300	50	cationic			

*0.45mEq/g combined primary and secondary amine

Water-borne Silsesquioxane Oligomers



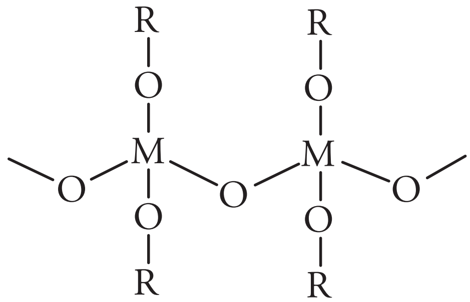
Water-borne silsesquioxane oligomers act as primers for metals, additives for acrylic latex sealants and as coupling agents for siliceous surfaces.[1] They offer both organic group and silanol functionality. These amphoteric materials are stable in water solutions and, unlike conventional coupling agents, have very low VOCs.

Water-borne Silsesquioxane Oligomers TSCA

Code	Group	Functional Mole %	Weight	Molecular in solution	Weight % Gravity	Specific Viscosity	pH	Price/100g	Price/3kg
WSA-7011*	Aminopropyl	65-75	250-500	19-21	1.10	5-15	10-10.5		
WSA-9911**	Aminopropyl	100	270-550	21-26	1.06	5-15	10-10.5		
WSA-7021	Aminoethylaminopropyl	65-75	370-650	23-27	1.10	5-10	10-11		
WSAV-6511‡	Aminopropyl, vinyl	60-65	250-500	15-20	1.11	3-10	10-11		
WSAF-1511	Aminopropyl, fluoroalkyl	15-20	—	15-20	1.06	1-5	3-5		

*CAS[1411854-75-5] **[29159-37-3] ‡[207308-27-8]

[1] Arkles, B. in *"Silanes & Other Coupling Agents"*, Mittal, K. L. Ed. **1992**, p91, Utrecht.



Polymeric Metal Alkoxides

Polymeric metal alkoxides fall into two main classes: oxo-bridged, which can be regarded as partially hydrolyzed metal alkoxides, and alkoxide bridged which can be regarded as organo diester alkoxides. Both classes have the advantages of high metal content and low volatility.

Polymeric metal alkoxides are used primarily as curing agents for 2-part RTVs and in the preparation of binders and coatings including investment casting resins and zinc-rich paints. The latter appplications can be considered as special examples of Sol-Gel technology. *Sol-Gel* is a method for preparing specialty metal oxide glasses and ceramics by hydrolyzing a chemical precursor or mixture of chemical precursors that pass sequentially through a solution state and a gel state before being dehydrated to a glass or ceramic.

Sol-Gel Process Technology and Chemistry

Preparation of metal oxides by the sol-gel route proceeds through three basic steps: 1) partial hydrolysis of metal alkoxides to form reactive monomers; 2) the polycondensation of these monomers to form colloid-like oligomers (sol formation); 3) additional hydrolysis to promote polymerization and cross-linking leading to a 3-dimensional matrix (gel formation). Although presented sequentially, these reactions occur simultaneously after the initial processing stage.

MONOMER FORMATION (PARTIAL HYDROLYSIS)

$$M(OR)_n + H_2O \longrightarrow (RO)_{n-1}MOH + ROH$$

$$\text{e.g.}\quad Ti(OC_2H_5)_4 + H_2O \xrightarrow[\text{catalyst}]{\text{solvent}} (C_2H_5O)_3TiOH + C_2H_5OH$$

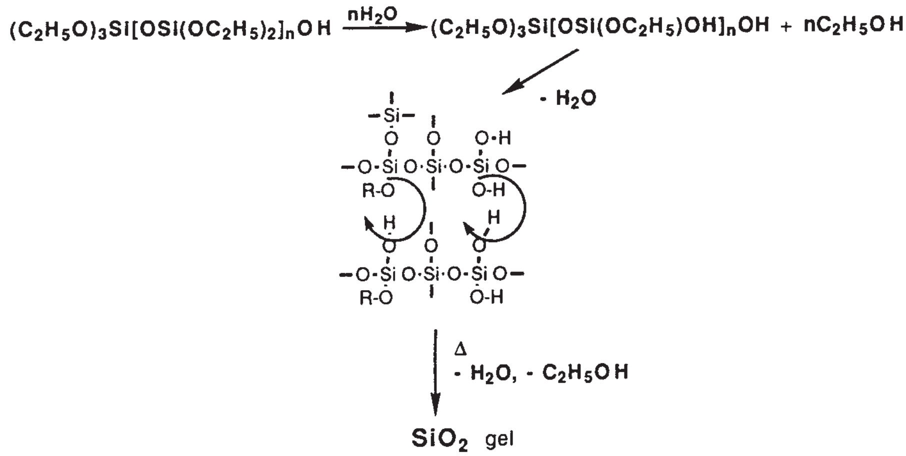
SOL FORMATION (POLYCONDENSATION)

$$2\ (RO)_{n-1}MOH \longrightarrow (RO)_{n-1}M\text{-}O\text{-}M(OR)_{n-2}OH + ROH$$

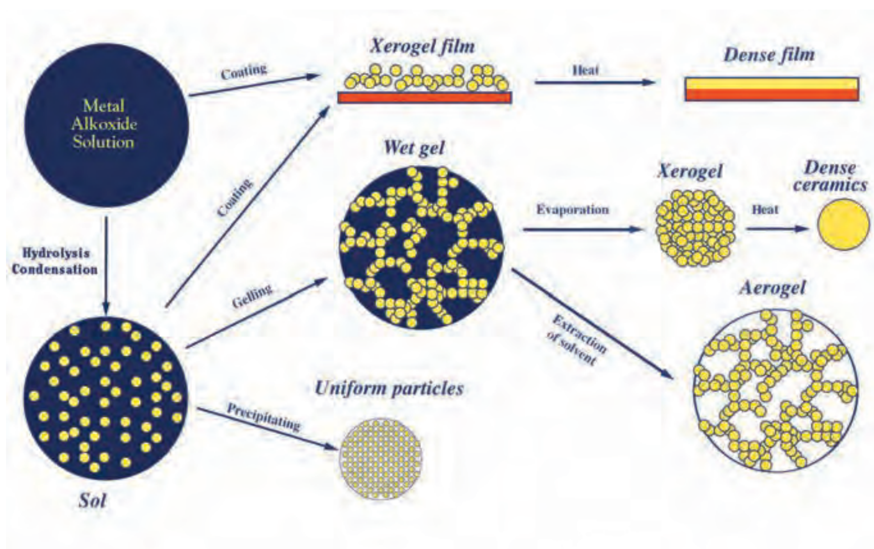
$$(RO)_{n-1}\text{-}O\text{-}M(OR)_{n-2}OH \xrightarrow[\text{dimers}]{\text{monomers}} (RO)_{n-1}M\text{-}O\text{-}M[\text{-}OM(OR)_{n-2}]_nOH + ROH$$

$$\text{e.g.}\quad n(C_2H_5O)_3SiOH \longrightarrow (C_2H_5O)_3Si[OSi(OC_2H_5)_2]_nOH + nC_2H_5OH$$

Gelation (Cross-Linking)



As polymerization and cross-linking progress, the viscosity of the sol gradually increases until the sol-gel transition point is reached. At this point the viscosity abruptly increases and gelation occurs. Further increases in cross-linking are promoted by drying and other dehydration methods. Maximum density is achieved in a process called densification in which the isolated gel is heated above its glass transition temperature. The densification rate and transition (sintering) temperature are influenced primarily by the morphology and composition of the gel.



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Brinker, C. J.; Clark, D. E.; Ulrich, D. R. *Better Ceramics Through Chemistry* II, III, IV (IV add'l ed. B. J. Zelinski) (Materials Research Society Proceedings 73, 121, 180) Mat'l. Res. Soc., 1984, 1988, 1990.

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Hench, L. L.; Ulrich, D. R. *Science of Ceramid Processing,* Wiley, 1986.

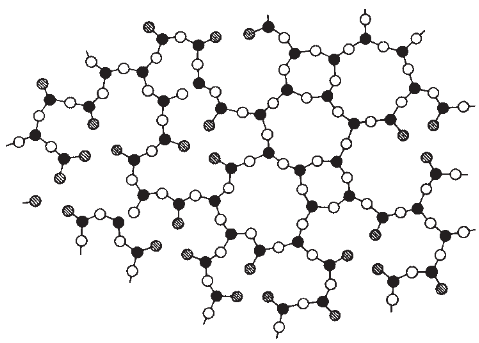
Klein, L. C. *Sol-Gel Technology for Thin Fillms, Fibers, Preforms, and Electronics,* Noyes, 1988.

Polymeric Metal Alkoxides

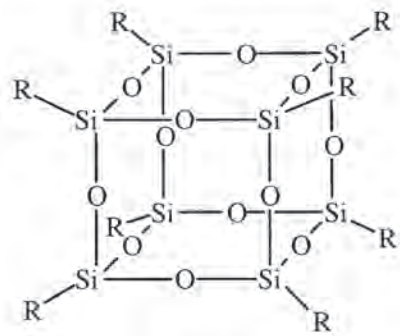
name	metal content	unit M.W.	viscosity, cSt	density
PSI-021				
Poly(DIETHOXYSILOXANE)	20.5-21.5% Si	134.20	3-5	1.05-1.07
$[(C_2H_5O)_2SiO]$	(40-42% SiO_2 equivalent)			
crosslinker for two-component condensation cure (silanol) RTVs.				
[68412-37-3] TSCA		100g/	2kg/	
PSI-023				
Poly(DIETHOXYSILOXANE)	23.0-23.5% Si	134.20	20-35	1.12-1.15
$[(C_2H_5O)_2SiO]$	(48-52% SiO_2 equivalent)			
base for zinc-rich paints				
[68412-37-3] TSCA		100g/	2.5kg/	
PSI-026				
Poly(DIMETHOXYSILOXANE)	26.0-27.0% Si	106.15	6-9	1.14-1.16
$[(CH_3O)_2SiO]$				
highest SiO_2 content precursor for sol-gel				
[25498-02-6] TSCA		100g/	500g/	
PSIAL-007				
DIETHOXYSILOXANE -s-BUTYLALUMINATE copolymer		7.5-8.5%Al		0.90-1.00
sol-gel intermediate for aluminum silicates.[1]		6.6-7.6% Si		
1. J. Boilot in "Better Ceramics Through Chemistry III, p121				
[68959-06-8] TSCA		100g/	500g/	
PSITI-019				
DIETHOXYSILOXANE - ETHYLTITANATE copolymer		19.1-19.6% Si	10-25	
$[(C_2H_5O)_2SiO][(C_2H_5O)_2TiO]$		2.1-2.3% Ti		
employed in formation of titania-silica aerogels.[1]				
1. Miller, J.; et al. J. Mater. Chem. **1995**, *5*, 1795.				
		25g/	100g/	
PSIPO-019				
DIETHOXYSILOXANE - ETHYLPHOSPHATE copolymer		19.1-19.6% Si	8-12	1.09-1.11
$[(C_2H_5O)_2SiO][(C_2H_5O)OPO]$	hygroscopic	1.4-1.5% P	R.I.: 1.400	
[51960-53-3]		25g/	100g/	
PAN-040				
Poly(ANTIMONY ETHYLENE GLYCOXIDE)	39.8-40.4% Sb	303.55	solid	
	catalyst for transesterification			
$[C_6H_{12}O_6Sb_2]$ [29736-75-2] TSCA		25g/	100g/	
PTI-023				
Poly(DIBUTYLTITANATE)	22.0-23.0% Ti	210.10	3200-3500	1.07-1.10
$[(C_4H_9O)_2TiO]$	stabilized with ~5% ethylene glycol			
[9022-96-2] TSCA		100g/	500g/	
PTI-008				
Poly(OCTYLENEGLYCOL-TITANATE)	7.5-7.6% Ti	482.54	1700	1.035
	contains ~5% free 2-ethyl-1,3-hexanediol, oligomeric			
$[OCH_2CHEt(CH_2)_4OTi(CH_2CHEt(CH_2)_4OH)_2]_n$		flashpoint: 50°C(122°F)		
[5575-43-9]		25g/	100g/	

PolySilsesquioxanes and T-Resins
$RSiO_{1.5}$

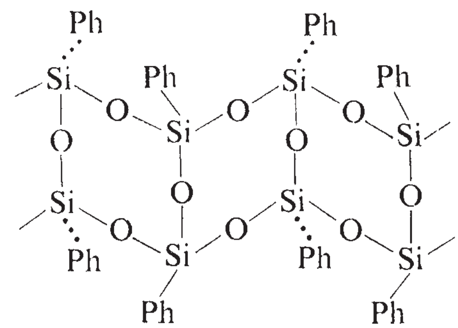
PolySilsesquioxanes and T-resins are highly crosslinked materials with the empirical formula $RSiO^{1.5}$. They are named from the organic group and a one and a half (sesqui) stoichiometry of oxygen bound to silicon. T-resin, an alternate designation, indicates that there are three (Tri-substituted) oxygens substituting the silicon. Both designations simplify the complex structures that have now come to be associated with these polymers. A variety of paradigms have been associated with the structure of these resins ranging from amorphous to cubes containing eight silicon atoms, sometimes designated as T_8 structures. Ladder structures have been attributed to these resins, but the current understanding is that in most cases these are hypothetical rather than actual structures.



Amorphous



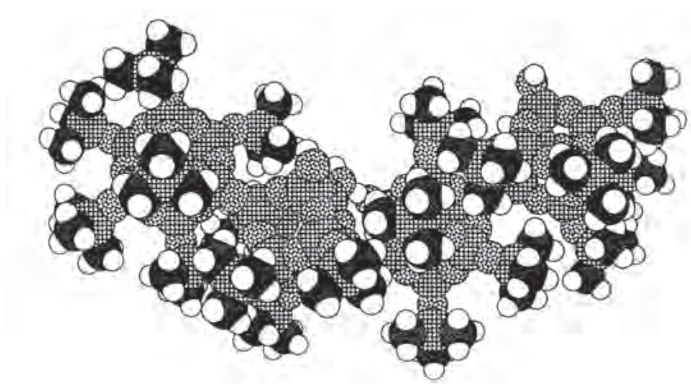
T_8 cube



Hypothetical Ladder

Polysilsesquioxanes are used as matrix resins for molding compounds, catalyst supports and coating resins. As dielectric, planarization and reactive ion etch resistant layers, they find application in microelectronics. As abrasion resistant coatings they protect plastic glazing and optics. As preceramic coatings they convert to silicon dioxide, silicon oxycarbide, and silicon carbide depending on the oxidizing conditions for the high temperature thermal conversion.

Polysilsesquioxane resins containing silanols (hydroxyls) can be cured at elevated temperatures. Formulation and catalysis is generally performed at room-temperature or below. At temperatures above 40°C most resins soften and become tacky, becoming viscous liquids by 120°C. The condensation of silanols leads to cure and the resins become tough binders or films. The cure is usually accelerated by the addition of 0.1-0.5% of a catalyst such as dibutyltindiacetate, zinc acetate or zinc 2-ethylhexanoate. The resins can also be dispersed insolvents such as methylethylketone for coating applications.



Polymeric Q resins with cage structure
(according to Wengrovius)

see Vinyl, Silanol & Hydride Q Resins

polySilsesquioxanes Liquid T-Resins

Code	Name	Viscosity (cSt)	M.W. (approxmate)	Refractive Index	Specific Gravity	Price/100g	Price/1kg
SLT-3A101	poly(Methylsilsesquioxane)	20-30	700-1100	1.402	1.143		
	[181186-37-8] TSCA	methoxy terminated		(alkoxy wgt% 25-30)			
SLT-3A102	poly(Methylsilsesquioxane)	5-10					
	[67762-97-4] TSCA	ethoxy terminated					
SLT-3A302	poly(Propylsilsesquioxane)	25-40	-	1.424	1.035		
	[314270-00-3] TSCA	ethoxy terminated					
SLT-3A802	poly(Octylsilsesquioxane)	400-600	1000-1800	1.454	0.979		
	[1385031-14-0] TSCA-L	ethoxy terminated					
SLT-3SA2	(80-85% Octylsilsesquioxane) – (15-20% Mercaptopropylsilsesquioxane) copolymer						
		500-1000			1.03		
SLT-3UM3	(85-90% Acryloxypropylsilsesquioxane)-(10-15% Methylsilsesquioxane) copolymer						
		25-50	500-1000	1.45	1.14		
	[1385031-14-0] TSCA-L	ethoxy terminated					

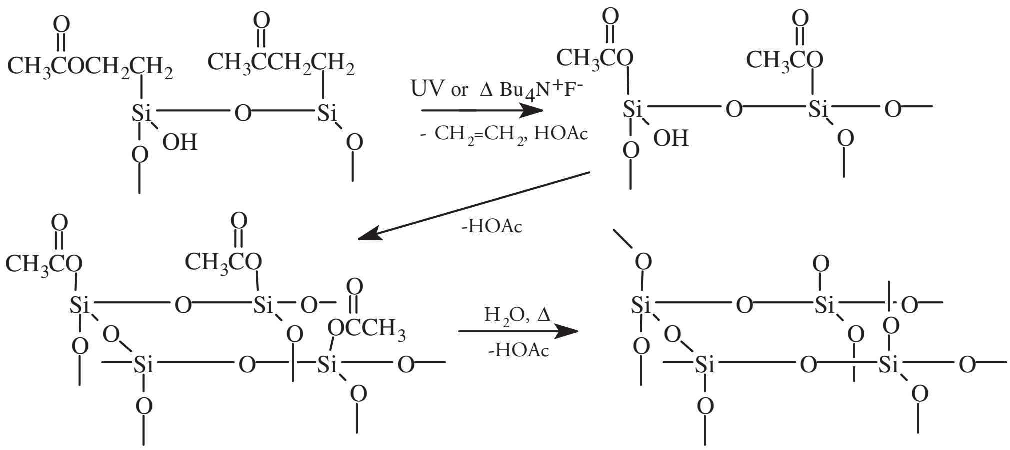
These materials are oligomeric alkoxysilane hydrolyzates and are the basis of coating resins. They can also be used as primer coatings or to modify organic resins such as polyesters. They generate small amounts of alcohols as byproducts during cure. Moisture-cure can be accelerated by adding 0.1-0.4wt% of titanates, such as AKT855 (p. 69).

polySilsesquioxanes Solid T-Resins

Code	Name	Viscosity (cSt)	M.W. (approxmate)	Refractive Index	Specific Gravity	Price/100g	Price/1kg
SST-3M01	poly(Methylsilsesquioxane) 100% Methyl [68554-70-1] TSCA	7000-8000	4.0-6.0	1.42	-		
SST-3M02	poly(Methylsilsesquioxane) 100% Methyl [68554-70-1] TSCA		2.5-4.0	1.42	1.08		
SST-3MH1.1	poly(Methyl-Hydridosilsesquioxane) 90% Methyl, 10% Hydride 10 wt% sol'n in methyltetrahydrofuran				0.91		
SST-3P01	poly(Phenylsilsesquioxane) 100% Phenyl [70131-69-0] TSCA	1200-1600	4.5-6.5	1.56	-		
SST-3PM1	poly(Phenyl-Methylsilsesquioxane) 90% Phenyl, 10% Methyl [181186-29-8]	-	-	1.55	-		
SST-3PM2	(Phenylsilsesquioxane)-(Dimethylsiloxane) copolymer 70% Phenyl, 30% DiMethyl [73138-88-2] TSCA		3.0-5.0	-	1.08		
SST-3PM4	(40% Phenyl- 45% Methylsilsesquioxane)-(5% Phenylmethylsiloxane) (10% Diphenylsiloxane) tetrapolymer 85% Silsesquioxane, 15% Siloxane [181186-36-7] TSCA	1400-1600	2.0-3.0	-	1.08		
SST-3PP1	poly(Phenyl-Propylsilsesquioxane) 70% Phenyl, 30% Propyl [68037-90-1] TSCA (equivalent weight: 400)	1500-1800	3.5-5.5	1.54	1.25		
SST-3PV1	poly(Phenyl-Vinylsilsesquioxane) 90% Phenyl, 10% Vinyl	1000-1300	-	-	-		
SST-3Q01	poly[(Octadecyldimethylammoniumchloride)propylsilsesquioxane] water soluble [1353244-79-7] Toxicity-oral rat, LD50: 12,270mg/kg			1.46	-		
SST-3R01	poly(Methacryloxypropylsilsesquioxane) [160185-24-0]	1000-3000	-	1.46	1.20		

Thermally & UV Labile Polysilsesquioxanes

Silsesquioxanes containing β-electron withdrawing groups can be converted to silicon dioxide via elimination and hydrolysis at low temperatures or under UV exposure.[1] The thermal reaction cascade for β-substituted silsesquioxanes leading to SiO_2-rich structures with a low level of carbon occurs at temperatures above 180°.[2]



UV exposure results in pure SiO_2 films and suggests that patterning β-substituted silsesquioxane films can lead to direct fabrication of dielectric architectures.

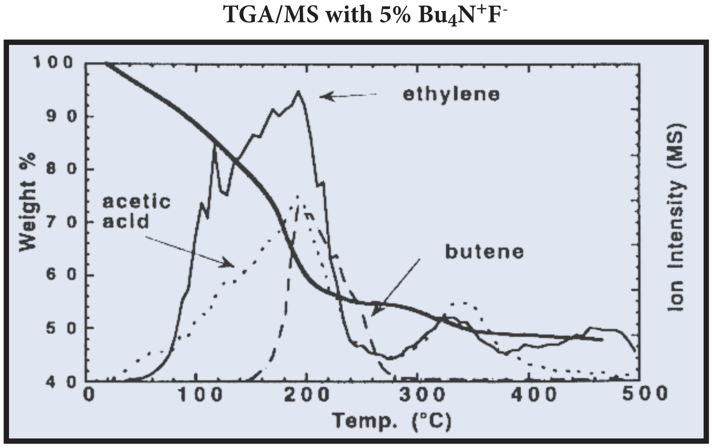
1. Arkles, B.; Berry, D.; Figge, L.; J. Sol-Gel Sci. & Technol. **1997**, *8*, 465.
2. Ezbiansky, K. et al, Mater. Res. Soc. Proc., **2001**, *606*, 251.

Thermally & UV labile polysilsesquioxanes

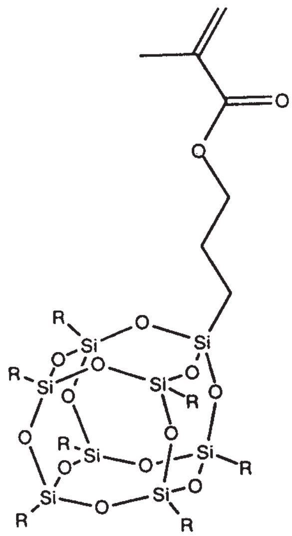
Code	Name	M.W. (approximate)	% (OH)		Price/100g
SST-BAE1.2	poly(2-Acetoxyethylsilsesquioxane) converts to SiO_2 >350°C	-	-	8-20% sol'n in methoxypropanol	CAS: [349656-50-4] TSCA
SST-BCE1.2	poly(2-Chloroethylsilsesquioxane) converts to SiO_2 >300°C	800-1400	3.0-5.5	14-16% sol'n in methoxypropanol	CAS: [188969-12-2]
SST-BBE1.2	poly(2-Bromoethylsilsesquioxane) converts to SiO_2 by UV	1200-2000	2.0-4.0	14-16% sol'n in methoxypropanol	

2-Acetoxyethylsilsesquioxane

TGA/MS with 5% $Bu_4N^+F^-$



Specialty polysilsesquioxanes

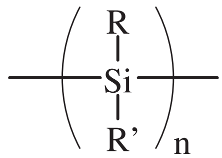


Specialty polysilsesquioxanes can be utilized as models and precursors for silica surfaces and zeolites. If a silicon is removed from a T_8 cube, the open position of the remaining T_7 cube can be substituted with catalytically active metals.[1] T_7 cubes can be converted to functionalized T_8 cubes. Functionalized T_8 cubes are sometimes designated POSS (polyhedral oligomeric silsesquioxane) monomers. Methacrylate T_8 cubes can be copolymerized with a variety of monomers to form homopolymers and copolymers. The polymers may be viewed structurally as nanocomposites or hybrid inorganic-organic polymers. The cube structures impart excellent mechanical properties and high oxygen permeability.[2] Hydride substituted T_8 cubes can be introduced into vinyl-addition silicone rubbers.[3] T_8 cubes in which all silicon atoms are substituted with hydrogen have demonstrated utility as flowable oxide precursors in microelectronics. Fluorinated polysilsesquioxanes demonstrate tunable oleophobicity.[4]

[1] Feher, F.; et al, J. Am. Chem. Soc., **1989**, *111*, 1741.
[2] Lichtenhan, J.; et al, Macromolecules, **1995**, *28*, 8435.
[3] Lichtenhan, J.; Comments Inorg. Chem. **1995**, *17*, 115.
[4] Choi,W.; et al, Adv. Mater., **2009**, *21(21)* 2190.

Code	Name			M.W. (approximate)	Solubility	Density	Price/10g
POSS materials							
SST-A8C42	Allyl substituted poly(Isobutylsilsesquioxane)						
	T8 cube with single substitution, employed in epoxy nanocomposites						
				851.55	THF, hexane	1.44	
SST-F3F61	poly(Trifluoropropylsilsesquioxane)						
	T12	[851814-19-2]		1789.72	THF		
SST-F8F41	poly(Tridecafluorooctylsilsesquioxane)						
				1000-2000			
	T8 cube	[1610607-30-1]	Toxicity-oral rat, LD50: >5,000mg/kg				
SST-H8H01	poly(Hydridosilsesquioxane) - polymeric T8 with all silicons hydride substituted						
				3000-5000	0.88		
	T8 cube	[137125-44-1]	17-20% hazy solution in methylisobutylketone				
SST-H8HS8	poly(Hydridosilsesquioxane) - T8 with all silicons dimethylsiloxy ($HSiMe_2O$) substituted						
				1017.98		1.23	
	T8 cube	[125756-69-6]	see also HQM-107 p.20.				
SST-R8C42	Methacryloxypropyl substituted poly(Isobutylsilsesquioxane)						
	T8 cube with single substitution with polymerizeable functionality						
				943.64	THF, hexane	1.13	
		[307531-94-8]					
SST-S7C41	Silanol functonal poly(Isobutylsilsesquioxane)						
	T7 Cube	[307531-92-6]		791.42			
SST-V8V01	poly(Vinylsilsesquioxane) - T8 with all silicons vinyl substituted						
	T8 cube	[69655-76-1]		633.04	THF, chloroform, hexane		

Preceramic Polymers - Silicon Carbide



polySILANES -(Si-Si)-

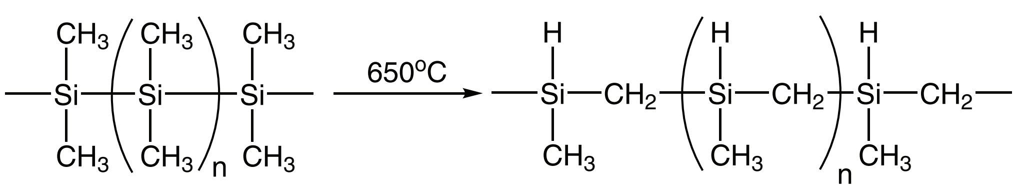
Polysilanes have applications as preceramic polymers and photolabile coatings. Applications for polysilanes with methyl and phenyl group substitution are usually limited to silicon carbide precursors.

PSS-1C01
poly(DICYCLOHEXYLSILANE) solid 1.0g/

PSS-1H01
poly(DIHEXYLSILANE)
[207925-46-0] solid 1.0g/

PSS-1K02
poly(PERCHLOROSILANE) oligomer
4 or more silicon atoms solid 10g/

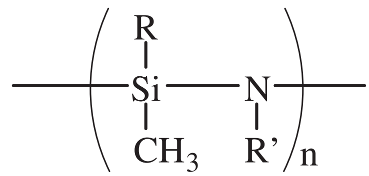
PSS-1M01
poly(DIMETHYLSILANE) MW 1000-3000
DP: 25-50 Flashpoint: 103° Tm: 250-270° (substantial degradation before mp)
Solid state source for volatile siliconcarbonitride (SiCN) precursors utilized in passivation of silicon-based photovoltaics
Employed in CVD of silicon carbonitride films.[1]
Intermediate for polycarbosilanes.[2]
1. Scarlete, M.; et al; US Patent 7,396,563; **2008** (Label Licensed Gelest Product)
2. Yajima, S. et al. *J. Mater. Sci.* **1978**, *13*, 2569.
[30107-43-8] / [28883-63-8] TSCA 10g/ 100g/



PSS-1P01
(50% DIMETHYLSILANE)(50% PHENYLMETHYLSILANE) copolymer
[143499-71-2]] solid 10g/

PSS-1P11
poly(PHENYLMETHYL)SILANE Density: 1.12
[146088-00-8] Tg: 112-122° fluorescent emission: 360nm 10g/

Preceramic Polymers - Silicon Nitride, Silicon Carbonitride



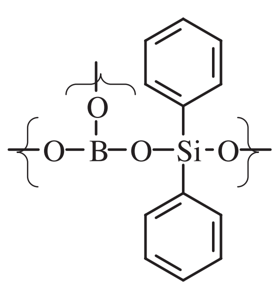
polySILAZANES -(Si-N)-

Polysilazanes are preceramic polymers primarily utilized for the preparation of silicon nitride for thermal shock resistant refractories and dielectric coatings for microelectronics.[1]

PSN-2H01.2 poly(PERHYDROSILAZANE) telomer [176948-80-4]	10wt% in heptanes		10g/
PSN-2M01 poly(1,1-DIMETHYLSILAZANE) telomer [89535-60-4] Tg: -82° >50 cSt. M.W.: 500-900	D_4^{20}	1.04	10g/
PSN-2M02 poly(1,1-DIMETHYLSILAZANE) crosslinked >1000 cSt.	% char, 700°: 15-20%		10g/
PSN-2M11 poly(1,2-DIMETHYLSILAZANE) 100-300 cSt.	D_4^{20}	0.99	10g/

1. Kroke, E. et al, *Material Science and Engineering Reports,* **2000**, *26,* 97.

Preceramic Polymers - Borosilicate



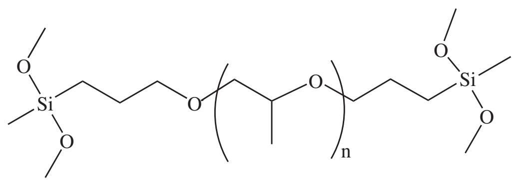
Pre-Ceramic Polymers

SSP-040
POLY(BORODIPHENYLSILOXANE) solid, Tg: 95-100°, Tm: 140-1°
employed in preparation of ceramic fibers.[1]
1. Yajima, S.; et al, Nature, **1977**, *266*, 521.
[70914-15-7] TSCA HMIS: 2-0-0-X 25g/ 100g/

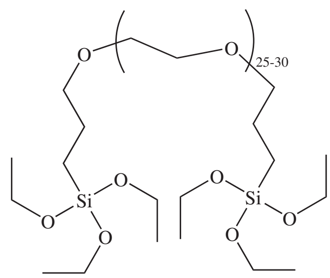
Silicon-Organic Hybrids with Hydrolyzable Functionality

Hybrid organic inorganic polymers containing alkoxy substitutions on silicon allow formulation of moisture cure adhesives, sealants and elastomers with physical properties, including adhesion and strength, which are significantly higher than conventional silicones. Moisture produces a condensation cure analogous to moisture cure silicones. Preferred catalysts are dibutylbispentanedionatetin, dimethyldineodecanoate tin and dibutyldilauryltin at levels of 0.2-1.0%. In order to allow through-section cure, maximum thickness is usually 1/4", (5mm).

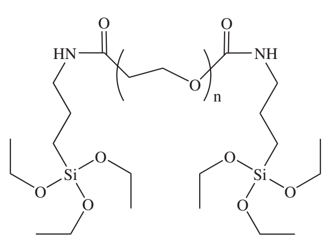
Polyether



SIB1660.0
BIS[3-METHYLDIMETHOXYSILYL)PROPYL]POLYPROPYLENE OXIDE
visc: 6000-10,000 cSt. M.W. 600-800 density: 1.00
base resin for tin catalyzed moisture-cure RTVs
[75009-80-0] HMIS: 3-1-1-X 100g/ 2kg/



SIB1824.84
BIS(3-TRIETHOXYSILYLPROPYL)POLYETHYLENE OXIDE (25-30 EO) 1,400 - 1,600 (38-42°)
Hydrolytically stable hydrophilic silane
Proton conducting polymer electrolyte.[1]
1. Ghosh, B. et al. Chem. Mater. **2010**, *22*, 1483.
See also SIB1860.0
HYDROLYTIC SENSITIVITY: 7: reacts slowly with moisture/water
[666829-33-0] HMIS: 2-1-1-X 25g/



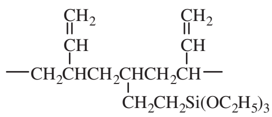
SIB1824.82
N,N'-BIS-[(3-TRIETHOXYSILYLPROPYL)AMINOCARBONYL]POLYETHYLENE OXIDE (10-15 EO)
UREASIL 1,000 - 1,200 1.088 1.458325
Dipodal hydrophilic silane
In combination with sulfolane forms gel electrolyte for solar cells.[1]
Forms proton conducting hybrid organic-inorganic polymer electrode membranes.[2]
1. Stathatos, E. et al. Adv. Funct. Mater. **2004**, *14*, 45.
2. Honma, I. et al. J. Membr. Sci. **2001**, *185*, 83.
HYDROLYTIC SENSITIVITY: 7: reacts slowly with moisture/water
[178884-91-8] TSCA HMIS: 1-1-1-X 25g/ 100g/

Antifog coatings can be formed from combinations of polyalkylene oxide functional silanes and film-forming hydrophilic silanes

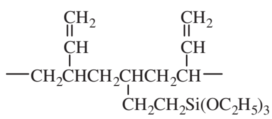
Multi-Functional and Polymeric Silanes

name	MW	D_4^{20}	n_D^{20}

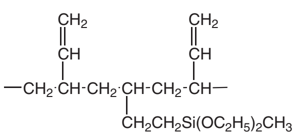
Polybutadiene



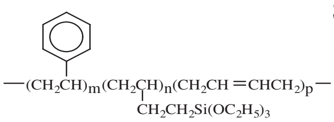
SSP-055
TRIETHOXYSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in toluene — MW 3500-4500 — D_4^{20} 0.90
viscosity: 75-400 cSt.
coupling agent for EPDM resins
[72905-90-9] TSCA HMIS: 2-4-1-X store <5° — 100g/ — 2.0kg/



SSP-056
TRIETHOXYSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in volatile silicone — MW 3500-4500 — D_4^{20} 0.93
viscosity: 600-1200 cSt.
primer coating for silicone rubbers
[72905-90-9] TSCA HMIS: 2-3-1-X store <5° — 100g/ — 2.0kg/

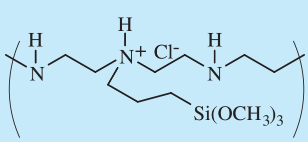


SSP-058
DIETHOXYMETHYLSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in toluene — MW 3500-4500 — D_4^{20} 0.90
viscosity: 75-150 cSt.
water tree resistance additive for crosslinkable HDPE cable cladding
HMIS: 2-4-1-X store <5° — 100g/ — -

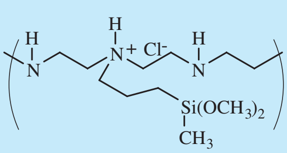


SSP-255
(30-35%TRIETHOXYSILYLETHYL)ETHYLENE-(35-40% 1,4-BUTADIENE) - (25-30% STYRENE) terpolymer, 50% in toluene — MW 4500-5500
viscosity: 20-30 cSt.
HMIS: 2-3-1-X — 100g/

Polyamine

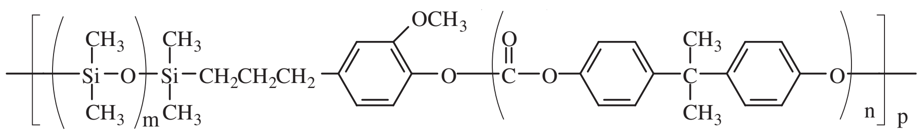


SSP-060
TRIMETHOXYSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol — MW 1500-1800 — D_4^{20} 0.92
visc: 125-175 cSt — ~20% of nitrogens substituted
employed as a coupling agent for polyamides.[1]
in combination with glutaraldehyde immobilizes enzymes.[2]
1. Arkles, B; et al, SPI 42nd Composite Inst. Proc., 21-C, 1987
2. Cramer, S; et al, Biotech. & Bioeng. **1989**, *33(3)*, 344.
[136856-91-2]/[37251-86-8] TSCA HMIS: 2-4-1-X — 100g/ — 2.0kg/

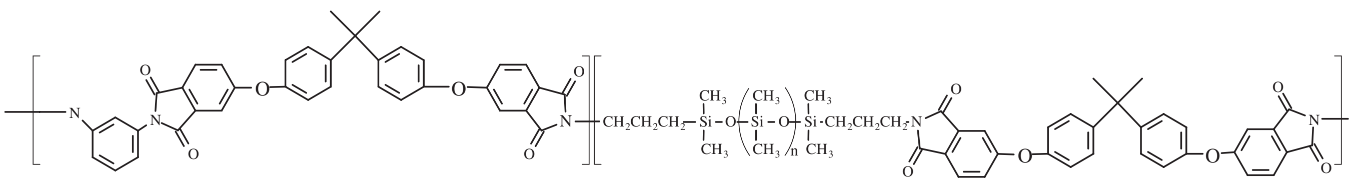


SSP-065
DIMETHOXYMETHYLSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol — MW 1500-1800 — D_4^{20} 0.92
visc: 100-200 cSt — ~20% of nitrogens substituted
primer for brass
[1255441-88-5] TSCA HMIS: 2-4-1-X — 100g/ — 3.0kg/

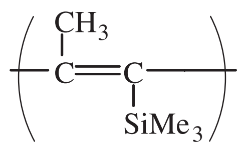
Thermoplastic Resins for Melt Processing or Solution Casting



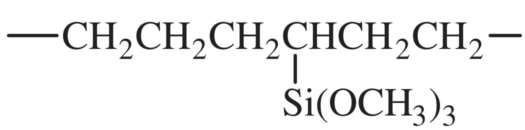
SSP-080
(DIMETHYLSILOXANE)(BISPHENOL -A CARBONATE) copolymer
(15 - 20% polydimethylsiloxane)
thermoplastic; tensile strength: 50MPa Vicat mp: 145° density: 1.19
[202483-49-6] TSCA HMIS: 1-1-0-X 100g/



SSP-085
(DIMETHYLSILOXANE)(ETHERIMIDE) copolymer
(35-40% polydimethylsiloxane)phenylenediaminepolyetherimide
thermoplastic; tensile strength: 2800psi Tg: 168°C density: 1.18
[99904-16-2] TSCA HMIS: 1-1-0-X 100g/



SSP-070
POLY(TRIMETHYLSILYL)PROPYNE
forms viscous 5% solutions in toluene/tetrahydrofuran
high oxygen permeability[1,2,3]; $PO_2/PN_2 = 1.7$
1. Masuda, T.; et al, *J. Am. Chem. Soc.*, **1983**, *105*, 7473.
2. Claes, S. et al, *J. Membrane Sci.*, **2012**, *389*, 459.
3. Claes, S. et al, *Macromolecules*, **2011**, *44*, 2766.
[87842-32-8] HMIS: 1-1-0-X 10g/



SSP-050
TRIMETHOXYSILYL MODIFIED POLYETHYLENE 0.927
0.5-1.2 mole % vinyltrimethoxysilane - ethylene copolymer
moisture crosslinkable thermoplastic melt process temp: 170 - 200°
[35312-82-4] TSCA HMIS: 1-1-1-X 100g/ 2.0kg/

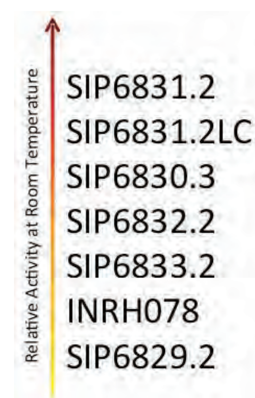
Precious Metal Catalysts for Vinyl-Addition Silicone Cure

The recommended starting point for platinum catalysts is 20ppm platinum or 0.05-0.1 parts of complex per 100 parts of vinyl-addition silicone formulation. Rhodium catalyst starting point is 30ppm based on rhodium. Other platinum concentrations are available upon request.

SIP6829.2
PLATINUM CARBONYL CYCLOVINYLMETHYLSILOXANE COMPLEX
1.85-2.1% platinum concentration in vinylmethylcyclicsiloxanes density: 1.02
catalyst for Si-H addition to olefins - silicone vinyl addition cure catalyst
employed in elevated temperature curing silicones
[73018-55-0] TSCA 2-2-0-X 5.0g/ 25g/

SIP6830.3
PLATINUM - DIVINYLTETRAMETHYLDISILOXANE COMPLEX
3-3.5% platinum concentration in vinyl terminated polydimethylsiloxane, neutral density: 0.98
catalyst for Si-H addition to olefins - silicone vinyl addition cure catalyst
employed in room temperature curing silicones
[68478-92-2] TSCA 2-2-0-X 5.0g/ 25g/

SIP6831.2
PLATINUM - DIVINYLTETRAMETHYLDISILOXANE COMPLEX in xylene density: 0.90
2.1-2.4% platinum concentration flashpoint: 38°C (100°F)
"hot" catalyst employed in room temperature curing silicones
[68478-92-2] TSCA 2-3-0-X 5.0g/ 25g/



SIP6831.2LC
PLATINUM - DIVINYLTETRAMETHYLDISILOXANE COMPLEX in xylene - LOW COLOR
2.1-2.4% platinum concentration flashpoint: 38°C (100°F) density: 0.90
[68478-92-2] TSCA 2-3-0-X 10.0g/

SIP6832.2
PLATINUM - CYCLOVINYLMETHYLSILOXANE COMPLEX
2-2.5% platinum concentration in cyclic methylvinylsiloxanes, neutral density: 1.02
catalyst for Si-H addition to olefins - silicone vinyl addition cure catalyst
employed in moderate elevated temperature curing silicones
[68585-32-0] TSCA 2-2-0-X 5.0g/ 25g/

SIP6833.2
PLATINUM-OCTANALDEHYDE/OCTANOL COMPLEX density: 0.84
2.0-2.5% platinum concentration in octanol
catalyst for Si-H addition to olefins - silicone vinyl addition cure catalyst
increases flammability resistance of silicones
[68412-56-6] TSCA 2-3-0-X 5.0g/ 25g/

INRH078
TRIS(DIBUTYLSULFIDE)RHODIUM TRICHLORIDE
3.0-3.5% rhodium concentration in toluene density: 0.91
catalyst for Si-H addition to olefins - silicone vinyl addition cure catalyst, less susceptible to inhibition
employed in moderately elevated temperature curing silicones
[55425-73-5] TSCA HMIS: 3-4-0-X 5.0g/ 25g/

Poisons for platinum catalysts used in vinyl-addition crosslinking must be avoided. Examples are:
Sulfur compounds (mercaptans, sulfates, sulfides, sulfites, thiols
and rubbers vulcanized with sulfur will inhibit contacting surfaces)
Nitrogen compounds (amides, amines, imides, nitriles)
Tin compounds (condensation-cure silicones, stabilized PVC)

Modifiers for Vinyl Addition Silicones

The following are the most common materials employed to modify aspects of platinum-cured vinyl-addition silicones. Other materials are found in the Silicon Compounds section.

Inhibitors and Moderators of Hydrosilylation

Product Code	M.W.	b.p.	density	R.I.
SID4613.0				
1,3-DIVINYLTETRAMETHYLDISILOXANE	186.40	139°	0.811	1.4123
$C_8H_{18}OSi_2$	TOXICITY- orl rat, LD50 >12,500mg/kg			
	flashpoint: 24°C(76°F)			
[2627-95-4] TSCA HMIS: 2-4-0-X	50g/		500g/	
SIT7900.0				
1,3,5,7-TETRAVINYL-1,3,5,7-TETRA-METHYLCYCLOTETRASILOXANE	344.66	110°/10 (-43°)mp	0.998	1.4342
$C_{12}H_{24}O_4Si_4$	flashpoint: 112°C (234°F)			
[2554-06-5] TSCA HMIS: 2-1-0-X	25g/		2kg/	

Adhesion Promoters

Product Code	M.W.	b.p.	density	R.I.
SIA0540.0				
ALLYLTRIMETHOXYSILANE	162.26	146-8°	0.963^{25}	1.4036^{25}
$C_6H_{14}O_3Si$	flashpoint: 46°C(115°F)			
[2551-83-9] TSCA HMIS: 3-2-1-X	10g/		50g/	

Special Crosslinkers

Product Code	M.W.	b.p.	density	R.I.
SIP6826.0				
PHENYLTRIS(DIMETHYLSILOXY)SILANE	330.68	91°/2	0.942	1.440^{25}
$C_{10}H_{26}O_3Si_4$	flashpoint: 87°C(190°F)			
crosslinker for medium refractive index vinyl addition silicone elastomers				
[18027-45-7] TSCA HMIS: 2-1-1-X	25g/		2kg/	
SIT7278.0				
TETRAKIS(DIMETHYLSILOXY)SILANE	328.73	188-90°	0.886	1.3841
$C_8H_{28}O_4Si_5$	flashpoint: 67°C(153°F)			
crosslinker for Pt cure 2-component RTVs				
[17802-47-2] TSCA HMIS: 2-2-1-X	25g/		100g/	
SIT8372.4				
TRIFLUOROPROPYLTRIS(DIMETHYLSILOXY)-SILANE	350.63	98-9°/40	0.962	1.3753
$C_9H_{25}F_3O_3Si_4$				
[3410-32-0] TSCA HMIS: 2-2-0-X	25g/			

Diluent Fluids for Gel Hardness and Tactile Response

Product Code				
DMS-T31				
polyDIMETHYLSILOXANE, 1000 cSt.	100g/		3kg/	
ALT-143				
polyOCTYLMETHYLSILOXANE, 600-1000 cSt.	100g/		1kg/	

Crosslinking Agents for Condensation Cure Silicones

Acetoxy Crosslinkers

Code | M.W. | density

SID2790.0
DI-t-BUTOXYDIACETOXYSILANE, tech-96 292.40 1.0196
SILICON DI-t-BUTOXIDE DIACETATE (-4°)mp
$C_{12}H_{24}O_6Si$ flashpoint: 95°C (203°F)
adhesion promoter for silicone RTVs
[13170-23-5] TSCA HMIS: 3-2-2-X 50g/ 3kg/

SIE4899.0
ETHYLTRIACETOXYSILANE 243.28 1.143
$C_8H_{14}O_6Si$ (7-9°)mp
flashpoint: 106°C(223°F)
liquid crosslinker for silicone RTVs
[17689-77-9] TSCA HMIS: 3-1-1-X 25g/ 2kg/

SIM6519.0
METHYLTRIACETOXYSILANE, 95% 220.25 1.175
$C_7H_{12}O_6Si$ (40°)mp
vapor pressure, 94°: 9mm flashpoint: 85°C(185°F)
most common cross-linker for condensation cure silicone RTVs
[4253-34-3] TSCA HMIS: 3-2-1-X 50g/ 2kg/

SIM6519.2
METHYLTRIACETOXYSILANE-
ETHYLTRIACETOXYSILANE 80:20 BLEND
liquid crosslinker blend for silicone RTVs
[4253-34-3] 100g/ 1kg/

SIV9098.0
VINYLTRIACETOXYSILANE 232.26 1.167
$C_8H_{12}O_6Si$ flashpoint: 88°C (190°F)
[4130-08-9] TSCA HMIS: 3-2-1-X 100g/ 2kg/

Alkoxy Crosslinkers

SIB1817.0
BIS(TRIETHOXYSILYL)ETHANE 354.59 0.957
HEXAETHOXYDISILETHYLENE
$C_{14}H_{34}O_6Si_2$
additive to formulations that enhances adhesion
[16068-37-4] TSCA HMIS: 3-1-1-X 25g/ 2kg/

SIM6555.0
METHYLTRIETHOXYSILANE 178.30 0.8948
$C_7H_{18}O_3Si$ TOXICITY- oral rat, LD50: 12,500mg/kg
[2031-67-6] TSCA HMIS: 1-3-1-X 25g/ 2kg/

SIM6560.0
METHYLTRIMETHOXYSILANE 136.22 0.955
$C_4H_{12}O_3Si$ (-78°)mp
TOXICITY- oral rat, LD50: 12,500mg/kg
viscosity: 0.50 cSt flashpoint: 8°C(46°F)
[1185-55-3] TSCA HMIS: 3-4-1-X 25g/ 2kg/

Code | M.W. | density

SIT7110.0
TETRAETHOXYSILANE, 98% 208.33 0.9335
TETRAETHYLORTHOSILICATE TEOS (-77°)mp
$C_8H_{20}O_4Si$ TOXICITY - oral rat, LD50: 6270mg/kg
flashpoint 46°C (116°F)
vapor pressure, 20°: 11.8mm viscosity: 0.8 cSt
[78-10-4] TSCA HMIS: 2-1-1-X 100g/ 3kg/

SIT7777.0
TETRA-n-PROPOXYSILANE 264.44 0.9158
$C_{12}H_{28}O_4Si$ (<-80°)mp
flashpoint: 95°C (203°F) viscosity: 1.66 cSt
[682-01-9] TSCA HMIS: 2-2-1-X 100g/ 2kg/

SIV9220.0
VINYLTRIMETHOXYSILANE 148.23 123° 0.970
$C_5H_{12}O_3Si$ TOXICITY- oral rat, LD50: 11,300mg/kg
viscosity: 0.6 cSt flashpoint: 28°C (82°F)
[2768-02-7] TSCA HMIS: 3-4-1-X 25g/ 2kg/

Oxime Crosslinkers

SIM6590.0
METHYLTRIS(METHYLETHYLKETOXIMINO) SILANE, tech-95
METHYLTRIS(2-BUTANONEOXINO)SILANE 301.46 0.982
$C_{13}H_{27}N_3O_3Si$ TOXICITY- oral rat, LD50: 2000-3000mg/kg
flashpoint: 90°C (194°F)
neutral crosslinker for condensation cure silicones
[22984-54-9] TSCA HMIS: 2-2-1-X 100g/ 2kg/

SIV9280.0
VINYLTRIS(METHYLETHYLKETOXIMINO) SILANE, tech-95
$C_{14}H_{27}N_3O_3Si$ 313.47 0.982
[2224-33-1] TSCA HMIS: 3-3-1-X 50g/ 2kg/

Enoxy (Acetone) Crosslinkers

SIV9209.0
VINYLTRIISOPROPENOXYSILANE, tech-95 226.35 0.926
$C_{11}H_{18}O_3Si$
[15332-99-7] TSCA HMIS: 3-1-1-X 25g/ 100g/

Amino and Benzamido Crosslinkers

SIB1610.0
BIS(N-METHYLBENZAMIDO)ETHOXYMETHYL- 356.50
SILANE, tech-90
$C_{19}H_{24}N_2O_3Si$
[16230-35-6] TSCA HMIS: 2-1-1-X 25g/ 100g/

SIT8710.0
TRIS(CYCLOHEXYLAMINO)METHYLSILANE, tech-95 337.62
$C_{19}H_{39}N_3Si$ flashpoint: 72°C(161°F)
[15901-40-3] TSCA HMIS: 3-2-1-X 25g/ 100g/

Tin Catalysts for Silicone Condensation Cure

name M.W. d^{20}

SNB1100
BIS(2-ETHYLHEXANOATE)TIN tech-95 405.11 1.28
TIN II OCTOATE contains free 2-ethylhexanoic acid
$C_{16}H_{30}O_4Sn$ TOXICITY - orl rat, LD50: 5,810 mg/kg
catalyst for two-component condensation RTVs
highest activity, short pot life,
does not cause silicone reversion
use level: 0.1-0.3%
[301-10-0] TSCA HMIS: 2-1-1-X 100g/ 2.5kg/

SNB1101
BIS(2-ETHYLHEXANOATE)TIN, 50% 405.11 1.12
in polydimethylsiloxane *TIN II OCTOATE*
$C_{16}H_{30}O_4Sn$
predilution results in better compatibility with silicones
[301-10-0] TSCA HMIS: 2-1-1-X 100g/ 1kg/

SNB1710
BIS(NEODECANOATE)TIN tech-90 461.23 1.16
TIN II NEODECANOATE contains free neodecanoic acid
$C_{20}H_{38}O_4Sn$ dark viscous liquid
catalyst for two-component condensation RTVs
slower than SNB1100
does not cause reversion
use level: 0.2-0.4%
[49556-16-3] TSCA HMIS: 2-1-0-X 50g/ 250g/

SND2930
DI-n-BUTYLBIS(2-ETHYLHEXYLMALEATE)TIN, tech-95 687.46 1.145
DIBUTYLTIN DIISOOCTYLMALEATE
$C_{32}H_{56}O_8Sn$
catalyst for one-component RTVs
good adhesion to metal substrates
[25168-21-2] TSCA HMIS: 2-2-0-X 50g/ 250g/

SND2950
DI-n-BUTYLBIS(2,4-PENTANEDIONATE)TIN, tech-95 431.13 1.2
$C_{18}H_{32}O_4Sn$ flashpoint: 91°C (196°F)
stable tin^{+4} catalyst with reduced reversion
can be used in conjunction with SND3260
catalyst in silicone RTV cures[1,2].
1. T. Lockhardt et al, US Pat. 4,517,337, **1985**
2. J. Wengrovius, US Pat. 4,788, 170, **1988**
[22673-19-4] TSCA HMIS: 2-2-1-X 25g/ 2kg/

SND3110
DI-n-BUTYLBUTOXYCHLOROTIN, tech-95 341.48
$C_{12}H_{27}ClOSn$
catalyst for two-component condensation cure silicone RTVs.[1]
1. Chadho, R.; et al, US Pat. 3,574,785, **1971**
[14254-22-9] TSCA HMIS: 3-2-1-X 25g/ 100g/

name M.W. d^{20}

SND3160
DI-n-BUTYLDIACETOXYTIN, tech-95 351.01 1.320
DIBUTYLTINDIACETATE (-10°)mp
$C_{12}H_{24}O_4Sn$ TOXICITY - oral mus, LD50: 109.7mg/kg
flashpoint: 143°C (290°F)
high activity catalyst for one-component condensation RTVs
suitable for acetoxy cure and neutral alkoxy cure
use level 0.1-0.3%
[1067-33-0] TSCA HMIS: 3-1-1-X 25g/ 2.5kg/

SND3260
DI-n-BUTYLDILAURYLTIN, tech-95 631.55 1.066
DIBUTYLTIN DILAURATE
TOXICITY-orl rat, LD50: 175-1600mg/kg
$C_{32}H_{64}O_4Sn$ flashpoint: 231°C (448°F)
viscosity, 25°: 31-4 cSt
widely used catalyst for two-component condensation RTVs
moderate activity, longer pot life, employed in silicone emulsions
FDA allowance as curing catalyst for silicones- 21CFR121.2514
use level: 0.2-0.6%
[77-58-7] TSCA HMIS: 2-1-1-X 100g/ 2.5kg/

SND4220
DIMETHYLDINEODECANOATETIN, tech-95 491.26 1.136
DIMETHYLTIN DINEODECANOATE
TOXICITY- oral rat, LD50: 1470mg/kg
$C_{22}H_{44}O_4Sn$ flashpoint: 153°C (307°F)
catalyst for one- and two-component condensation RTVs
use level: 0.5-0.8%
[68928-76-7] TSCA HMIS: 2-1-0-X 50g/ 250g/

SND4240
DIMETHYLHYDROXY(OLEATE)TIN, 85% 447.23 1.15
$C_{20}H_{40}O_3Sn$ viscous liquid
TOXICITY - oral rat, LD50: 800mg/kg
elevated temperature catalyst for condensation cure silicones
use level: 0.8-1.2%
[43136-18-1] TSCA HMIS: 2-1-0-X 25g/ 100g/

SND4430
DIOCTYLDILAURYLTIN tech-95 743.76 0.998
DIOCTYLTINDILAURATE
TOXICITY - oral rat, LD50: 6450mg/kg
$C_{40}H_{80}O_4Sn$ flashpoint: 70°C (158°F)
low toxicity tin catalyst
moderate activity, longer pot life
applications in silicone emulsions and solvent based adhesives
use level: 0.8-1.3%
[3648-18-8] TSCA HMIS: 2-2-1-X 25g/ 2kg/

SNT7955
TIN II OLEATE, tech-90 681.61 1.06
$C_{36}H_{66}O_4Sn$ contains free oleic acid
[1912-84-1] HMIS: 2-1-0-X 100g/

Titanate Catalysts for Alkoxy and Oxime Neutral Cure RTVs

name	MW	b.p./mm(m.p.)	d[20]	n[20]
AKT853				
TITANIUM DI-n-BUTOXIDE (BIS-2,4-PENTANEDIONATE)	392.32		1.085	
$C_{18}H_{32}O_6Ti$	flashpoint: >110°C(230°F)			
[16902-59-3] TSCA HMIS: 2-3-1-X	100g/		500g/	
AKT855				
TITANIUM DIISOPROPOXIDE(BIS-2,4-PENTANEDIONATE), 75% in isopropanol	364.26		0.992	1.4935
$C_{16}H_{28}O_6Ti$ *TIACA*	TOXICITY- oral rat, LD50: 2,870mg/kg			
miscible: aqueous acetone, most organics	flashpoint: 12°C (54°F)			
	viscosity, 25°: 8-11 cSt			
[17927-72-9] TSCA HMIS: 2-3-1-X	100g/		2kg/	
AKT865				
TITANIUM DIISOPROPOXIDE BIS(ETHYLACETOACETATE), 95%	424.33		1.05	
$C_{18}H_{32}O_8Ti$ 11.0 - 11.2% Ti	TOXICITY - oral rat, LD50: 23,020 mg/kg			
	viscosity, 25°: 45-55 cSt			
	flashpoint: 27°C (80°F)			
[27858-32-8] TSCA HMIS: 2-3-1-X	100g/		500g/	
AKT867				
TITANIUM 2-ETHYLHEXOXIDE	564.79	194°/0.25	0.937	1.482
TETRAOCTYLTITANATE 8.4-8.6% Ti	viscosity, 25°: 120-130 cSt.			
$C_{32}H_{68}O_4Ti$	flashpoint: 71°C (160°F)			
catalyst for silicone condensation RTVs				
[1070-10-6] TSCA HMIS: 2-2-1-X	100g/		2kg/	
SIT7305.0				
TITANIUM TRIMETHYLSILOXIDE	404.66	110°/10	0.900	1.4278
TETRAKIS(TRIMETHYLSILOXY)TITANIUM	flashpoint: 51°C (124°F)			
$C_{12}H_{36}O_4Si_4Ti$				
[15990-66-6] HMIS: 2-2-1-X	25g/		100g/	

Peroxide Catalysts for Heat-Cured Silicone Rubber

SID3352.0
2,4-DICHLOROBENZOYL PEROXIDE, MW: 380.00 density: 1.26
50% in polydimethylsiloxane paste consistency
silicone compounding temp. <50°; cure temp. >90°; recommended cure temp: 105-120°
[133-14-2] TSCA HMIS: 3-4-1 100g/ 500g/

SID3379.0
DICUMYL PEROXIDE, 25% MW: 270.36
in polydimethylsiloxane, 40% w/ calcium carbonate, 35%
silicone compounding temp. <60°; cure temp. >125°; recommended cure temp: 155-175°
$C_{18}H_{22}O_2$
[80-43-3] TSCA HMIS: 2-3-2-X 100g/ 500g/

Pigments and Coloration

Pigment concentrates in silicone oil are readily dispersed in all silicone cure systems. Pigments are generally mixed at 1-4 parts per hundred with the A part of two part vinyl addition silicones. Silicone coatings generally employ 2-6 parts per hundred.

Pigment Concentrates (dispersed in silicone)

Code	Color	Concentration	Pigment Type	Price/100g	Price/1kg
PGWHT01	White	45%	titanium dioxide		
PGRED01	Red	50%	cadmium sulfoselenide		
PGORR01	Orange-Red	45%	iron oxide		
PGORA01	Orange	15-25%	diarylide pyrazolone		
PGYLW01	Yellow	55%	bismuth vanadate		
PGGRN01	Green	30-40%	cobalt titanate		
PGBLU01	Blue	45%	sodium aluminosulfosilicate		
PGFLS01	Beige	50-60%	mixed Fe-Mg-Ti oxides		
PGBRN01	Brown	55%	mixed Fe-Cr-Cu oxides		
PGBLK01	Black - nonconductive	55%	manganese ferrite		
PGBLK02	Black - conductive	45%	carbon		
PGXRA01	X-Ray Opaque	35%	barium sulfate		

Dyes in silicone oils provide coloration without compromising transparency. The fluids may be used directly in applications such as gauges or as tints for silicone elastomers.

DMS-T21BLU (Blue dye in 100cSt. silicone) 100g/ 1kg/
DMS-T21RED (Red dye in 100cSt. silicone) 100g/ 1kg/

Fillers and Reinforcements

Hexamethyldisilazane treated silica is the preferred filler for silicones. The material is very fine and hydrophobic. Enclosed high-shear compounding equipment is required for adequate dispersion.

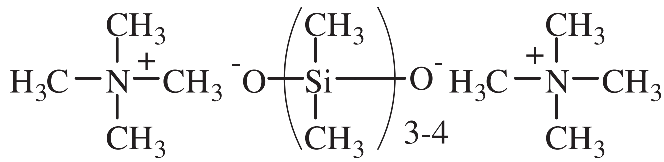
Product Code M.W. density

SIC2050.0
CALCIUM METASILICATE 116.16 2.69
WOLLASTONITE hardness: 4.5-5
CaO_3Si
weakly reinforcing filler for silicone rubbers- suitable for putty
[13983-17-0] TSCA HMIS: 1-0-0-X 500g/ 2.5kg/

SIS6962.0
SILICON DIOXIDE, AMORPHOUS 60.09 2.2
HEXAMETHYLDISILAZANE TREATED
FUMED SILICA, HMDZ TREATED surface area, 150-200m^2/g
SiO_2 ultimate article size: 0.02m
reinforcing filler for high tear strength silicone rubbers
[168909-20-6]/[7631-86-9] TSCA HMIS: 2-0-0-X 500g/ 2kg/

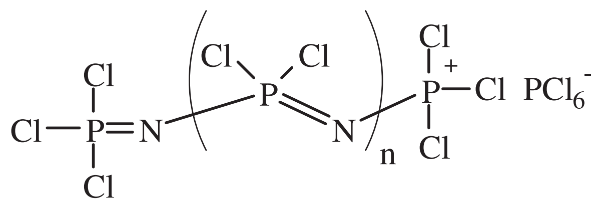
SIS6964.0
SILICON DIOXIDE, CRYSTALLINE 60.09 2.65
QUARTZ POWDER TOXICITY- oral- rat, LD50: 3160mg/kg
SiO_2 hardness: 7.0
[7631-86-9] TSCA HMIS: 1-0-0-X 500g/ 10kg/

Polymerization Catalysts

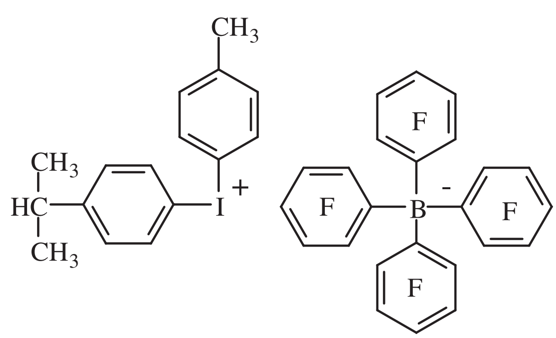


nominal structure

SIT7520.0
TETRAMETHYLAMMONIUM SILOXANOLATE density: 0.98
1.5-2.0% nitrogen as endcapped polydimethylsiloxane
catylyst for ring opening polymerization of cyclic siloxanes at 85-100°;
decomposes >120°C with release of trimethylamine
[68440-88-0] TSCA HMIS: 3-3-1-X 25g/ 100g/



INPH055
POLYPHOSPHONITRILIC CHLORIDE, 95% mp 60-80°
$Cl_3(NPCl_2)_nNOCl_3{\cdot}PCl_6$
for silanol oligomer polymerization[1,2,3]
1. Nitzsche, S.; et al, US Pat. 3,839,388, **1974**
2. Nye, S.; et al, US Pat. 5,753,751, **1988**
3. Dittrich, U.; et al, US Pat. 5,919,883, **1999**
[31550-05-7] HMIS: 3-1-1-X 10g/



OMBO037
(p-ISOPROPYLPHENYL)(p-METHYLPHENYL)- mp 120-133°
IODONIUM TETRAKIS(PENTAFLUOROPHENYL) BORATE
UV initiator for cationic polymerizations, e.g. cycloaliphatic epoxides
[178233-72-2] TSCA HMIS: 2-1-0-X 5g/ 25g/

Product Code Definitions for Reactive Fluids

Note: All comonomer % are in mole %
All block copolymer % are in weight %

3 Character Suffix for Functional Termination

Prefix:
DMS = DiMethylSiloxane

Suffix:
1st character describes termination
A = Amino
B = CarBoxy
C = Carbinol
D = Diacetoxy
E = Epoxy
F = TriFluoropropyl
H = Hydride
I = Isocyanate
K = Chlorine (hydrolyzeable)
L = ChLorine (non-hydrolyzeable)
M = Methyl
N = DimethylamiNe
R = MethacRylate
S = Mercapto
T = Trimethylsilyl
U = Acrylate (UV) or UV stabilizer
V = Vinyl
W = Acrylamido
X = MethoXy or EthoXy
Y = Polar Aprotic (cYano, pYrrolidone)
Z = Anhydride

m (lower case) = monodisperse
2nd character = viscosity in decades, i.e. 10x
3rd character = viscosity to 1 significant figure

Example: DMS-V41

Prefix = DMS = DiMethylSiloxane
Suffix = V41 = Vinyl Terminated (10^4 x 1) cSt
or Vinyl Terminated polyDimethylsiloxane, 10,000 cSt

4 Character Suffix for Functional Copolymers

Prefix:
1st character describes non-methyl substitution
A = Amino
C = Carbinol
D = Dimethyl
E = Epoxy
EC = Epoxy Cyclohexy
F = TriFluoropropyl
H = Hydride
L = ChLorine (non-hydrolyzeable)
M = Methyl
P = Phenyl
R = MethacRylate
S = Mercapto
U = Acrylate (UV) or UV stabilizer
V = Vinyl
X = MethoXy or EthoXy
Y = Polar Aprotic (cYano, pYrrolidone)
Z = Anhydride

2nd character = substitution type for 1st digit
B = Block
D = Difunctional
M = Monofunctional
3rd character = termination type including bloc
E = Ethylene oxide block
P = Propylene oxide block
S = Silanol
V = Vinyl

Suffix:
1st 2 characters = mole % non-dimethyl monomer
3rd character = viscosity in decades, i.e. 10x
4th character = viscosity to 1 significant figure

Example: PDS – 1615
Prefix = PDS — P = Phenyl
D = Di (i.e. Diphenyl)
S = Silanol
Suffix = 1615 — 1st 2 digits = 16%
2nd 2 digits = (10^1 x 5) cSt
or 16% Diphenylsiloxane-Dimethylsiloxane

Silicones Product Code Index

Appendix 1 – Viscosity Conversion Chart

Centistokes	Poise	SSU	Zahn #1	Zahn #2	Zahn #3	Zahn #4	Zahn #5	Ford #3	Ford #4	Krebs Units	SAE	Liquid Example
1	.01	.31										Water
10	.10	60	30	16				9	5			
20	.20	100	37	18				12	10			
40	.40	210	52	22				25	18			
60	.60	320	68	27				33	25	33	10	
80	.80	430	81	34				41	31	37		
100	1.0	530		41	12	10		50	34	40	20	olive oil
200	2.0	1,000		82	28	17	10	90	58	52		
300	3.0	1,475			34	24	15	130	74	60		
400	4.0	1,950			46	30	20	170	112`	64	30	glycerine
500	5.0	2,480			58	38	25	218	143	68	40	
1,000	10.0	4,600				69	49	390	264	85	90	castor oil
2,000	20.0	9,400						800	540	103		
3,000	30.0	14,500						1,230	833	121		
4,000	40.0	18,500						1,570	1,060	133		molasses
5,000	50.0	23,500							1,350			corn syrup
6,000	60.0	28,000							1,605			
7,000	70.0	32,500							1,870			
8,000	80.0	37,000							2,120			
9,000	90.0	41,000							2,360			
10,000	100	46,500							2,670			honey
15,000	150	69,400										
20,000	200	92,500										
30,000	300	138,600										
40,000	400	185,600										
50,000	500	231,000										
60,000	600	277,500										
70,000	700	323,500										
80,000	800	370,500										
90,000	900	415,500										
100,000	1,000	462,000										sour cream
125,000	1,250	578,000										molasses*
150,000	1,500	694,000										
175,000	1,750	810,000										
200,000	2,000	925,000										peanut butter

viscosities at 25°C unless otherwise stated *measured at 2°C (a cold winter day)

Note: The precision of conversion in this table is limited by two factors. It assumes that the density of liquids is 1 so that stokes and poises are the same and that viscosity is independent of shear rate, i.e., the fluid is Newtonian. To correct for density in converting from centistokes to centipoises, multiply specific gravity by centistokes.

Appendix 2 – Blending Silicone Fluids

Any standard viscosity grade of polydimethylsiloxane can be blended together with another viscosity grade of the same fluid to produce an intermediate viscosity. This chart provides a means for determining the proper blend ratio. The chart should be used as follows:

Decide upon the viscosity grades to be blended. For high accuracy, measure the actual viscosity of the blending fluids.

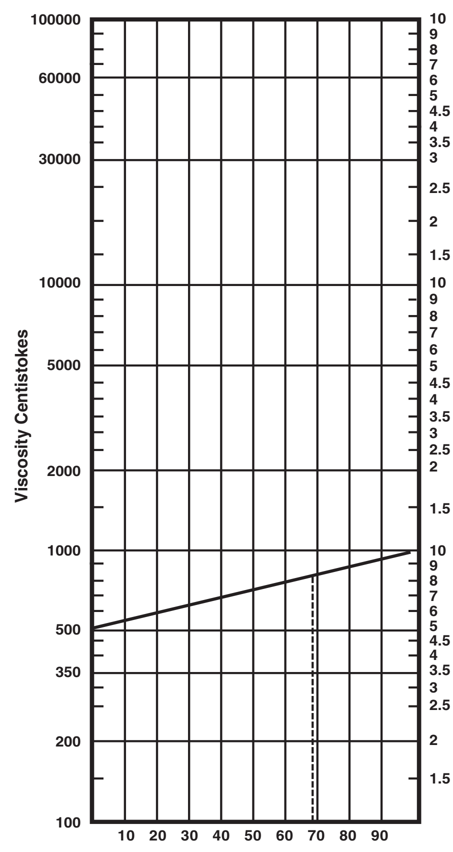
Locate the lower viscosity on the left hand scale.

Locate the higher viscosity on the right hand scale.

Connect these two points with a straight line.

Locate the point where the line indicating the desired blend viscosity intersects the constructed line. From this point, follow down to the horizontal scale to read the percent of the higher viscosity fluid to use in the blend.

This method is reasonably accurate in predicting blend viscosity when the two fluids differ in viscosity by no more than one magnitude (one power of ten). When fluids covering a wider range are blended, the chart will only approximate the finished viscosity. To achieve a viscosity of 800 cSt. as shown in the example, 68% of 1000 cSt. and 32% of 500 cSt. fluids are blended.



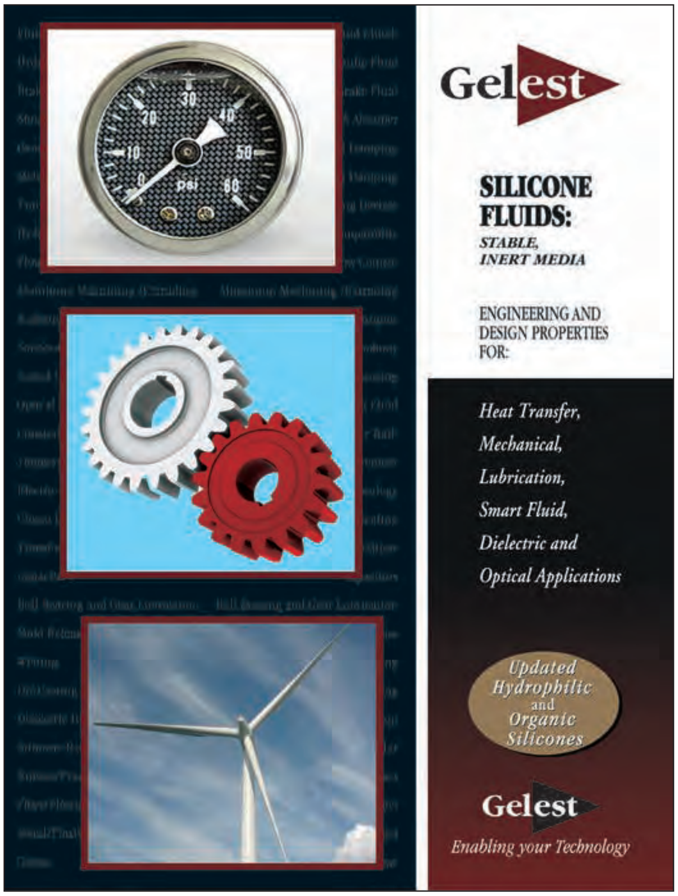
The calculation basis for blending is:

$$\log = \frac{A \log^1 + B \log^2}{A + B}$$

Silicon Compounds: Silanes & Silicones

Detailed chemical properties and reference articles for over 2000 compounds.

The 608 page catalog of silane and silicone chemistry features physical properties, structures, scholarly reviews as well as detailed application information to enable scientists to select materials that meet process and performance criteria in applications such as Advanced Ceramics, Adhesives & Sealants, Alternative Energy, Conductive Coatings, Microelectronic Metallization and Dielectrics, Micro-Particles, Optical Materials, Photolithography, Separation & Diagnostic Sciences and Superconductors.



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 a 30 page 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.

Gelest

Enabling Your Technology

11 East Steel Road
Morrisville, PA 19067
USA
Tel: (215) 547-1015
Toll-Free: (888) 734-8344
Fax: (215) 547-2484
Internet: www.gelest.com

In Europe:

Gelest Inc.
Stroofstrasse 27 Geb.2901
65933 Frankfurt am Main,
Germany
Tel: +49-(0)-69-3800-2150
Fax: +49-(0)-69-3800-2300
e-mail: info@gelestde.com
Internet: www.gelestde.com