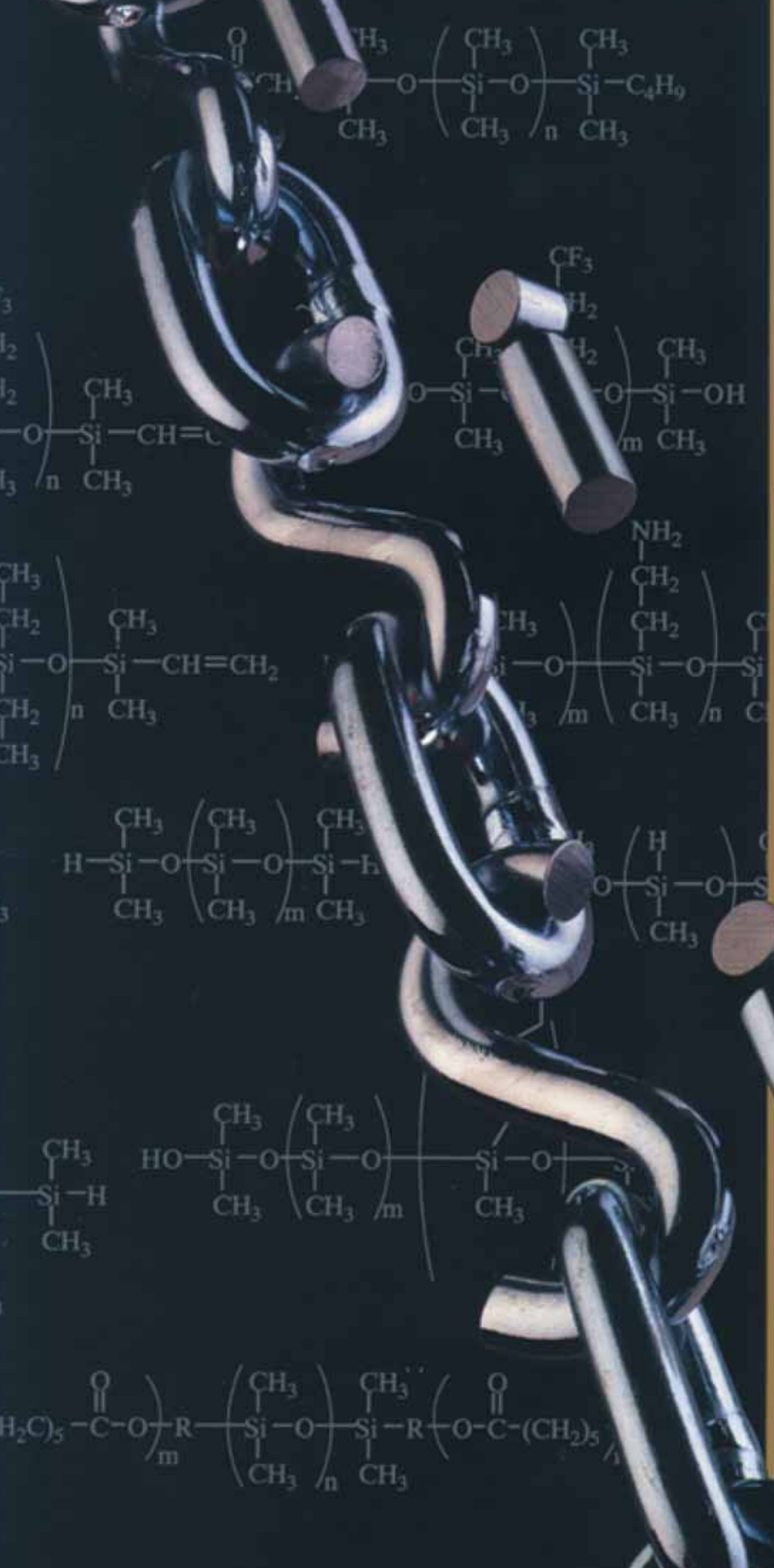


Gelest

# REACTIVE SILICONES:

*FORGING NEW POLYMER LINKS*

## MATERIALS FOR:

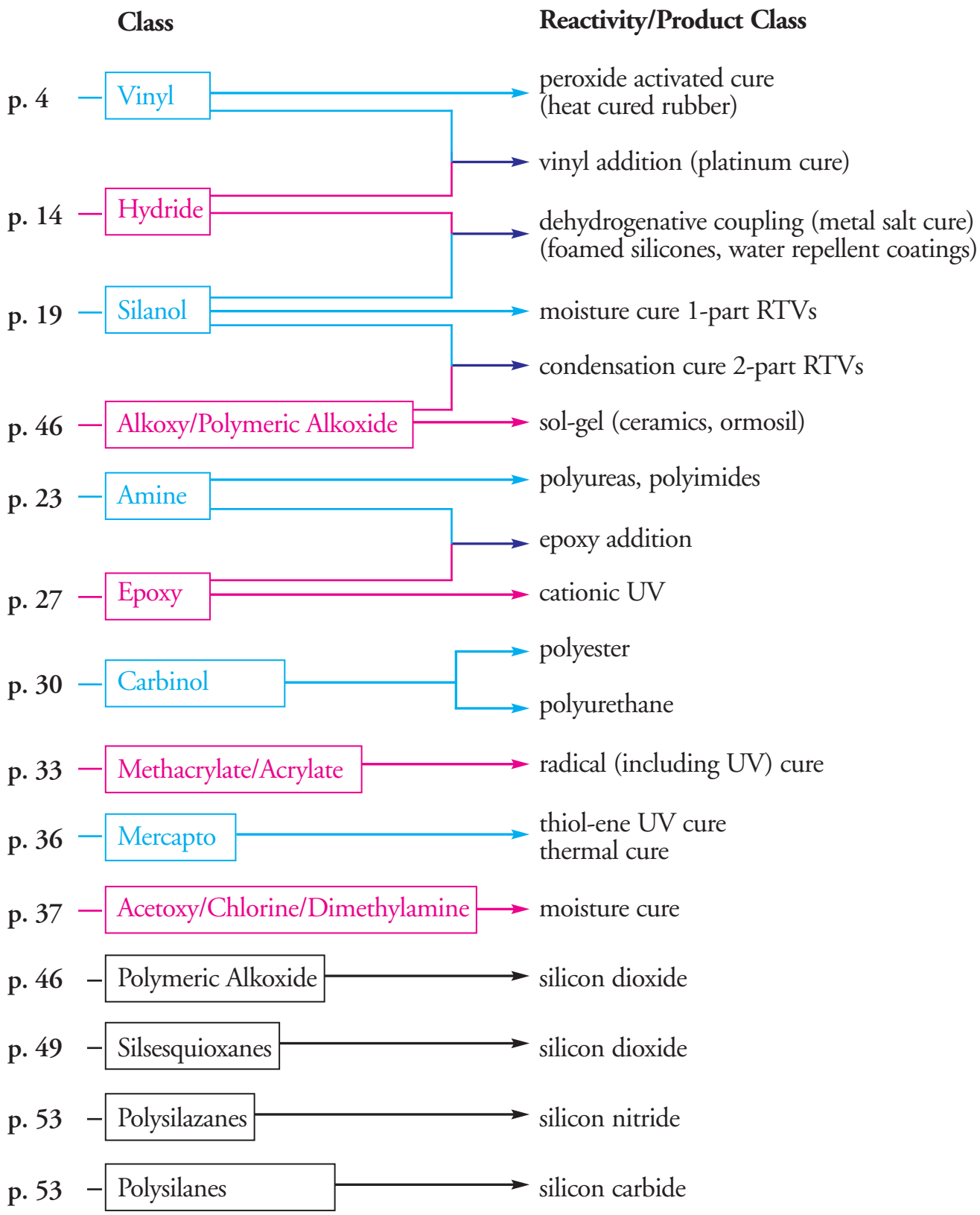
*Adhesives*
*Binders*
*Ceramic Coatings*
*Dielectric Coatings*
*Encapsulants*
*Gels*
*Membranes*
*Optical Coatings*
*Photolithography*
*Polymer Synthesis*
*Sealants*

*New!*
Monodisperse
Reactive Fluids
Liquid Silicone Resins
*Ver. 5*

Gelest

***Enabling your technology***

# Functional Silicone Reactivity Guide



# REACTIVE SILICONES:
## *FORGING NEW POLYMER LINKS*

Gelest

*Enabling Your Technology*

**Gelest Inc.**
**11 East Steel Rd.**
**Morrisville, PA 19067 USA**
**Phone (United States): (215) 547-1015**
**Phone (United Kingdom): 44(0)1622 741115**
**www.gelest.com**

Gelest Inc., headquartered in Morrisville, PA, is recognized worldwide as an innovator, manufacturer and supplier of commercial and research quantities of organosilicon and metal-organic compounds. Gelest serves advanced technology markets through a materials science driven approach. Gelest silicone materials find applications in:

| | |
|---|---|
| **Catalysis** | **Optical Coatings** |
| **Ceramics** | **Polymer Synthesis** |
| **Microelectronics** | **Surface Modification** |
| **Coupling Agents** | **Pharmaceutical Synthesis** |

**Research & Development**

**Commercial Status -** produced on a regular basis for inventory

**Developmental Status -** available to support development and commercialization

Supplement to the Gelest Catalogs, "Silicon Compounds: Silanes and Silicones" and "Metal-Organics for Materials, Polymers and Synthesis," which are available upon request.

# TERMS AND CONDITIONS OF SALE

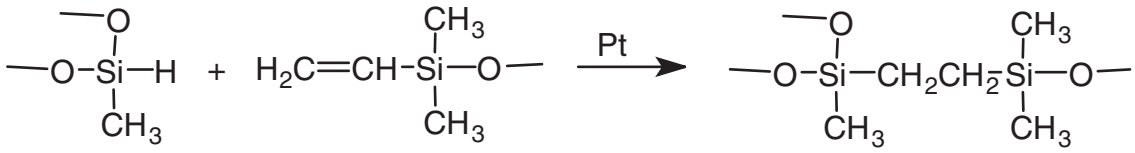
1. (a) Except as expressly stated herein, the seller does not warrant the material covered by this agreement in any manner whatsoever and no warranty, express, implied or statutory, is made by the seller. Seller makes no representation or warranty that the material is merchantable or fit for a particular purpose.
   (b) Seller in no event shall be liable for incidental or consequential damages in connection with this contract. Consequential damages shall include loss of use, income or profit.
   (c) The maximum liability of the seller or producer, if any, on account of inferior quality, defective condition, delay, unsuccessful reactions, failure to ship or from any other cause shall be to refund if paid, or otherwise credit buyer the purchase price of that part of the material which is subject to the condition or cause on which claim is based.
2. Acceptance of this order is expressly conditioned upon the terms and conditions contained herein and buyer agrees to comply with said terms and conditions unless agreed to in writing by the Seller and Buyer.
3. The terms of sale are net 30 days of the date of the invoice unless otherwise stated. If the financial condition of the Buyer results in the insecurity of the Seller, in its discretion, the Seller may without notice to Buyer postpone delivery of the goods and Seller, at its option, is authorized to change the terms of payment by Buyer. Buyer will incur a finance charge of eighteen percent per annum (1.5% per month) for unpaid invoices beyond the stated terms. Buyer agrees to pay all costs, including but not limited to attorney fees or other expenses of collection resulting from any default by Buyer.
4. Title and risk of loss shall pass to Buyer as soon as the materials delivered on board common carrier or other carrier specified by Buyer at our warehouse or delivered on board common carrier at other specified F.O.B. point.
5. Carrier weights at point of shipment shall govern. Shortages of less than one percent (1%) of the net weight will not be allowed.
6. Buyer will examine and test each shipment on arrival at destination. Any claims against Seller or producer will be waived unless made in writing and received by Seller within fifteen days (15) after the arrival of the material at the destination. No claim shall be allowed for any cause as to material which has been treated or processed in any manner. No material shall be returned for credit by Buyer without prior written consent of Seller.
7. Buyer assumes all risks and liability for results of the use of the material, including any changes made in the composition or form thereof or its use in combination with other materials.
8. The goods sold are for research and development use or for manufacturing use in compliance with EPA regulations. Buyer realizes that, since Seller's products are, unless otherwise stated, intended for research purposes, they may not be on the Toxic Substances Control Act (TSCA) inventory. Buyer assumes responsibility to assure that the products purchased from Seller are approved for use under TSCA, if applicable. The goods are not to be used clinically, pharmaceutically or as a food preparation.
9. Buyer assumes all responsibility for the safe handling and utilization of the goods sold. Buyer is responsible to take all appropriate precautions against possible dangers arising out of any unknown hazard or toxicity of the goods. Buyer has the sole responsibility of disposing of any waste associated with material purchased including containers in full compliance with federal, state, or other regulations.
10. Seller, upon Buyer's request, may furnish technical advice with reference to the use of the material sold hereunder, but it is expressly agreed that there is no obligation to furnish any such advice and, if any such advice is furnished, it shall be given and accepted at Buyer's sole risk. Buyer agrees to indemnify and save harmless Seller from costs, fees or losses resulting from claims or suits brought by third parties claimed to be based upon advice by seller.
11. Seller shall not be held responsible for failure or delay in shipping or delay in manufacture of the goods. Any shipment made by Seller before receipt of written notice from Buyer that the latter cannot accept shipments shall be accepted by Buyer and in any event paid for by Buyer.
12. Prices are subject to change by Seller without notice. Pricing for orders accepted for shipment within sixty days will be invoiced at the price stated at the time of acceptance of the order. On any order or any part of an order actually shipped sixty days or more after the date of acceptance, prices in effect at the time of shipment will apply. Before making any shipment at a price in excess of that stated in the accepted order, Seller will notify Buyer and thereupon Buyer shall have the right to cancel the part of the order to which the increased price applies.
13. Seller makes no express or implied representation that 1) the goods sold do not infringe on any existing or pending patent, or 2) patents covering the goods do not exist, or 3) the goods are sold pursuant to a license held by the Seller under any existing or pending patent. Buyer assumes all responsibility for determining if patents or pending patents exist which cover the goods sold.
14. Seller reserves the right to refuse sale of any materials if the user is unable to demonstrate that professional supervision is available to provide compliance with EPA, OSHA, Right to Know Laws or to handle materials of unknown safety and toxicity potential.
15. This agreement shall be deemed separable as to the materials sold. Buyer may not refuse to accept any lot or portion of the material shipped hereunder on the ground that there has been a failure to deliver any other lot or material if any other lot was nonconforming.
16. All orders are subject to written acceptance and confirmation by the Seller at its Office in Morrisville, Pennsylvania. Changes to the contract shall be made only in writing signed by duly authorized representatives. This contract shall be governed and construed according to the Uniform Commercial Code as adopted in the Commonwealth of Pennsylvania.

# CONTENTS

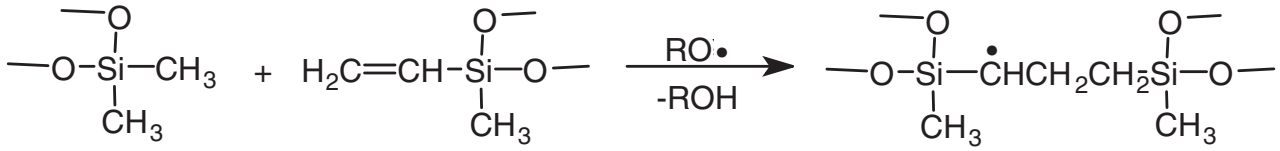
$$Si—CH=CH_2$$

## Vinyl Functional Polymers

The reactivity of vinyl functional polymers is utilized in two major regimes. 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:




**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.

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. 53)

*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.

**Platinum Catalysts- see p. 57**
**Addition Cure Modifiers- see p. 58**

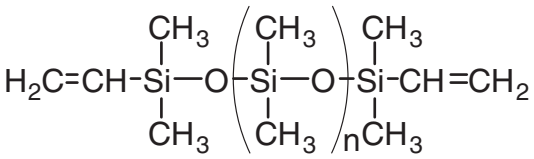
**Peroxide Activated Cure**

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. 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]. 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.

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.

**Peroxide Catalysts- see p. 61**



## 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 | $44.00 | $568.00 | - |
| DMS-V03 | 2-3 | 500 | 10-12 | 3.6-4.3 | 0.92 | $72.00 | $930.00 | - |
| DMS-V05 | 4-8 | 800 | 7-9 | 2.4-2.9 | 0.93 | $74.00 | $960.00 | - |
| | | | | | | | | |
| DMS-V21 | 100 | 6000 | 0.8-1.2 | 0.33-0.37 | 0.97 | $24.00 | $166.00 | $432.00 |
| DMS-V22 | 200 | 9400 | 0.4-0.6 | 0.21-0.24 | 0.97 | $16.00 | $138.00 | $360.00 |
| DMS-V25 | 500 | 17,200 | 0.37-0.43 | 0.11-0.13 | 0.97 | $19.00 | $148.00 | $384.00 |
| | | | | | | | | |
| DMS-V31 | 1000 | 28,000 | 0.18-0.26 | 0.07-0.10 | 0.97 | $15.00 | $124.00 | $322.00 |
| DMS-V33 | 3500 | 43,000 | 0.12-0.15 | 0.05-0.06 | 0.97 | $19.00 | $148.00 | $384.00 |
| DMS-V35 | 5000 | 49,500 | 0.10-0.13 | 0.04-0.05 | 0.97 | $15.00 | $124.00 | $322.00 |
| | | | | | | | | |
| DMS-V41 | 10,000 | 62,700 | 0.08-0.12 | 0.03-0.04 | 0.97 | $19.00 | $148.00 | $384.00 |
| DMS-V42 | 20,000 | 72,000 | 0.07-0.09 | 0.025-0.030 | 0.98 | $24.00 | $166.00 | $432.00 |
| DMS-V46 | 60,000 | 117,000 | 0.04-0.06 | 0.018-0.020 | 0.98 | $24.00 | $166.00 | $432.00 |
| | | | | | | | | |
| DMS-V51 | 100,000 | 140,000 | 0.03-0.05 | 0.016-0.018 | 0.98 | $29.00 | $200.00 | $590.00 |
| DMS-V52 | 165,000 | 155,000 | 0.03-0.04 | 0.013-0.016 | 0.98 | $29.00 | $200.00 | $590.00 |

COMMERCIAL

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 | $80.00 | $560.00 |
| DMS-Vm35 | 5000 | 49,500 | 0.10-0.13 | 0.04-0.05 | 0.97 | $80.00 | $560.00 |

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 | $65.00 | $525.00 |
| DMS-V35R | 5000 | 49,500 | 0.10-0.13 | 0.04-0.05 | 0.97 | $85.00 | $660.00 |

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

### Fumed Silica Reinforced Vinyl Terminated PolyDimethylsiloxane

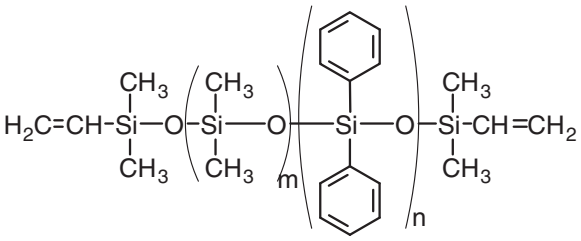
| Code | Viscosity | Base Fluid Viscosity | wt% Silica | Vinyl - Eq/Kg | Density | Price/100g | Price/3kg | Price/16kg |
|---|---|---|---|---|---|---|---|---|
| DMS-V31S15 | 3000 | 1000 | 15-18 | 0.06 | 1.1 | $34.00 | $264.00 | $684.00 |

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 | | | Part B | | |
|---|---|---|---|---|---|
| DMS-V31S15 | Base | 99.85% | DMS-V31 | Vinyl Silicone | 90.0% |
| SIP6831.2 | Catalyst | 0.15% | 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-kg | Price 18kg-kg |
|---|---|---|---|---|---|---|---|---|
| PDV-0325 | 3.0-3.5 | 500 | 15,500 | 0.10-0.16 | 1.420 | $40.00 | $107.00 | $65.00 |
| PDV-0331 | 3.0-3.5 | 1000 | 27,000 | 0.065-0.11 | 1.420 | $45.00 | $120.00 | $73.00 |
| PDV-0341 | 3.0-3.5 | 10,000 | 62,000 | 0.027-0.037 | 1.420 | $48.00 | $128.00 | $82.00 |
| PDV-0346 | 3.0-3.5 | 60,000 | 78,000 | 0.017-0.021 | 1.420 | $56.00 | $150.00 | $85.00 |
| | | | | | | | | |
| PDV-0525 | 4-6 | 500 | 14,000 | 0.12-0.16 | 1.430 | $40.00 | $107.00 | $71.00 |
| PDV-0535 | 4-6 | 5000 | 47,500 | 0.03-0.06 | 1.430 | $48.00 | $128.00 | $85.00 |
| PDV-0541 | 4-6 | 10,000 | 60,000 | 0.027-0.038 | 1.430 | $63.00 | $168.00 | $140.00 |
| | | | | | | | | |
| PDV-1625 | 15-17 | 500 | 9,500 | 0.19-0.23 | 1.465 | $44.00 | $117.00 | $98.00 |
| PDV-1631 | 15-17 | 1000 | 19,000 | 0.09-0.12 | 1.465 | $75.00 | $205.00 | $180.00 |
| PDV-1635 | 15-17 | 5,000 | 35,300 | 0.052-0.060 | 1.465 | $105.00 | $280.00 | $220.00 |
| PDV-1641 | 15-17 | 10,000 | 55,000 | 0.033-0.040 | 1.465 | $150.00 | $400.00 | $265.00 |
| | | | | | | | | |
| PDV-2331 | 22-25 | 1000-1500 | 12,500 | 0.13-0.19 | 1.493 | $235.00 | $620.00 | - |
| PDV-2335 | 22-25 | 4000-5000 | 23,000 | 0.07-0.10 | 1.493 | $275.00 | $735.00 | - |

COMMERCIAL

**Vinyl Terminated polyPhenylMethylsiloxane** CAS: [225927-21-9] TSCA-L

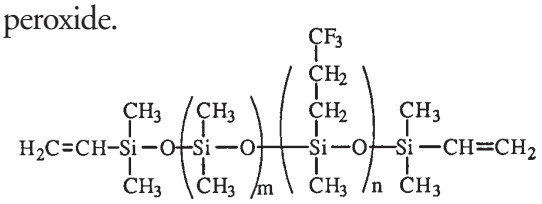
| Code | Mole % PhenylMethylsiloxane | Viscosity | Molecular Weight | Vinyl– Eq/Kg | Refractive Index | Density | Price/100g |
|---|---|---|---|---|---|---|---|
| PMV-9925 | 99-100 | 300-600 | 2000-3000 | 0.5-1.2 | 1.537 | 1.11 | $140.00 |

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 | $160.00 |

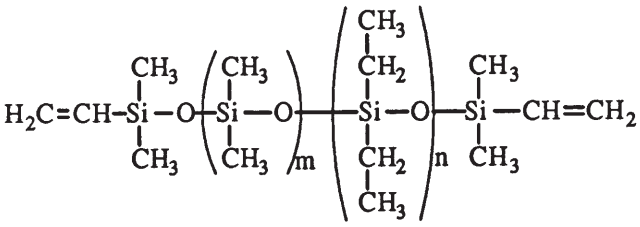
Crosslinks with dicumyl peroxide.



**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 | $110.00 | $710.00 |
| FMV-4042 | 35-45 | 14,000-18,000 | 25,000-35,000 | 1.388 | 1.13 | $175.00 | $1,050.00 |

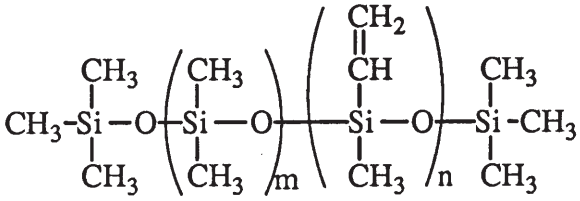
Trifluoropropylmethylsiloxane copolymers offer greater solvent resistance (lower hydrocarbon solubility) and lower refractive index than analogous dimethylsiloxane homopolymers.



**Vinyl Terminated Diethylsiloxane - Dimethylsiloxane Copolymers**

| Code | Mole % Diethylsiloxane | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100 g |
|---|---|---|---|---|---|---|
| EDV-2022 | 18-22 | 150-300 | 8000-12,000 | 1.413 | 0.953 | $180.00 |

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 | $24.00 | $166.00 |
| VDT-127 | 0.8-1.2 | 700-800 | 23,000 | 0.11-0.15 | 0.97 | $36.00 | $252.00 |
| VDT-131 | 0.8-1.2 | 800-1200 | 28,000 | 0.11-0.15 | 0.97 | $24.00 | $166.00 |
| VDT-163 | 0.3-0.7 | 2,000,000-4,000,000 | 425,000 | 0.04-0.08 | 0.98 | $60.00 | $420.00 |
| VDT-431 | 4.0-5.0 | 800-1200 | 28,000 | 0.5-0.7 | 0.97 | $26.00 | $182.00 |
| VDT-731 | 7.0-8.0 | 800-1200 | 28,000 | 0.9-1.1 | 0.96 | $24.00 | $166.00 |
| VDT-954 | 11.0-13.0 | 300,000-500,000 | 225,000 | 1.1-1.4 | 0.98 | $125.00 | $875.00 |
| VDT-5035 | 48-52 | 4500-5500 | 50,000 | 6.0-6.5 | 0.98 | $45.00 | $315.00 |

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

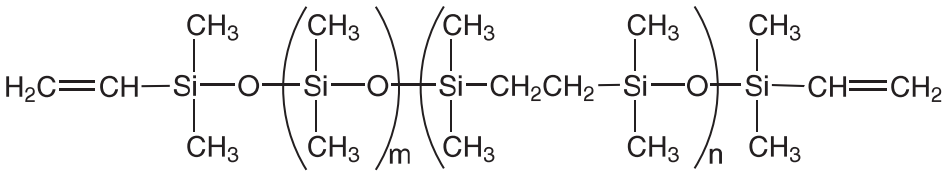
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| VDS-1013 | 10-15 | 25-40 | 550-650 | 0.9-1.4 | 0.99 | $54.00 | $378.00 |

**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 | $80.00 | $480.00 |

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

See also MCS-V212, p. 12.

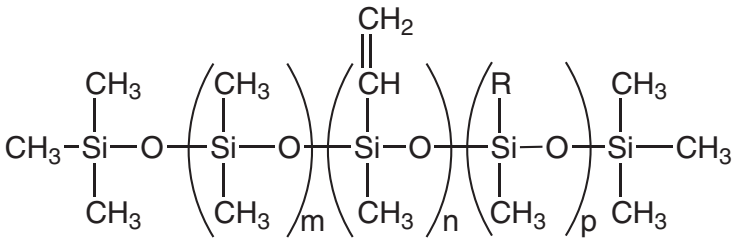


## Vinyl Terminated Ethylene-Siloxane Copolymer Fluids

[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 | $120.00 | $840.00 |

Ethylene-siloxane copolymer polymers exhibit reversion resistant behavior.



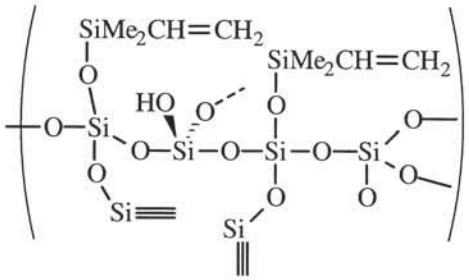
## Vinyl Gums (balance dimethylsiloxane unless otherwise specified)

TSCA

| Code | Mole % Vinylmethylsiloxane | Comonomer % | Specific Gravity | Price/100 g | Price/1kg |
|---|---|---|---|---|---|
| VGM-021 | 0.2-0.3 | | 0.98 | $36.00 | $120.00 |
| VGP-061 | 0.1-0.2 | 6-7% Diphenylsiloxane | 0.99 | $36.00 | $180.00 |
| VGF-991 | 1.0-2.0% | 98-9% Trifluoropropylmethylsiloxane | 1.35 | $64.00 | $384.00 |
| DGM-000* | 0.0 | 100% dimethylsiloxane | 0.98 | $43.00 | $145.00 |

* This gum is listed here for convenience. It contains no vinyl functionality.

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



## Vinyl Q Resins Dispersions

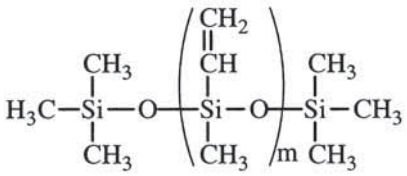
CAS: [68584-83-8] TSCA

| 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 | $19.00 | $285.00 |
| VQM-146* | DMS-V46 | 50,000-60,000 | 0.18-0.23 | 1.406 | 1.02 | $25.00 | $370.00 |
| VQX-221 | 50% in xylene | - | 0.4-0.6 | - | 1.05 | $30.00 | $450.00 |

*20-25% Q-resin

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

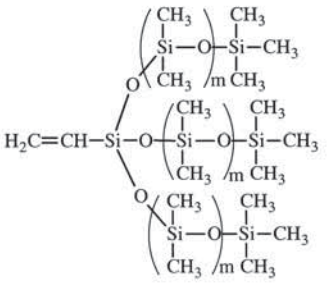
See also Hydride Q resins.

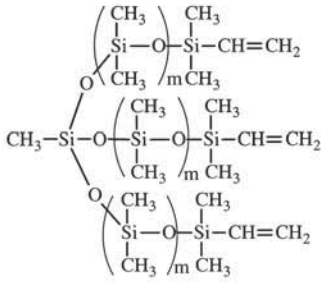


**Vinylmethylsiloxane Homopolymers** TSCA

| Code | Description | Molecular Weight | Viscosity | Density | Price/100g | Price 3kg-kg |
|---|---|---|---|---|---|---|
| VMS-005 | cyclics | 258-431 | 3-7 | 0.99 | $45.00 | $80.00 |
| VMS-T11* | linear | 1000-1500 | 7-15 | 0.96 | $110.00 | $660.00 |

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



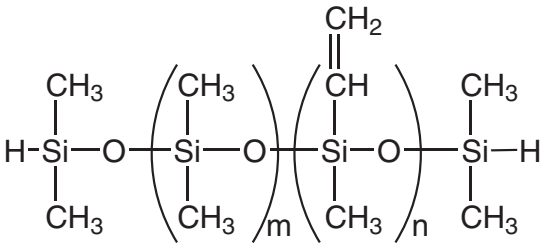


**Vinyl T-structure Polymers**

| Code | Branch Point | Branch Terminus | Vinyl – Eq/Kg | Viscosity | Density | Refractive Index | Price/100g |
|---|---|---|---|---|---|---|---|
| VTT-106* | Vinyl | Methyl | 2-4 | 5-8 | 0.90 | - | $48.00 |
| MTV-112 | Methyl | Vinyl | 3-6 | 15-30 | 0.96 | 1.407 | $110.00 |

*CAS: [126581-51-9] TSCA

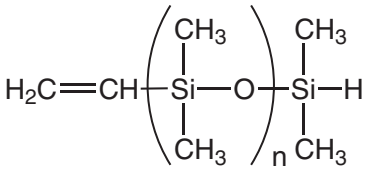
T-structure polymers contain multiple branch points.
These materials are additives and modifiers for addition cure and activated cure elastomers.



**VinylMethylsiloxane – Dimethylsiloxane copolymer, hydride terminated**

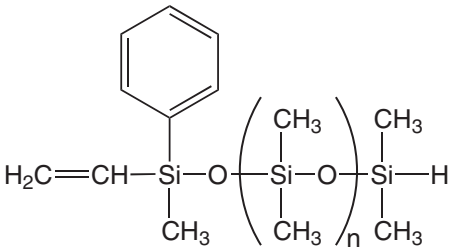
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Vinyl-Eq/Kg | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| VDH-422 | 150-250 | 8000-10,000 | - | 0.98 | 0.3-0.5 | $60.00 | $420.00 |

## Vinyl Functional Macromers



**α-MonoVinyl-Ω-MonoHydride Terminated PolyDimethylsiloxane**

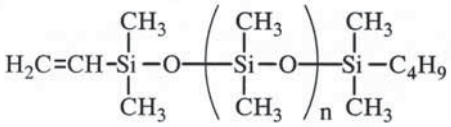
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| DMS-HV15 | 40-60 | 2000-3000 | 1.404 | 0.96 | $150.00 | $900.00 |
| DMS-HV22 | 150-250 | 10,000 | 1.403 | 0.97 | $150.00 | $900.00 |



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

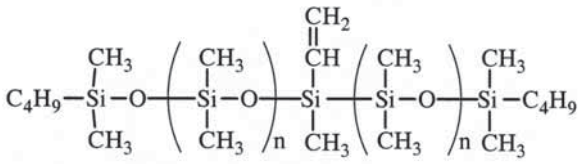
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| PMM-HV12 | 20 | 2000 | 1.4135 | 0.97 | $145.00 | $940.00 |

Hetero bi-functional silicones fluids contain little or no low molecular weigh components. They can be used as additives into traditional RTV-2 silicone formulations or base fluid for 1 part silicone RTVs.



**MonoVinyl Terminated PolyDimethylsiloxanes - asymmetric**

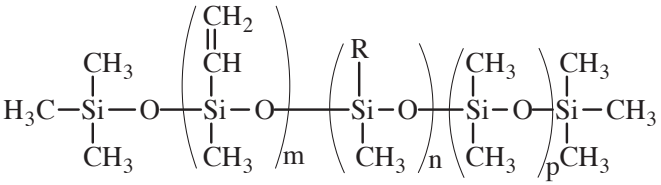
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-V21 | 80-120 | 5500-6500 | 1.403 | 0.97 | $110.00 | $660.00 |
| MCR-V41 | 8000-12000 | 55,000-65,000 | 1.404 | 0.98 | $210.00 | $1260.00 |



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

| Code | Viscosity | Molecular Weight | Refractive Index | Density | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-V212 | 16-20 | 1200-1400 | 1.419 | 0.95 | $110.00 | $560.00 |

Components in silicone gels; release coatings modifiers.



## 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 | $55.00 | $322.00 |

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**

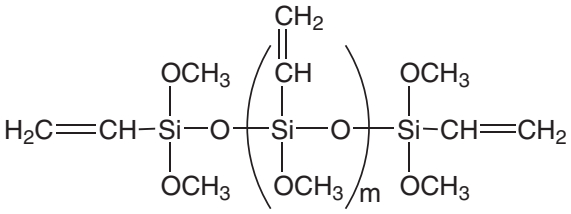
| Code | Viscosity | Molecular Weight | Density | Refractive Index | Vinyl-Eq/Kg | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| VPT-1323 | 250-350 | 2500-3000 | 1.03 | 1.467 | 0.25-0.29 | $48.00 | $336.00 |

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 | 200 | 10,000 | - | - | 0.08-0.10 | $75.00 | $450.00 |
| DBP-V052 | 200 | 10,000 | - | - | 0.03-0.05 | $75.00 | $450.00 |

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



**Vinylmethoxysiloxane Homopolymer** CAS: [131298-48-1] TSCA

| Code | Description | Viscosity | Density | Price/100g | Price/1kg |
|---|---|---|---|---|---|
| VMM-010* | oligomer | 8 - 12 | 1.10 | $28.00 | $196.00 |

*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 | $36.00 | $252.00 |

*19-22 wgt% vinyl

**Vinylethoxysiloxane-Propylethoxysiloxane Copolymer** TSCA

| Code | Description | Viscosity | Density | Price/100g | Price/1kg |
|---|---|---|---|---|---|
| VPE-005* | oligomer | 3 - 7 | 1.02 | $36.00 | $252.00 |

*9-11 wgt% vinyl

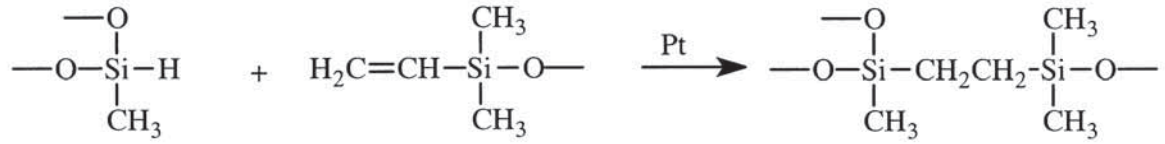
These materials are employed as adhesion promoters for vinyl-addition cure RTVs, as crosslinking agents for neutral cure RTVs, and as coupling agents in polyethylene for wire and cable applications.

≡Si–H

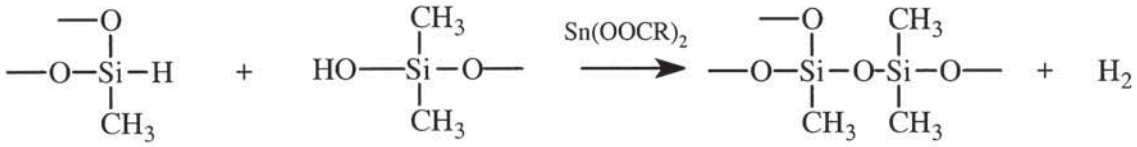
# Hydride Functional Polymers

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

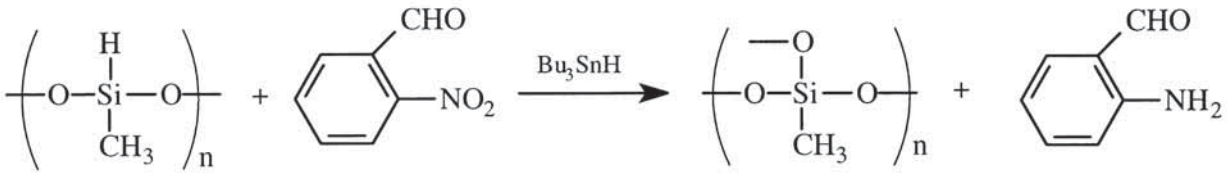
## Hydrosilylation




## 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. Polyethylhydrosiloxane imparts water-repellency, but has greater organic compatibility.

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.

**Reduction**

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.[3,4,5] Esters are reduced to primary alcohols in the presence of $Ti(OiPr)_4$.[6] See brochure "Silicon-Based Reducing Agents".

**Physical Properties**

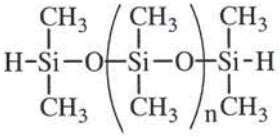
Polymethylhydrosiloxanes exhibit the highest compressibility of the silicone fluids, 9.32% at 20,000 psi and the lowest viscosity temperature coefficient, 0.50.

[3] Lipowitz, J. et al. *J. Org. Chem.* **1973**, *38*, 162.

[4] Keinan, E. et al. *Israel J. Chem.* **1984**, *24*, 82. and *J. Org. Chem.* **1983**, *48*, 3545.

[5] Mukaiyama, T. et al. *Chem. Lett.* **1983**, 1727.

[6] Reding, M. et al. *J. Org. Chem.* **1995**, *60*, 7884.



## Hydride Terminated PolyDimethylsiloxanes

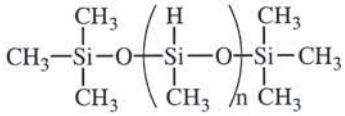
CAS: [70900-21-9] TSCA

| Code | Viscosity | Molecular Weight | wt% H | Equivalent Weight | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|---|
| DMS-H03 | 2 - 3 | 400-500 | 0.5 | 225 | 0.90 | 1.395 | $39.00 | $234.00 |
| DMS-H11 | 7-10 | 1000-1100 | 0.2 | 550 | 0.93 | 1.399 | $39.00 | $234.00 |
| DMS-H21 | 100 | 4000-5000 | 0.04 | 3,000 | 0.97 | 1.403 | $68.00 | $408.00 |
| DMS-H25 | 500 | 17,200 | 0.01 | 8,600 | 0.97 | 1.403 | $45.00 | $270.00 |
| DMS-H31 | 1000 | 28,000 | 0.007 | 14,000 | 0.97 | 1.403 | $45.00 | $270.00 |
| DMS-H41 | 10,000 | 62,700 | 0.003 | 31,350 | 0.97 | 1.403 | $50.00 | $300.00 |

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 | Equivalent Weight | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|---|
| DMS-Hm15 | 50 | 3000-3500 | 0.07 | 1,625 | 0.96 | 1.403 | $85.00 | $595.00 |
| DMS-Hm25 | 500 | 17,200 | 0.01 | 8,600 | 0.97 | 1.403 | $85.00 | $595.00 |

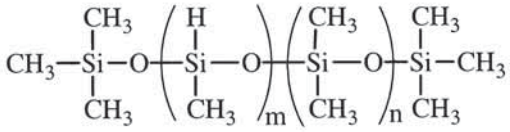


## polyMethylHydrosiloxanes, Trimethylsiloxy terminated

Tg: -119° V.T.C: 0.50 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 | $16.00 | $110.00 |
| HMS-992 | 20-35 | 1800-2100 | 100 | 65 | 0.99 | 1.396 | $19.00 | $134.00 |
| HMS-993 | 30-45 | 2100-2400 | 100 | 64 | 0.99 | 1.396 | $28.00 | $232.00 |

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 | $55.00 | $605.00 |
| HMS-031 | 25-35 | 1900-2000 | 3-4 | 1600 | 0.97 | 1.401 | $45.00 | $315.00 |
| HMS-053 | 750-1000 | 20,000-25,000 | 4-6 | 1475 | 0.97 | 1.403 | $50.00 | $400.00 |
| HMS-064 | 6000-9000 | 50,000-60,000 | 4-8 | 1240 | 0.97 | 1.403 | $64.00 | $720.00 |
| HMS-071 | 25-35 | 1900-2000 | 6-7 | 1000 | 0.97 | 1.401 | $60.00 | $420.00 |
| HMS-082 | 110-150 | 5500-6500 | 7-9 | 925 | 0.97 | 1.403 | $24.00 | $192.00 |
| HMS-151 | 25-35 | 1900-2000 | 15-18 | 490 | 0.97 | 1.400 | $24.00 | $192.00 |
| HMS-301* | 25-35 | 1900-2000 | 25-35 | 245 | 0.98 | 1.399 | $19.00 | $150.00 |
| HMS-501 | 10-15 | 900-1200 | 45-55 | 135 | 0.96 | 1.394 | $24.00 | $192.00 |

*available in reduced volatility grade

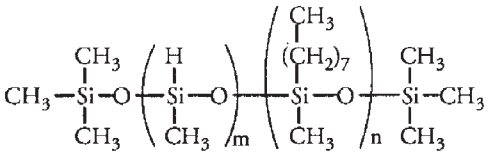
## Specialty Hydrosiloxanes

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

| Code | Viscosity | Weight | Molecular (MeHSiO) | Mole % Weight | Equivalent Gravity | Specific Index | Refractive Price/100g | Price/3kg |
|---|---|---|---|---|---|---|---|---|
| HMS-H271 | 24-60 | 2000-2600 | 25-30 | 200 | 0.96 | 1.402 | $31.00 | $275.00 |
| HMS-HM271* | 30-70 | 2000-3000 | 25-30 | 200 | 0.96 | 1.402 | $28.00 | $225.00 |

*mixed methyl, hydride terminated.

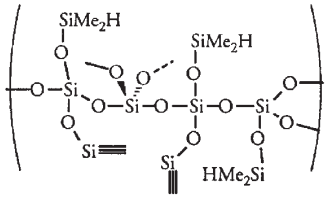
MethylHydrosiloxane copolymers are the primary crosslinkers for vinyl-addition silicones. They are also intermediates for functional copolymers.



**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 | $60.00 | $195.00 |
| HAM-3012** | 20-60 | 25-30 | 280-320 | 0.93 | 1.425 | $50.00 | $162.00 |

*CAS: [68554-69-8] TSCA ** contains, 30-35% $C_8H_{17}MeSiO$, 35-40% $Me_2SiO$

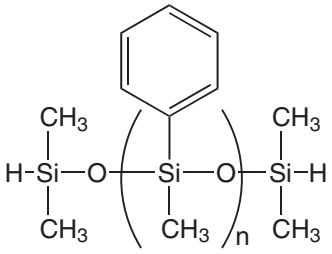


**Hydride Q Resin** CAS: [68988-57-8] TSCA

| 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 | $19.00 | $62.00 |
| HQM-107 | 6-8 | 7.5-9.0 | 115-135 | 0.95 | 1.410 | $29.00 | $94.00 |

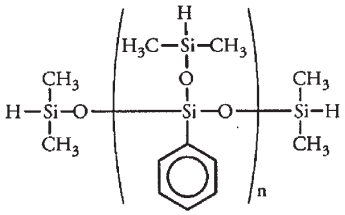
see also SST-3MH1.1 p.50; SST-H8HS8 p.52

## Phenyl Functional Hydrosiloxanes



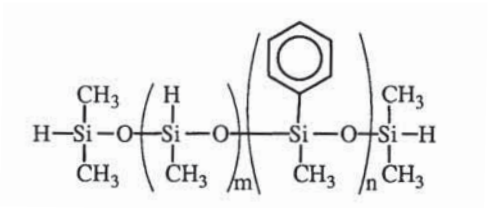
**polyPhenylMethylsiloxane, Hydride Terminated***

| Code | Mole % Viscosity | Equivalent [(HMe$_2$SiO)(C$_6$H$_5$Si)O] | Specific Weight | Refractive Gravity | Index | Price/100g | Price/1 kg |
|---|---|---|---|---|---|---|---|
| PMS-H03 | 2 - 5 | 300-500 | 200 | 0.93 | 1.453 | $120.00 | - |
| PMS-H11 | 8 - 12 | 900-1100 | 500 | - | - | $150.00 | - |



**polyPhenyl - (DiMethylHydrosiloxy)siloxane, hydride terminated**

| Code | Viscosity | Mole % [(HMe$_2$SiO)(C$_6$H$_5$Si)O] | Equivalent Weight | Specific Gravity | Refractive Index | Price/25g | Price/100g |
|---|---|---|---|---|---|---|---|
| HDP-111 | 50-80 | 99-100 | 150-155 | 1.01 | 1.463 | $74.00 | $240.00 |



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

| Code | Viscosity | Mole % (MeHSiO) | Equivalent Weight | Specific Gravity | Refractive Index | Price/25g | Price/100g |
|---|---|---|---|---|---|---|---|
| HPM-502* | 75-110 | 45-50 | 160-170 | 1.08 | 1.500 | $55.00 | $175.00 |

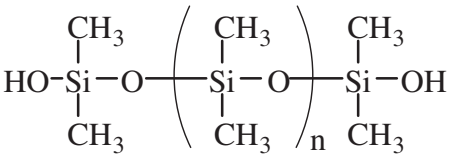
*unit MW: 200

Component in flexible optical waveguides[1].

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

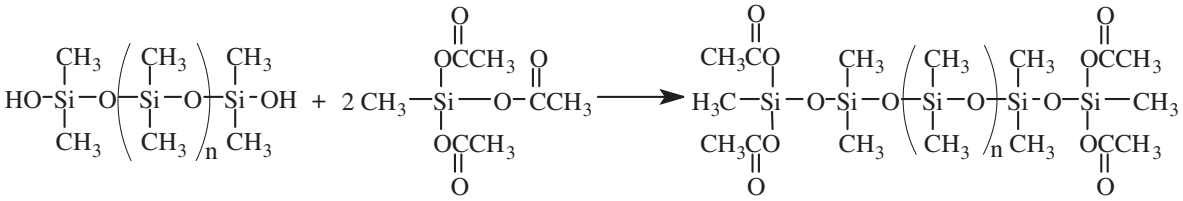
≡Si—OH

## Silanol Functional Polymers

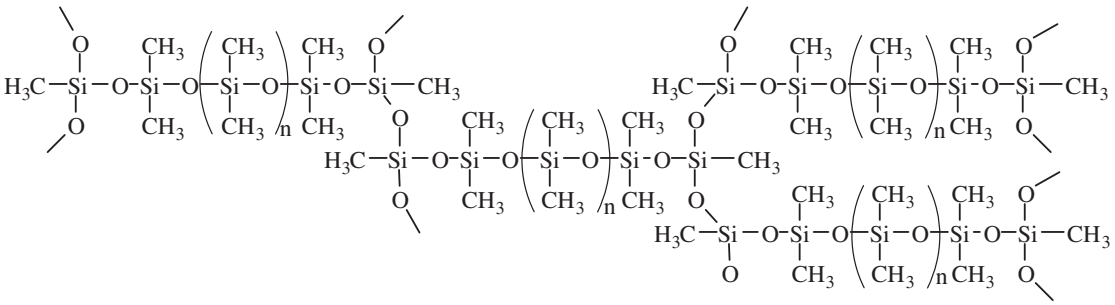


Terminal silanol groups render polydimethylsiloxanes susceptible to condensation under both mild acid and base conditions. They are intermediates for most room temperature vulcanizeable (RTV) silicones. Low molecular weight silanol fluids are generally produced by kinetically controlled hydrolysis of 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.

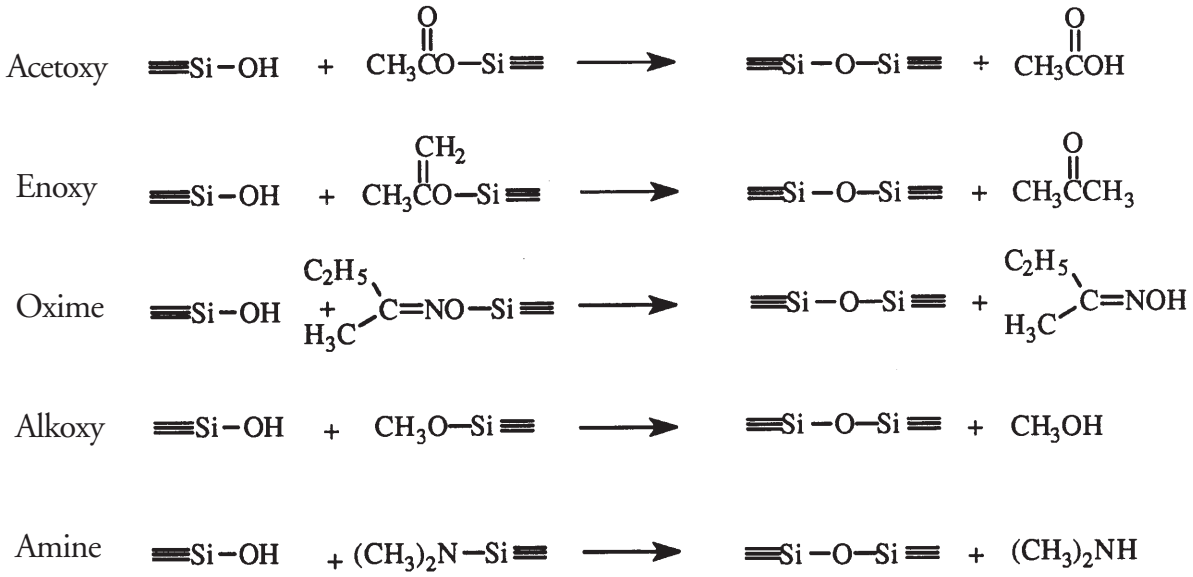
**Condensation cure** one-part and two-part RTV systems are formulated from silanol terminated polymers with molecular weights ranging from 15,000 to 150,000. One-part systems are the most widely used. One-part systems are crosslinked with moisture-sensitive multi-functional silanes in a two stage reaction. 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.

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% |

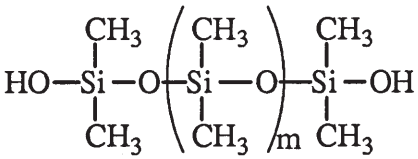
This low tear strength formulation can be improved by substituting fumed silica for silica powder.

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.

**Condensation Cure Catalysts- see p. 60**
**Condensation Cure Crosslinkers- see p. 59**

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.



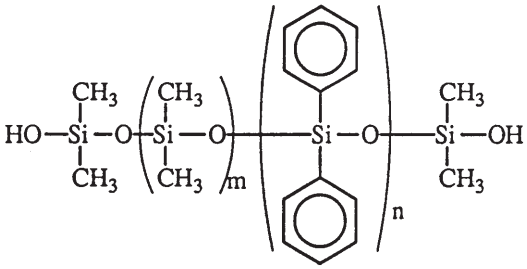
**Silanol Terminated PolyDimethylsiloxanes**

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 | $25.00 | $165.00 | $696.00 |
| DMS-S14 | 35-45 | 700-1500 | 3.0-4.0 | 1.7-2.3 | 0.96 | 1.402 | $20.00 | $135.00 | $540.00 |
| DMS-S15 | 45-85 | 2000-3500 | 0.9-1.2 | 0.53-0.70 | 0.96 | 1.402 | $20.00 | $135.00 | $540.00 |
| | | | | | | | | | |
| DMS-S21 | 90-120 | 4200 | 0.8-0.9 | 0.47-0.53 | 0.97 | 1.402 | $17.00 | $114.00 | $284.00 |
| DMS-S27 | 700-800 | 18,000 | 0.2 | 0.11-0.13 | 0.97 | 1.403 | $15.00 | $99.00 | $256.00 |
| | | | | | | | | | |
| DMS-S31 | 1000 | 26,000 | 0.1 | 0.055-0.060 | 0.98 | 1.403 | $15.00 | $99.00 | $256.00 |
| DMS-S32 | 2000 | 36,000 | 0.09 | 0.050-0.055 | 0.98 | 1.403 | $15.00 | $99.00 | $256.00 |
| DMS-S33* | 3500 | 43,500 | 0.08 | 0.045-0.050 | 0.98 | 1.403 | $15.00 | $99.00 | $256.00 |
| DMS-S35 | 5000 | 49,000 | 0.07 | 0.039-0.043 | 0.98 | 1.403 | $17.00 | $114.00 | $276.00 |
| | | | | | | | | | |
| DMS-S42 | 18,000 | 77,000 | 0.04 | 0.023-0.025 | 0.98 | 1.403 | $20.00 | $129.00 | $324.00 |
| DMS-S45 | 50,000 | 110,000 | 0.03 | 0.015-0.017 | 0.98 | 1.403 | $20.00 | $129.00 | $324.00 |
| | | | | | | | | | |
| DMS-S51 | 90,000-150,000 | 139,000 | 0.02 | 0.010-0.015 | 0.98 | 1.403 | $37.00 | $285.00 | $784.00 |

*also available as an emulsion (see DMS-S33M50 pg 45)

COMMERCIAL



**Silanol Terminated Diphenylsiloxane - Dimethylsiloxane Copolymers** TSCA

| Code | Viscosity | Mole % Diphenylsiloxane | Molecular Weight | Refractive Index | wt% (OH) | Price/100g | Price 3kg-kg |
|---|---|---|---|---|---|---|---|
| PDS-0338* | 6000-8000 | 2.5-3.5 | 50,000 | 1.420 | 0.4-0.7 | $58.00 | $495.00 |
| PDS-1615** | 50-60 | 14-18 | 900-1000 | 1.473 | 3.4-4.8 | $46.00 | $455.00 |

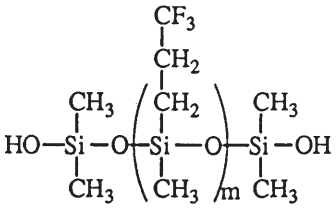
*CAS: [68083-14-7] **CAS: [68951-93-9]

Employed as 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 | 3.4-2.4 | $84.00 | $630.00 |



**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 | 5-7% | 1.28 | $90.00 |
| FMS-9922 | 150-250 | 100 | 800-1200 | 1.379 | 3-5% | 1.28 | $132.00 |

**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-kg |
|---|---|---|---|---|---|---|---|
| SQO-299 | 100 | 3000-4000 | 1.7-2.0 | - | - | $102.00 | $460.00 |
| SQD-255 | 50 | 3000-4000 | - | - | 50% D5 | $25.00 | $64.00 |
| SQT-221 | 60 | 3000-4000 | - | - | 40% toluene | $19.00 | $42.00 |
| SQS-261 | 35-40 | 3000-4000 | - | DMS-S61* | 40% toluene | $45.00 | $101.00 |

COMMERCIAL

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

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

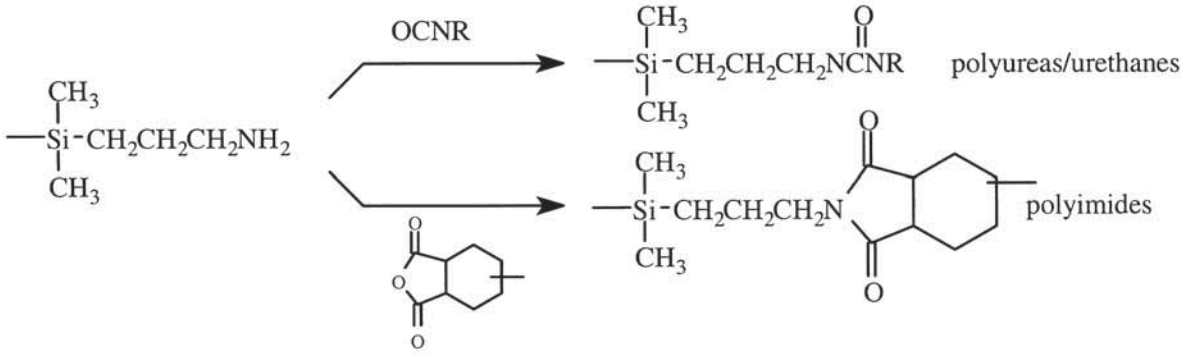
**Silanol terminated vinylmethylsiloxane copolymers - see Vinylmethylsiloxane Dimethylsiloxane Copolymers, silanol terminated, p. 9**

$\equiv SiCH_2CH_2CH_2NH_2$

## 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].



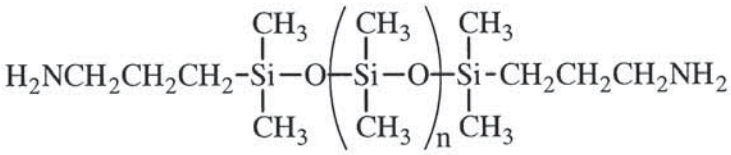

Amino functionality pendant from the siloxane backbone is available in two forms: (aminopropyl)-methylsiloxane-dimethylsiloxane copolymers and (aminoethylaminopropyl)-methylsiloxane-dimethylsiloxane copolymers. They are frequently used in modification of polymers such as epoxies and urethanes, internal 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

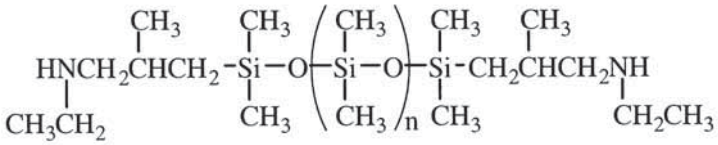
| Code | Viscosity | Molecular Weight | wt% Amine ($NH_2$) | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DMS-A11 | 10-15 | 850-900 | 3.2-3.8 | 0.98 | 1.412 | $78.00 | $468.00 |
| DMS-A12 | 20-30 | 900-1000 | 3.0-3.2 | 0.98 | 1.411 | $60.00 | $360.00 |
| DMS-A15 | 50-60 | 3000 | 1.0-1.2 | 0.97 | 1.408 | $43.00 | $234.00 |
| DMS-A21 | 100-120 | 5000 | 0.6-0.7 | 0.98 | 1.407 | $39.00 | $234.00 |
| DMS-A31 | 900-1100 | 25,000 | 0.11-0.12 | 0.98 | 1.407 | $39.00 | $234.00 |
| DMS-A32 | 1800-2200 | 30,000 | 0.08-0.09 | 0.98 | 1.404 | $29.00 | $174.00 |
| DMS-A35 | 4000-6000 | 50,000 | 0.05-0.06 | 0.98 | 1.404 | $39.00 | $243.00 |

COMMERCIAL

**Reduced Volatility Grades**

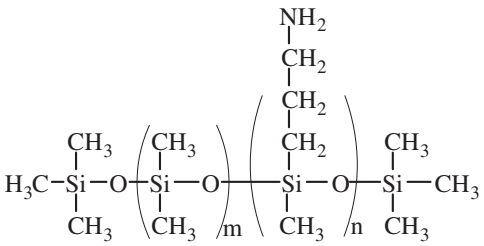
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DMS-A32R* | 1900-2300 | 30,000 | 0.08-0.09 | 0.98 | 1.404 | $76.00 | $418.00 |

*total volatiles, 4 hours @ 150°C: 2.0wt% 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 | $96.00 | $672.00 |
| DMS-A214 | 32-40 | 2500-3000 | 1.0-1.4 | 0.96 | 1.411 | $96.00 | $672.00 |

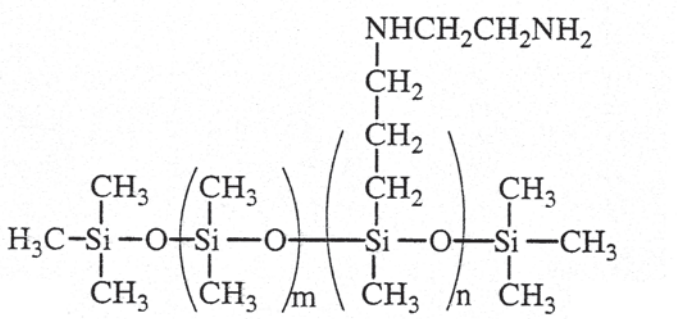


**AminopropylMethylsiloxane - Dimethylsiloxane Copolymers** CAS: [99363-37-8] TSCA

| 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 | $34.00 | $204.00 |
| AMS-152 | 100-300 | 7000-9000 | 4-5 | 0.97 | 1.408 | $34.00 | $204.00 |
| AMS-162 | 64-200 | 4000-5000 | 6-7 | 0.97 | 1.410 | $34.00 | $204.00 |
| AMS-163 | 1800-2200 | 50,000 | 6-7 | 0.97 | 1.411 | $85.00 | $525.00 |
| AMS-191 | 40-60 | 2000-3000 | 9-11 | 0.97 | 1.412 | $75.00 | $486.00 |
| AMS-1203 | 900-1100 | 20,000 | 20-25 | 0.98 | 1.426 | $75.00 | $486.00 |

COMMERCIAL

**PLEASE INQUIRE ABOUT BULK QUANTITIES**



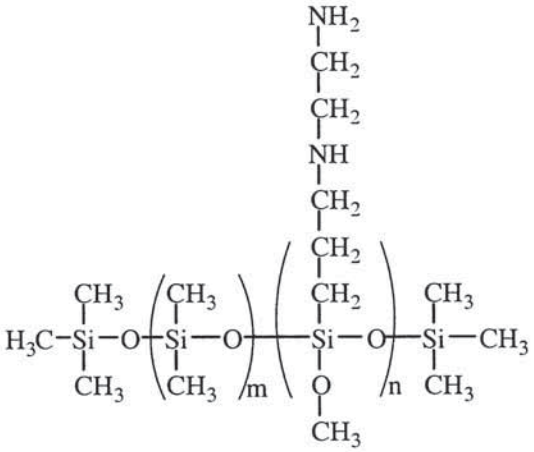
**AminoethylaminopropylMethylsiloxane - Dimethylsiloxane Copolymers** CAS: [71750-79-3] TSCA

| 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 | $34.00 | $238.00 |
| AMS-2202 | 300-500 | - | 18-24 | 0.98 | 1.41 | $80.00 | $480.00 |

**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 | $48.00 | $336.00 |

## 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 | $56.00 | $441.00 |
| ATM-1322* | 200-300 | - | 2 - 4 | 0.97 | - | $29.00 | $174.00 |

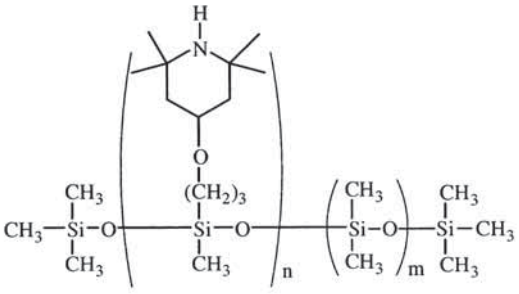
*also available as an emulsion

Diaminoalkoxysilane cure to form durable films on metal substrates.

See ATM-1322M50; p. 45.

# 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 | $72.00 | $504.00 |
| UBS-0822 | 250 | 7-9 | 0.98 | 1.409 | $60.00 | $420.00 |

## 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.

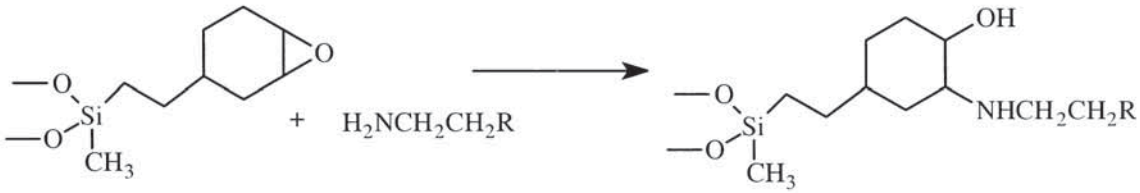
The compatibility of epoxy functional silicones with conventional epoxies varies. In simple unfilled systems, total solubility is required. For filled systems, it is often desireable to consider systems that are miscible but have only limited solubility since microphase separation can allow a mechanism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

[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 | $60.00 | $420.00 |
| DMS-E11 | 12-18 | 500-600 | 1.9-2.2 | 0.98 | 1.419 | $90.00 | $540.00 |
| DMS-E12 | 20-35 | 1000-1400 | 1.6-1.9 | 0.98 | 1.417 | $120.00 | $840.00 |
| DMS-E21 | 100-140 | 4500-5500 | 0.45-0.35 | 0.98 | 1.408 | $120.00 | $840.00 |

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

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

### (Epoxypropoxypropyl Methylsiloxane)-(Dimethylsiloxane) Copolymers

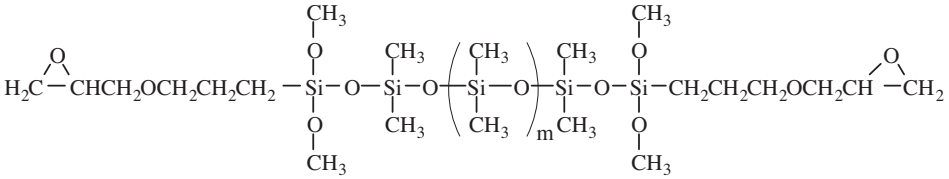
CAS: [68440-71-7] TSCA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| EMS-622 | 200-300 | 7,000-9,000 | 5-7 | 0.99 | 1.412 | $30.00 | $175.00 |

### Epoxypropoxypropyl Terminated PolyPhenylMethylsiloxanes

[102782-98-9] TSCA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PMS-E11 | 15-30 | 500-600 | 3.0-3.6 | 1.01 | 1.475 | $180.00 | - |
| PMS-E15 | 30-50 | 1200-1500 | 1.0-1.7 | 1.01 | 1.490 | $210.00 | - |

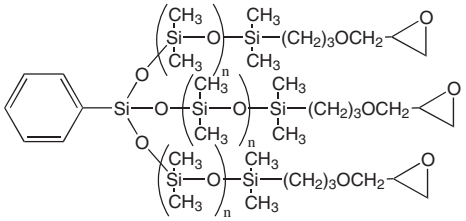


### (Epoxypropoxypropyl)dimethoxysilyl Terminated PolyDimethylsiloxanes

[188958-73-8] TSCA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DMS-EX21 | 80-120 | 3500-4000 | 0.48-0.5 | 0.98 | 1.408 | $49.00 | $295.00 |

## Multifunctional Siloxanes

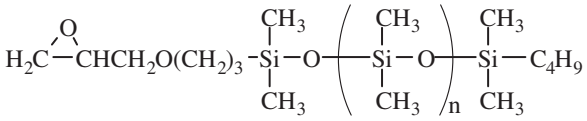


### MonoPhenyl functional Tris(Epoxy Terminated PolyDimethylsiloxane)

[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 | $55.00 |

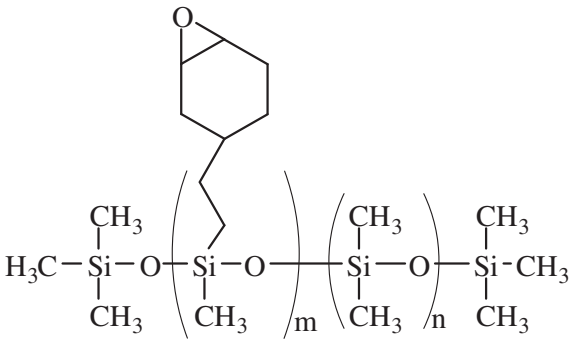
## Epoxy Functional Macromers



### 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 | $90.00 | $630.00 |
| MCR-E21 | 100-120 | 5000 | 0.1-0.3 | 0.97 | 1.408 | $85.00 | $510.00 |

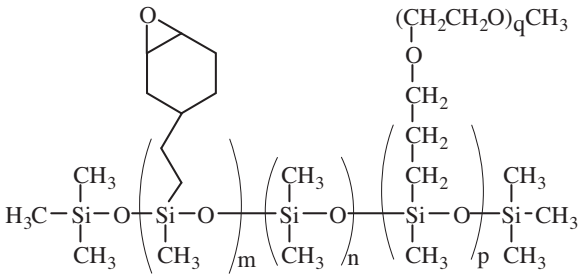


## Cycloaliphatic Epoxy Silicones

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 | Price 10 kg-kg |
|---|---|---|---|---|---|---|---|---|
| ECMS-127 | 500-1200 | 12,000-15,000 | 1-2 | 0.98 | 1.407 | $19.00 | $114.00 | $79.90 |
| ECMS-227 | 650-800 | 18,000-20,000 | 2-3 | 0.98 | 1.407 | $19.00 | $114.00 | $79.90 |
| ECMS-327 | 650-850 | 18,000-20,000 | 3-4 | 0.99 | 1.409 | $19.00 | $114.00 | $79.90 |
| ECMS-924 | 300-450 | 10,000-12,000 | 8-10 | 0.97 | 1.421 | $24.00 | $144.00 | $101.00 |



**(2-3% EpoxycyclohexylethylMethylsiloxane)(10-15% MethoxypolyalkyleneoxyMethylSiloxane)-(Dimethylsiloxane) Terpolymers**

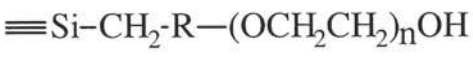
| Code | Viscosity | Molecular Weight | Epoxy-Eq/Kg | Specific Gravity | Refractive Index | Price/100g | Price/1 kg | Price/10 kg |
|---|---|---|---|---|---|---|---|---|
| EBP-234 | 4000-5000 | 25,000-36,000 | 0.75-0.80 | 1.03 | 1.445 | $22.00 | $132.00 | $924.00 |

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/1 kg |
|---|---|---|---|---|---|---|---|
| DMS-EC13 | 25-35 | 900-1100 | 1.9-2.0 | 0.99 | 1.433 | $180.00 | $1080.00 |

see also SIB1092.0



## Carbinol Functional Silicones

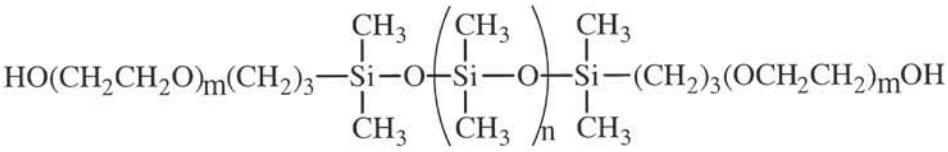
Carbinol (Hydroxy) Functional Siloxanes

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.

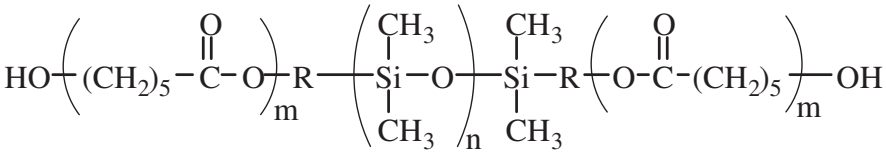
**Carbinol functional Macromers - see Macromers p. 39**



## 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 | $72.00 | $432.00 |
| DMS-C16 | 50-65 | 600-850 | - | 0.97 | 1.416 | $65.00 | $390.00 |
| DMS-C21 | 110-140 | 4500-5500 | 4 | 0.98 | 1.407 | $42.00 | $252.00 |
| DMS-C23 | 300-350 | 10,000 | - | 0.98 | 1.406 | $48.00 | $288.00 |
| DBE-C25* | 400-450 | 3500-4500 | 60 | 1.07 | 1.450 | $29.00 | $174.00 |
| DBP-C22** | 200-300 | 2500-3200 | 45-55 | 0.99 | 1.434 | $46.00 | $277.00 |
| 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] | | | | | | | |

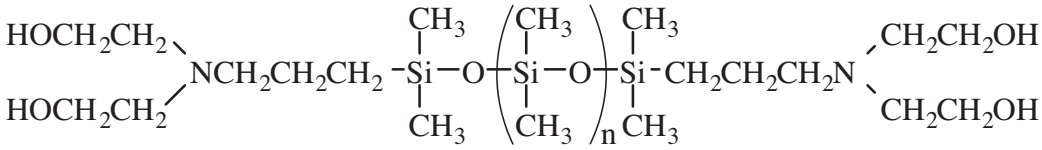
COMMERCIAL



## Carbinol (Hydroxyl) Terminated PolyDimethylsiloxanes

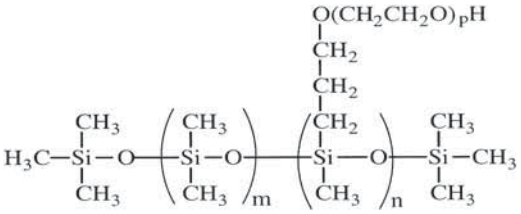
| Code | Melting Point | Molecular Weight | Weight % Non-Siloxane | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DBL-C31* | 52-6° | 5700-6900 | 50 | 1.05 | - | $64.00 | $396.00 |
| DBL-C32** | 80-85° | 7000-8000 | 25-30 | 1.05 | - | $75.00 | $465.00 |

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 | $106.00 | $848.00 |

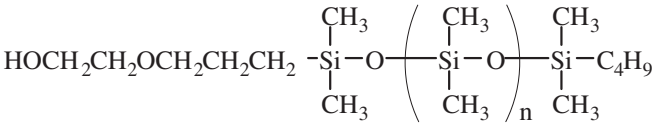


## (Carbinol functional)Methylsiloxane-Dimethylsiloxane Copolymers

| Code | wt% Non-Siloxane | OH Content (meq/g) | Glycol chains/mol | Viscosity | Molecular Weight | Specific Gravity | Refractive Index | CAS | Price 100g | Price 1kg | Price 10kg-kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CMS-221 | 20-25 | 0.7-0.9 | 3-4 | 125-150 | 4000 | 1.00 | 1.419 | 68937-54-2 | $20.00 | $176.00 | - |
| CMS-222 | 20 | 0.4-0.6 | 2-3 | 150-200 | 5500-6500 | 0.98 | 1.411 | 68957-00-6 | $40.00 | $238.00 | $162.00 |
| CMS-832* | 50-60 | 0.2-0.3 | - | 1000-2000 | 2000-5000 | 1.09 | 1.505 | 200443-93-2 | $48.00 | $336.00 | - |
| CMS-626 | 65 | 0.3-0.5 | 1-3 | 550-650 | 4500-5500 | 1.09 | 1.458 | 68937-54-2 | $39.00 | $234.00 | $132.00 |

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

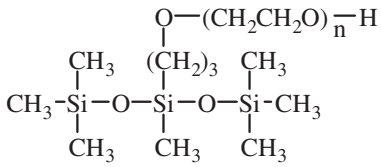
## Carbinol Functional Macromers



### MonoCarbinol Terminated PolyDimethylsiloxane

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-C12 | 15-20 | 1000 | 1.409 | 0.96 | $125.00 | $525.00 |
| MCR-C18 | 60-140 | 5000 | 1.405 | 0.97 | $81.00 | $485.00 |
| MCR-C22 | 250 | 10,000 | 1.404 | 0.98 | $75.00 | $415.00 |

MCR-C12, MCR-C18, MCR-C22: hydroxyethoxypropyl terminated, CAS: [207308-30-3] TSCA

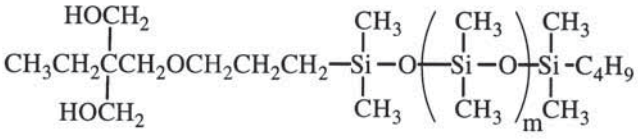


### MonoCarbinol Terminated Functional PolyDimethylsiloxanes - symmetric

CAS: [67674-67-3] TSCA

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-C13 | 35-40 | 550-650 | - | 1.02 | $48.00 | $288.00 |

hydroxypoly(ethyleneoxy) propyl terminated

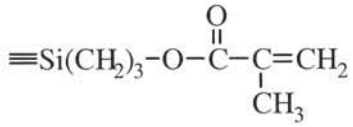


### MonoDiCarbinol Terminated PolyDimethylsiloxane

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 | $60.00 | $480.00 |
| MCR-C62 | 100-125 | 5000 | 1.409 | 0.97 | $60.00 | $480.00 |

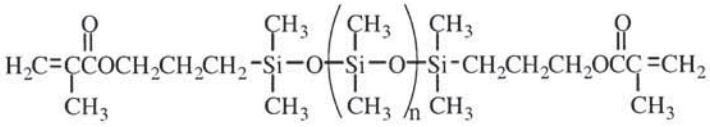
Diol terminated silicones improve electrical and release properties of polyurethanes.



## 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]

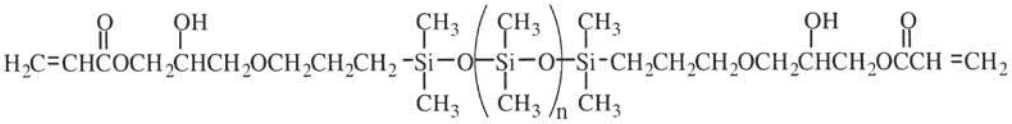
Oxygen is an inhibitor for methacrylate polymerization in general. The high oxygen permeability of siloxanes usually makes it necessary to blanket these materials with nitrogen or argon in order to obtain reasonable cures.



### 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 | $62.00 | $202.00 |
| DMS-R11 | 8-14 | 900-1200 | 1.422 | 0.98 | $78.00 | $254.00 |
| DMS-R18 | 50-90 | 4500-5500 | 1.409 | 0.98 | $78.00 | $254.00 |
| DMS-R22 | 125-250 | 10,000 | 1.405 | 0.98 | $78.00 | $254.00 |
| DMS-R31 | 1000 | 25,000 | 1.404 | 0.98 | $65.00 | $212.00 |



### (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 | $35.00 | $112.00 |

### Acryloxy Terminated Ethyleneoxide - Dimethylsiloxane-Ethyleneoxide ABA Block Copolymers

CAS: [117440-21-9] TSCA

| Code | Viscosity | Molecular Weight | MW PDMSO block | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DBE-U12* | 80-120 | 1500-1600 | 700-800 | 1.450 | 1.03 | $60.00 | $420.00 |
| DBE-U22** | 110-150 | 1700-1800 | 1000-1200 | 1.445 | 1.03 | $40.00 | $280.00 |

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

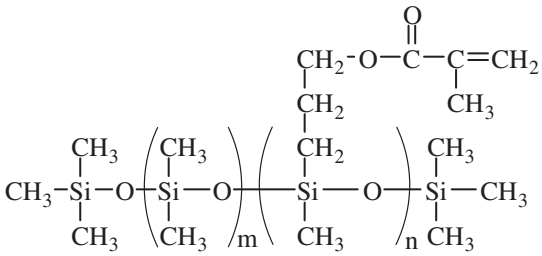
### Methacryloxypropyl Terminated Branched PolyDimethylsiloxanes

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 | $44.00 | $143.00 |

see also- methacrylate functional macromers

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



## (Methacryloxypropyl)methylsiloxane - Dimethylsiloxane Copolymers

CAS: [104780-61-2] TSCA

| Code | Viscosity | Specific Gravity | Mole % (Methacryloxypropyl)Methylsiloxane | Price/100g |
|---|---|---|---|---|
| RMS-044 | 8000-10,000 | 0.98 | 4 - 6 | $250.00 |
| RMS-033 | 1000-2000 | 0.98 | 2 - 4 | $150.00 |
| RMS-083 | 2000-3000 | 0.99 | 7 - 9 | $185.00 |

## (Acryloxypropyl)methylsiloxane - Dimethylsiloxane Copolymers

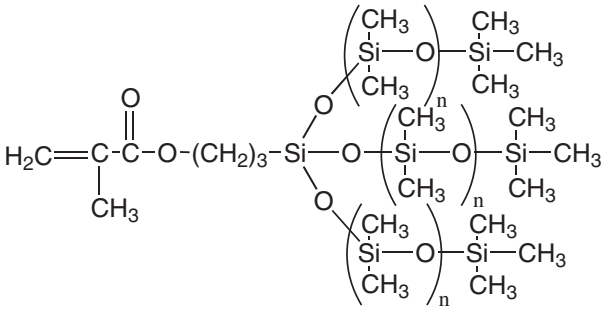
| Code | Viscosity | Specific Gravity | Mole % (Acryloxypropyl)Methylsiloxane | Price/100g |
|---|---|---|---|---|
| UMS-182 | 80-120 | 1.01 | 15-20 | $140.00 |
| UMS-992* | 50-125 | 1.10 | 99-100 | $110.00 |

*homopolymer Refractive Index: UMS-182 = 1.426; UMS-992 = 1.464 UMS-182-CAS: 158061-40-6

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

| Code | Viscosity | Molecular Weight | Mole % (Acryloxyfunctional)Methylsiloxane | Price/100g |
|---|---|---|---|---|
| UCS-052 | 500-900 | 7500-8500 | 4-6 | $78.00 |

amber liquid



## Methacryloxypropyl T-structure Siloxanes

CAS: [67923-18-6] TSCA

| Code | Viscosity | Molecular Weight | Specific Gravity | Price/100g |
|---|---|---|---|---|
| RTT-1011 | 10 - 20 | 570-620 | 0.95 | $86.00 |

contains multiple branch points (>2 methacrylate groups)

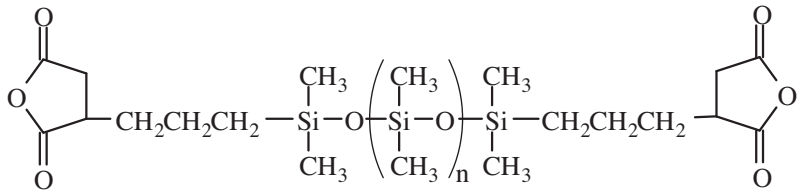
## Acryloxypropyl T-structure Siloxanes

| Code | Viscosity | Molecular Weight | Specific Gravity | Refractive Index | Price/100g |
|---|---|---|---|---|---|
| UTT-1012 | 8 - 20 | 500-900 | 0.96 | 1.421 | $110.00 |

contains multiple branch points (>2 acrylate groups)

**Methacrylate functional macromers- see p. 43**

# Anhydride, Bicycloheptenyl, and Carboxylate functional Silicones

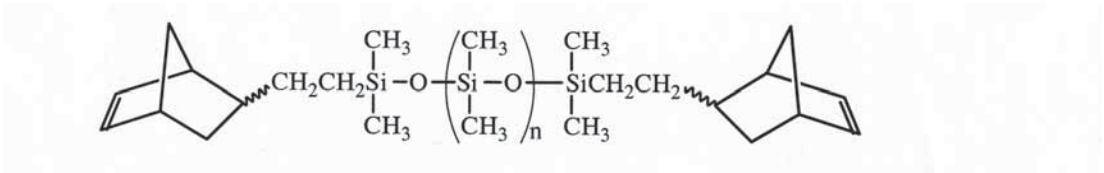


## Anhydride functional Silicones

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

### Succinic Anhydride Terminated PolyDimethylsiloxane

| Code | Viscosity | Molecular Weight | Specific Gravity | Refractive Index | Price/25g | Price/100g |
|---|---|---|---|---|---|---|
| DMS-Z21 | 75-100 | 600-800 | 1.06 | 1.436 | $80.00 | $260.00 |



## Bicycloheptenyl functional Silicones

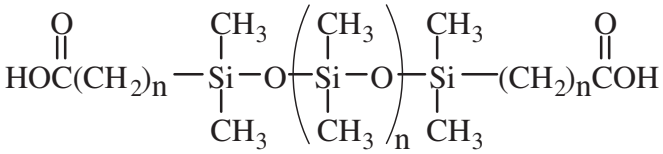
Bicycloheptenyl terminated silicones undergo ring-opening metathesis polymerization (ROMP) reactions.[1,2]

[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 | $80.00 | $250.00 |
| DMS-NB32 | 1300-1800 | 16,000-20,000 | 0.96 | 1.406 | $80.00 | $250.00 |



## 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

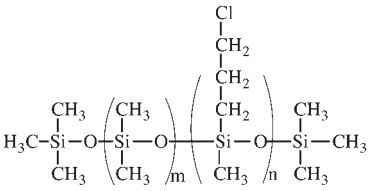
| Code | Viscosity | Molecular Weight | Termination | Specific Gravity | Refractive Index | Price/25g | Price/100g |
|---|---|---|---|---|---|---|---|
| DMS-B12* | 15-30 | 1000 | Carboxydecyl | 0.96 | 1.421 | $58.00 | $190.00 |
| DMS-B25* | 450-550 | 10,000 | Carboxydecyl | 0.97 | 1.403 | $52.00 | $170.00 |
| DMS-B31** | 800-1200 | 28,000 | Carboxypropyl | 0.98 | - | $52.00 | $170.00 |

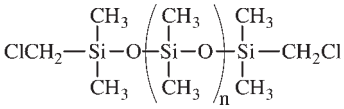
*CAS: [58130-04-4] ** [158465-59-9]

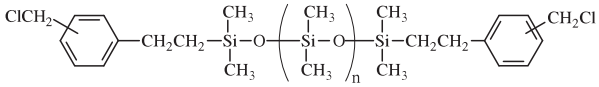
# Chloroalkyl and Mercapto Functional Silicones

## 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

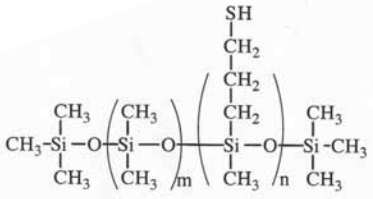
| Code | Viscosity | Molecular Weight | Mole % (Chloropropyl) MethylSiloxane | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| LMS-152 | 300-450 | 7500-10,000 | 14 - 16 | 1.01 | 1.420 | $96.00 | $576.00 |

**Chloromethyl terminated PolyDimethylsiloxane**

| Code | Viscosity | Molecular Weight | | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DMS-L21 | 100-150 | 6000-8000 | - | 0.98 | 1.406 | $80.00 | $560.00 |

**Chloromethylphenethyl terminated PolyDimethylsiloxane**

| Code | Viscosity | Molecular Weight | | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DMS-LP21 | 100-150 | 5000 | - | 0.98 | 1.420 | $110.00 | - |



## 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**

| Code | Viscosity | Molecular Weight | | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| DMS-SM21 | 80-120 | 10000 | - | - | - | $180.00 | - |

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

| Code | Viscosity | Molecular Weight | Mole % (Mercaptopropyl) MethylSiloxane | Specific Gravity | Refractive Index | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| SMS-022 | 120-180 | 6000-8000 | 2 - 3 | 0.97 | 1.406 | $22.00 | $132.00 |
| SMS-042 | 120-170 | 6000-8000 | 4 - 6 | 0.98 | 1.408 | $22.00 | $132.00 |
| SMS-142 | 100-200 | 3000-4000 | 13 - 17 | 0.98 | 1.410 | $60.00 | $420.00 |
| SMS-992* | 75-150 | 4000-7000 | 99-100 | 0.97 | 1.496 | $120.00 | - |

*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 | $60.00 | $390.00 |
| DMS-K13 | 20-50 | 2000-4000 | 0.99 | $120.00 | $780.00 |
| DMS-K26 | 500-800 | 15,000-20,000 | 0.99 | $94.00 | $655.00 |

### 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 | $82.00 | $266.00 |

### 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 | $64.00 | $445.00 |

### 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 | $160.00 | $1120.00 |
| DMS-N12 | 15 - 30 | 1550-2000 | 0.95 | $140.00 | $980.00 |

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 | $32.00 | $210.00 |

### TriEthoxysilylethyl Terminated PolyDimethylsiloxanes

CAS: [195158-81-7]

| Code | Viscosity | Molecular Weight | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|
| DMS-XT11 | 8-12 | 600-900 | 0.96 | $32.00 | $210.00 |

### 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 | $29.00 | $188.00 |

### MethoxyMethylsiloxane-Dimethylsiloxane copolymer

methoxy terminated with branch structure

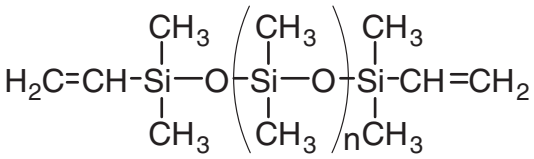
CAS: [68440-84-6] TSCA

| Code | Viscosity | Mole % MethoxyMethylsiloxane | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|
| XMS-5025.2* | 2-5 | 10-20 | 0.83 | $30.00 | $240.00 |

*20% in isopropanol

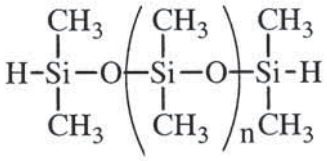
## Monodisperse Reactive Silicones via Anionic Living Polymerization

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.



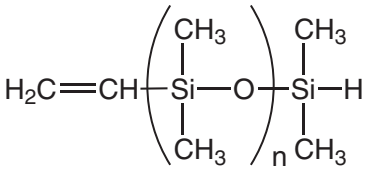
**Monodisperse Vinyl Terminated PolydiMethylsiloxane**

| Code | Viscosity | Molecular Weight | Wt% Vinyl | Vinyl – Eq/kg | Specific Gravity | Price/100g | Price/3kg |
|---|---|---|---|---|---|---|---|
| DMS-Vm31 | 1000 | 28,000 | 0.18-0.26 | 0.07-0.10 | 0.97 | $80.00 | $560.00 |
| DMS-Vm35 | 5000 | 49,500 | 0.10-0.13 | 0.04-0.05 | 0.97 | $80.00 | $560.00 |



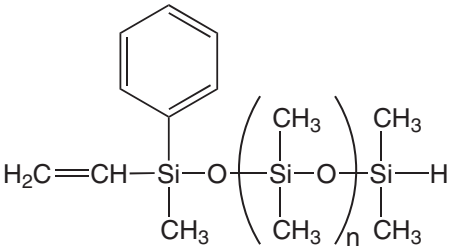
**Monodisperse Hydride Terminated PolyDimethylsiloxane**

| Code | Viscosity | Molecular Weight | Wt% H | Equivalent Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|---|
| DMS-Hm15 | 50 | 3000-3500 | 0.07 | 1,625 | 0.96 | 1.403 | $85.00 | $595.00 |
| DMS-Hm25 | 500 | 17,200 | 0.01 | 8,600 | 0.97 | 1.403 | $85.00 | $595.00 |



**α-MonoVinyl-Ω-MonoHydride Terminated PolyDimethylsiloxane**

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| DMS-HV15 | 40-60 | 2000-3000 | 1.404 | 0.96 | $150.00 | $900.00 |
| DMS-HV22 | 150-250 | 10,000 | 1.403 | 0.97 | $150.00 | $900.00 |



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

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| PMM-HV12 | 20 | 2000 | 1.4135 | 0.97 | $125.00 | - |

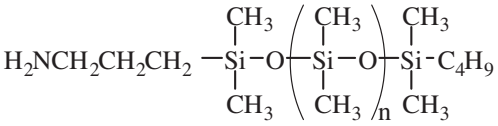
## Macromers and Monofunctional Silicones

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.

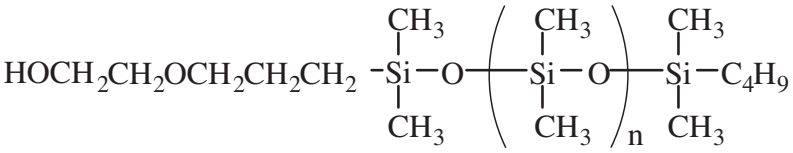


**MonoAminopropyl Terminated PolyDimethylsiloxanes - asymmetric**

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-A11 | 8-12 | 800-1000 | 1.411 | 0.92 | $175.00 | $1135.00 |
| MCR-A12 | 18-25 | 2000 | 1.411 | 0.97 | $170.00 | $1025.00 |

## MonoCarbinol Terminated PolyDimethylsiloxanes

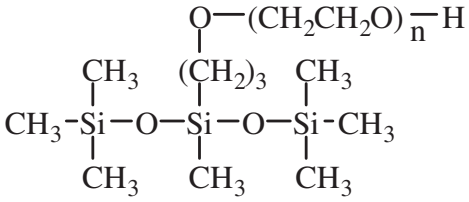
Monocarbinol terminated silicones are pigment dispersants and compatibilizers for a variety of resin systems including epoxies, urethanes and silicones. The action of these materials has been likened to surfactants for non-aqueous systems.



**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 | $125.00 | $525.00 |
| MCR-C18 | 80-90 | 5000 | 1.405 | 0.97 | $81.00 | $485.00 |
| MCR-C22 | 250 | 10000 | 1.404 | 0.98 | $75.00 | $415.00 |

hydroxyethoxypropyl terminated

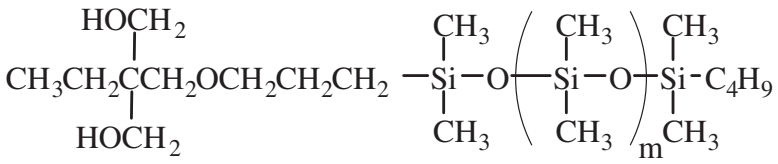


**MonoCarbinol Terminated Functional PolyDimethylsiloxanes - symmetric** CAS: [67674-67-3] TSCA

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-C13 | 35-40 | 550-650 | 1.446 | 1.02 | $48.00 | $288.00 |

hydroxypoly(ethyleneoxy) propyl substituted

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.



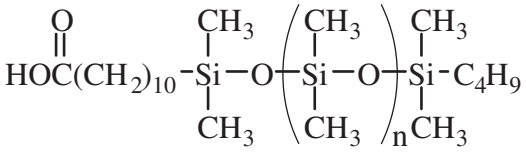
**MonoDiCarbinol Terminated PolyDimethylsiloxanes - asymmetric** CAS: [218131-11-4] TSCA

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-C61 | 50-60 | 1000 | 1.417 | 0.97 | $60.00 | $480.00 |
| MCR-C62 | 100-125 | 5000 | 1.409 | 0.97 | $60.00 | $480.00 |

**PLEASE INQUIRE ABOUT BULK QUANTITIES**

## MonoCarboxy Terminated PolyDimethylsiloxanes

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

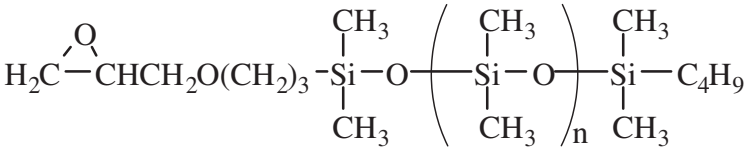


**MonoCarboxydecyl Terminated PolyDimethylsiloxanes - asymmetric**

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-B12 | 20 | 1500 | 1.415 | 0.94 | $180.00 | - |

## 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.



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

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

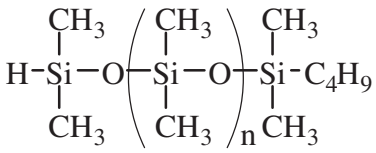
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-E11 | 10-15 | 1000 | 1.410 | 0.96 | $165.00 | $990.00 |
| MCR-E21 | 120 | 5000 | 1.408 | 0.97 | $145.00 | $870.00 |

**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 | $140.00 | $980.00 |

## 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.

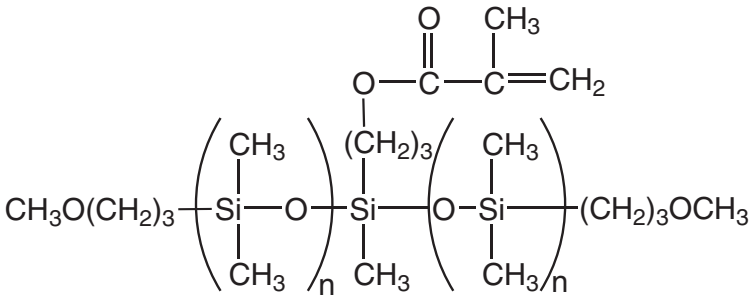


**MonoHydride Terminated PolyDimethylsiloxanes - asymmetric** CAS:[1038821-58-7] TSCA

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-H07 | 5-8 | 800-900 | 1.404 | 0.96 | $140.00 | $950.00 |
| MCR-H11 | 8-12 | 900-1100 | 1.407 | 0.96 | $110.00 | $750.00 |
| MCR-H21 | 80-120 | 4500-5000 | 1.411 | 0.96 | $110.00 | $750.00 |

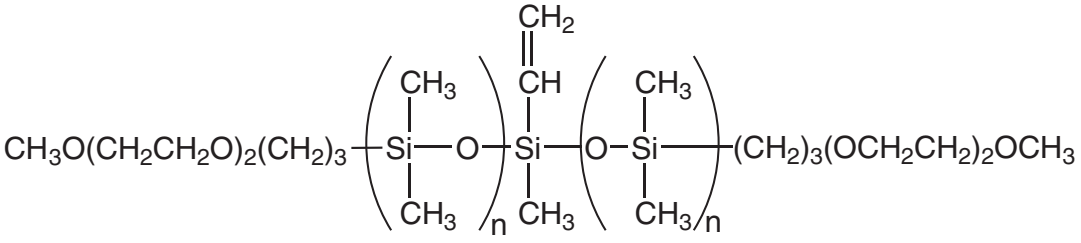
## Polar Endcapped Symmetric Macromers

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 | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-MX11 | 8-12 | 1000 | - | 0.96 | $210.00 | - |



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

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-VX15 | 40-60 | 5000 | - | 0.96 | $210.00 | - |

# MonoMethacrylateTerminated 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

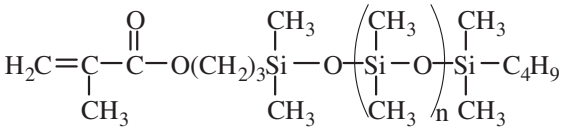
**Reactivity Ratios**

| 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 |

**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 |

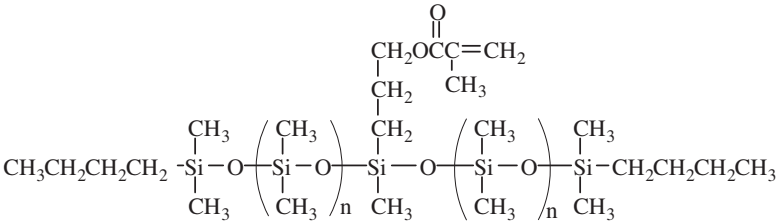
*M1M1°/M1M2°:M2M2°/M2M1°; **no meaningful results



**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 | $125.00 | $875.00 |
| MCR-M11 | 10 | 800-1000 | 1.411 | 0.96 | $75.00 | $475.00 |
| MCR-M17 | 70-80 | 5000 | 1.406 | 0.97 | $90.00 | $595.00 |
| MCR-M22 | 150-200 | 10000 | 1.405 | 0.97 | $90.00 | $595.00 |

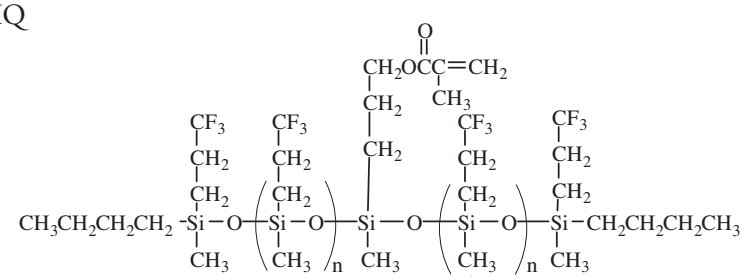
inhibited with BHT



**MonoMethacryloxypropyl Functional PolyDimethylsiloxanes - symmetric** TSCA

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCS-M11 | 7-9 | 800-1000 | 1.417 | 0.93 | $65.00 | $425.00 |

inhibited with MEHQ



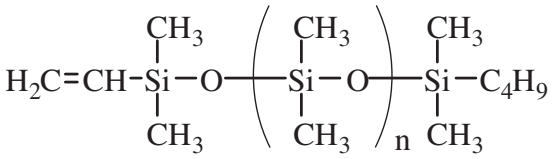
**MonoMethacryloxypropyl Terminated PolyTrifluoropropylMethylsiloxanes - symmetric**

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MFS-M15 | 45-55 | 800-1000 | 1.398 | 1.09 | $180.00 | - |

inhibited with MEHQ

## MonoVinylTerminated PolyDimethylsiloxanes

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



**MonoVinyl Terminated PolyDimethylsiloxanes - asymmetric**

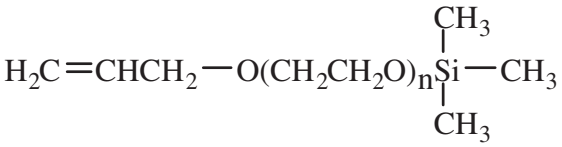
| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|
| MCR-V21 | 80-120 | 5500-6500 | 1.403 | 0.97 | $110.00 | $660.00 |
| MCR-V41 | 8000-12000 | 55000-65000 | 1.404 | 0.98 | $175.00 | $1125.00 |

**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 | $110.00 | $560.00 |

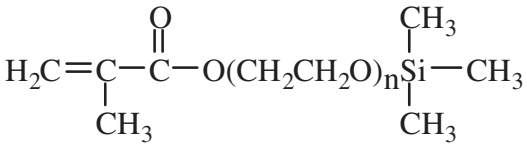
## Silylated Organic Macromers

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 | $36.00 | $117.00 |



**MonoMethacryloxy-Mono Trimethylsiloxy Terminated Polyethylene Oxide - asymmetric**

| Code | Viscosity | Molecular Weight | Refractive Index | Specific Gravity | Price/25g | Price/100g |
|---|---|---|---|---|---|---|
| SIM6485.9 | - | 400 | - | 1.02 | $29.00 | $96.00 |

## Reactive Silicone Emulsions

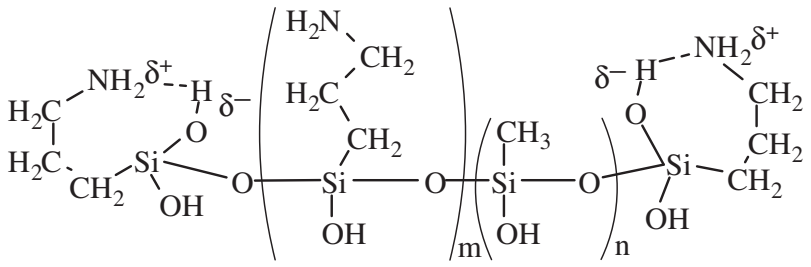
Emulsions of reactive silicones are playing an increasing role in formulation technology for water-borne systems. Primary applications for silicone emulsions are in textile finishes, release coatings and automotive polishes. Silanol fluids are stable under neutral conditions and have non-ionic emulsifiers. 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 | $10.00 | $96.00 | $256.00 |
| ATM-1322M50* | diamino/alkoxy | 200-300 | 50 | cationic | $10.00 | $96.00 | $256.00 |
| *0.45mEq/g combined primary and secondary amine | | | | | | | |

## Water-borne Silsesquioxane Oligomers



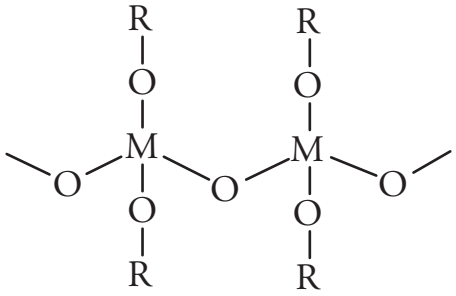
Water-borne silsesquioxane oligomers act as primers for metals, additives for acrylic latex sealants and as coupling agents for siliceous surfaces.[1] They offer both organic group and silanol functionality. These amphoteric materials are stable in water solutions and, unlike conventional coupling agents,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

**Water-borne Silsesquioxane Oligomers** TSCA

| Code | Functional Group | Mole % | Molecular Weight | Weight % in solution | Specific Gravity | Viscosity | pH | Price/100g | Price/3kg |
|---|---|---|---|---|---|---|---|---|---|
| WSA-7011* | Aminopropyl | 65-75 | 250-500 | 19-21 | 1.10 | 5-15 | 10-10.5 | $22.00 | $288.00 |
| WSA-9911** | Aminopropyl | 100 | 270-550 | 21-26 | 1.06 | 5-15 | 10-10.5 | $19.00 | $255.00 |
| WSA-7021 | Aminoethylaminopropyl | 65-75 | 370-650 | 23-27 | 1.10 | 5-10 | 10-11 | $29.00 | $360.00 |
| WSAV-6511‡ | Aminopropyl, vinyl | 60-65 | 250-500 | 15-20 | 1.11 | 3-10 | 10-11 | $35.00 | $480.00 |

*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)

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

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

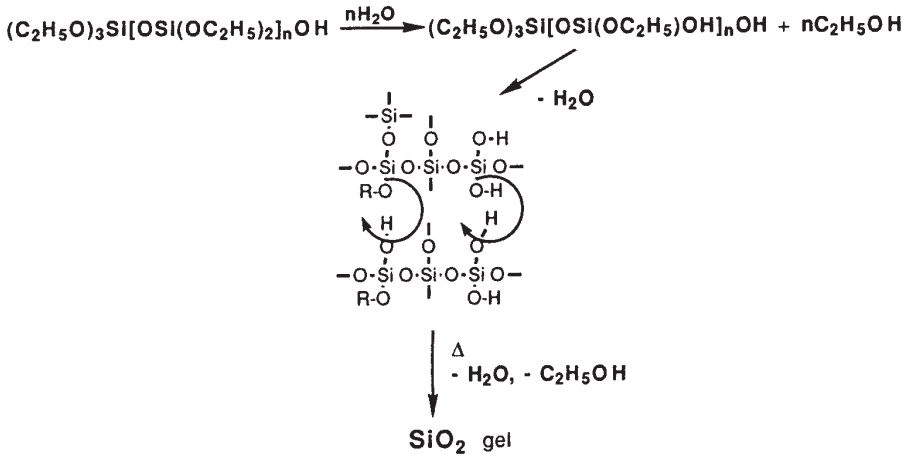
SOL FORMATION (POLYCONDENSATION)

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

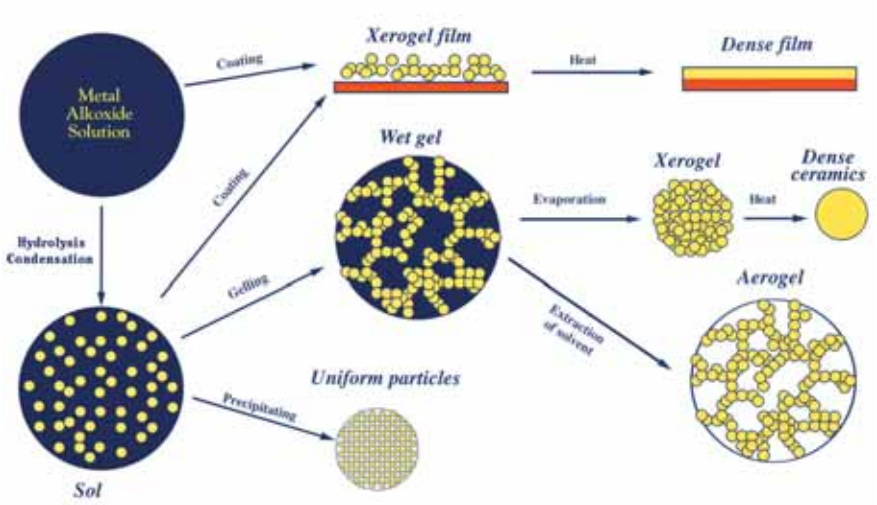
$$(RO)_{n-1}\text{-}O\text{-}M(OR)_{n-2}OH \xrightarrow[\text{dimers}]{\text{monomers}} (RO)_{n-1}M\text{-}O\text{-}M[\text{-}OM(OR)_{n-2}]_nOH + ROH$$

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

## 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.




### REFERENCES:

**METAL ALKOXIDES AND DIKETONATES**

Bradley, D. C.; Mehrotra, R. C.; Gaur, D. P. *Metal Alkoxides,* Acadmeic Press, 1978.

Mehrotra, R. C.; Bohra, R.; Gaur, D. P. *"Metal Diketonates and Allied Derivatives"* Academic Press, 1978.

**SOL-GEL TECHNOLOGY**

Brinker, C. J.; Scherer, G. W. *Sol-Gel Science,* Academic Press, 1990.

Brinker, C. J.; Clark, D. E.; Ulrich, D. R. *Better Ceramics Through Chemistry,* (Materials Research Society Proceedings 32), Elsevier, 1984.

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.

Hench, L. L.; Ulrich, D. R. *Ultrastructure Processing of Ceramics, Glasses and Composites,* Wiley, 1984.

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.

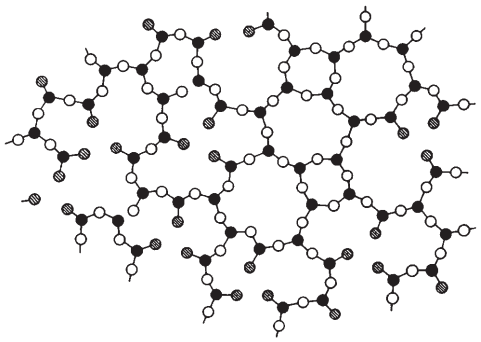
## Polymeric Metal Alkoxides

| name | metal content | unit M.W. | viscosity, cSt | density |
|---|---|---|---|---|
| PSI-021<br>Poly(DIETHOXYSILOXANE)<br>$[(C_2H_5O)_2SiO]$<br>crosslinker for two-component condensation cure (silanol) RTVs.<br>[68412-37-3] TSCA | 20.5-21.5% Si<br>(40-42% $SiO_2$ equivalent) | 134.20<br>100g/$10.00 | 3-5<br>2kg/$60.00 | 1.05-1.07 |
| PSI-023<br>Poly(DIETHOXYSILOXANE)<br>$[(C_2H_5O)_2SiO]$<br>base for zinc-rich paints<br>[68412-37-3] TSCA | 23.0-23.5% Si<br>(48-52% $SiO_2$ equivalent) | 134.20<br>100g/$16.00 | 20-35 | 1.12-1.15 |
| PSI-026<br>Poly(DIMETHOXYSILOXANE)<br>$[(CH_3O)_2SiO]$<br>highest $SiO_2$ content precursor for sol-gel<br>[25498-02-6] TSCA | 26.0-27.0% Si | 106.15<br>100g/$32.00 | 6-9<br>500g/$128.00 | 1.14-1.16 |
| PSIAL-007<br>DIETHOXYSILOXANE -s-BUTYLALUMINATE copolymer<br>sol-gel intermediate for aluminum silicates.[1]<br>1. J. Boilot in "Better Ceramics Through Chemistry III, p121<br>[68959-06-8] TSCA | | 7.5-8.5%Al<br>6.6-7.6% Si<br>100g/$78.00 | <br><br>500g/$312.00 | 0.90-1.00 |
| PSITI-019<br>DIETHOXYSILOXANE - ETHYLTITANATE copolymer<br>$[(C_2H_5O)_2SiO][(C_2H_5O)_2TiO]$<br>employed in formation of titania-silica aerogels.[1]<br>1. Miller, J.; et al, J. Mater. Chem. **1995**, *5*, 1795. | | 19.1-19.6% Si<br>2.1-2.3% Ti<br>25g/$40.00 | 10-25<br><br>100g/$130.00 | |
| PSIPO-019<br>DIETHOXYSILOXANE - ETHYLPHOSPHATE copolymer<br>$[(C_2H_5O)_2SiO][(C_2H_5O)OPO]$<br>[51960-53-3] | hygroscopic | 19.1-19.6% Si<br>1.4-1.5% P<br>25g/$40.00 | 8-12<br>R.I.: 1.400<br>100g/$130.00 | 1.09-1.11 |
| PAN-040<br>Poly(ANTIMONY ETHYLENE GLYCOXIDE)<br>$[C_6H_{12}O_6Sb_2]$ [29736-75-2] TSCA | 39.8-40.4% Sb<br>catalyst for transesterification | 303.55<br>25g/$18.00 | solid<br>100g/$58.00 | |
| PTI-023<br>Poly(DIBUTYLTITANATE)<br>$[(C_4H_9O)_2TiO]$<br>[9022-96-2] TSCA | 22.0-23.0% Ti<br>stabilized with ~5% ethylene glycol | 210.10<br>100g/$24.00 | 3200-3500<br>500g/$76.00 | 1.07-1.10 |
| PTI-008<br>Poly(OCTYLENEGLYCOL-TITANATE)<br>$[OCH_2CHEt(CH_2)_4OTi(CH_2CHEt(CH_2)_4OH)_2]_n$<br>[5575-43-9] | 7.5-7.6% Ti<br>contains ~5% free 2-ethyl-1,3-hexanediol, oligomeric | 482.54<br>flashpoint: 50°C(122°F)<br>25g/$20.00 | 1700<br>100g/$65.00 | 1.035 |

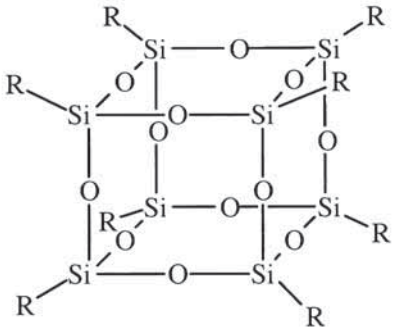
**PLEASE INQUIRE ABOUT BULK QUANTITIES**

## PolySilsesquioxanes and T-Resins
## $RSiO_{1.5}$

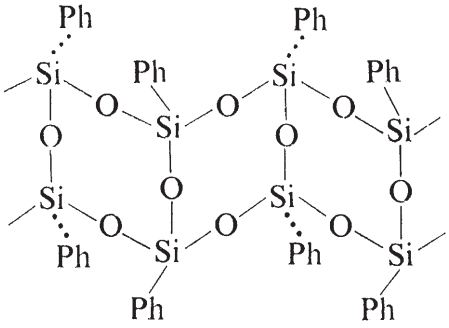
PolySilsesquioxanes and T-resins are highly crosslinked materials with the empirical formula $RSiO_{1.5}$. They are named from the organic group and a one and a half (sesqui) stoichiometry of oxygen bound to silicon. T-resin, an alternate designation, indicates that there are three (Tri-substituted) 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



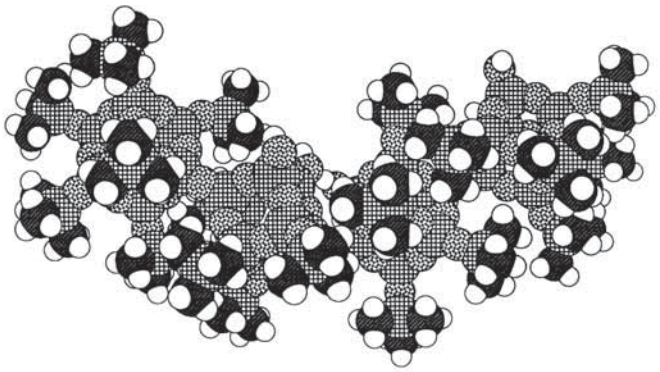
$T_8$ cube



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 in solvents such as methylethylketone for coating applications.



**Polymeric Q resins with cage structure**
(according to Wengrovius)

see Vinyl, Silanol & Hydride Q Resins

## polySilsesquioxanes Solid T-Resins

| Code | Name | M.W. (approximate) | % (OH) | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| SST-3M01 | poly(Methylsilsesquioxane)<br>100% Methyl<br>[68554-70-1] TSCA | 7000-8000 | 4.0-6.0 | 1.42 | | $64.00 | $384.00 |
| SST-3M02 | poly(Methylsilsesquioxane)<br>100% Methyl<br>[68554-70-1] TSCA | | 2.5-4.0 | | 1.08 | $60.00 | $360.00 |
| SST-3MH1.1 | poly(Methyl-Hydridosilsesquioxane)<br>90% Methyl, 10% Hydride | 10 wt% sol'n in methyltetrahydrofuran | | | 0.91 | $60.00 | - |
| SST-3P01 | poly(Phenylsilsesquioxane)<br>100% Phenyl<br>[70131-69-0] TSCA | 1200-1600 | 4.5-6.5 | 1.56 | | $72.00 | $485.00 |
| SST-3PM1 | poly(Phenyl-Methylsilsesquioxane)<br>90% Phenyl, 10% Methyl<br>[181186-29-8] | | | 1.55 | | $60.00 | $420.00 |
| SST-3PM2 | (Phenylsilsesquioxane)-(Dimethylsiloxane) copolymer<br>70% Phenyl, 30% DiMethyl<br>[73138-88-2] TSCA | | 3.0-5.0 | | 1.08 | $44.00 | $310.00 |
| SST-3PM4 | (40% Phenyl- 45% Methylsilsesquioxane)-(5% Phenylmethylsiloxane) (10% Diphenylsiloxane) tetrapolymer<br>85% Silsesquioxane, 15% Siloxane<br>[181186-36-7] TSCA | 1400-1600 | 2.0-3.0 | | 1.08 | $60.00 | $420.00 |
| SST-3PP1 | poly(Phenyl-Propylsilsesquioxane)<br>70% Phenyl, 30% Propyl<br>[68037-90-1] TSCA | 1500-1800<br>(equivalent weight: 400) | 3.5-5.5 | 1.54 | 1.25 | $19.00 | $114.00 |
| SST-3PV1 | poly(Phenyl-Vinylsilsesquioxane)<br>90% Phenyl, 10% Vinyl | 1000-1300 | | | | $86.00 | - |
| SST-3Q01 | poly[(Octadecyldimethylammoniumchloride)propylsilsesquioxane]<br>[1353244-79-7] | water soluble | | | | $80.00 | - |
| SST-3R01 | poly(Methacryloxypropylsilsesquioxane) | 1000-3000 | | | | $180.00 | - |

## polySilsesquioxanes Liquid T-Resins

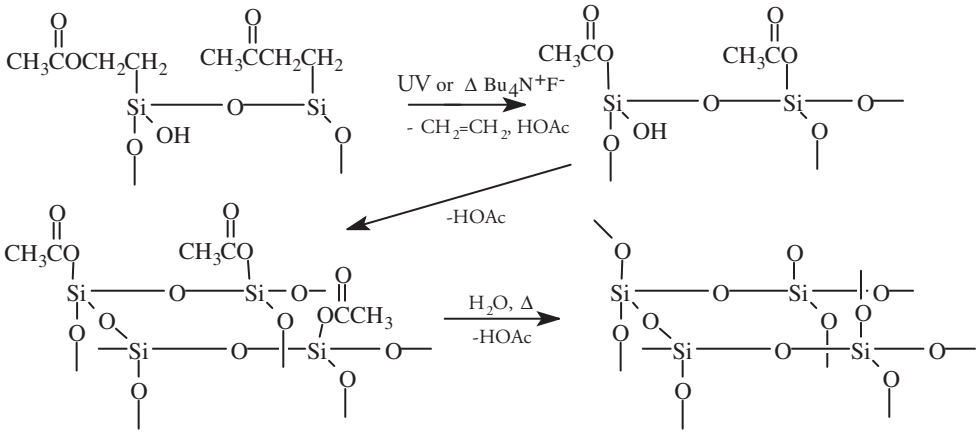
| Code | Name | Viscosity (cSt) | M.W. (approximate) | Refractive Index | Specific Gravity | Price/100g | Price/1kg |
|---|---|---|---|---|---|---|---|
| SLT-3A101 | poly(Methylsilsesquioxane)<br>methoxy terminated | 20-30<br>(alkoxy wgt% 25-30) | 700-1100 | 1.402 | 1.143 | $26.00 | - |
| SLT-3A802 | poly(Octylsilsesquioxane)<br>[1385031-14-0] TSCA-L | 400-600<br>ethoxy terminated | 1000-1800 | | 0.979 | $16.00 | - |

These materials are oligomeric alkoxysilane hydrolyzates and are the basis of coating resins.

**Water - borne silsesquioxanes- see p. 45**

## 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.

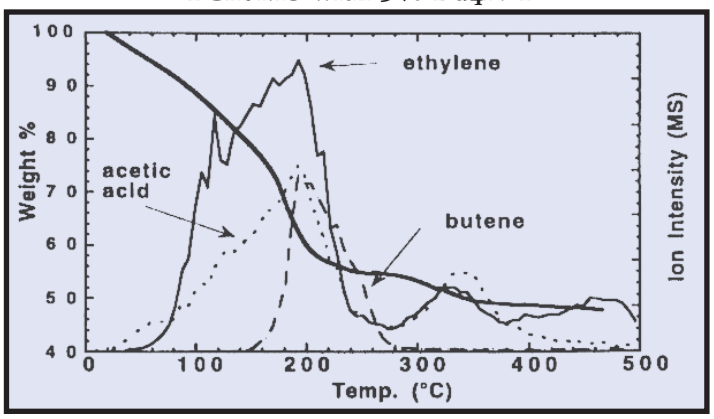
[2] Ezbiansky, K. et al, Mater. Res. Soc. Proc., **2001**, *606*, 251.

### Thermally & UV labile polysilsesquioxanes

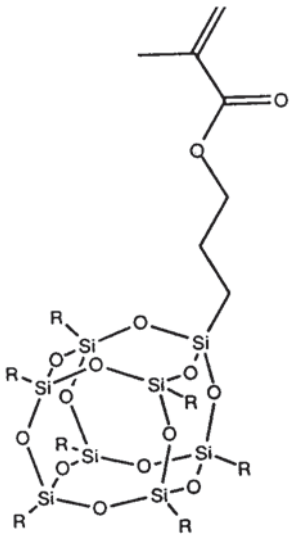
| | | M.W. (approximate) | | % (OH) | Price/100g |
|---|---|---|---|---|---|
| SST-BAE1.2 | poly(2-Acetoxyethylsilsesquioxane) | | | | CAS: [349656-50-4] TSCA |
| | converts to $SiO_2$ >350°C | - | - | 18-20% sol'n in methoxypropanol | $84.00 |
| SST-BCE1.2 | poly(2-Chloroethylsilsesquioxane) | | | | CAS: [188969-12-2] |
| | converts to $SiO_2$ >300°C | 800-1400 | 3.0-5.5 | 14-16% sol'n in methoxypropanol | $78.00 |
| SST-BBE1.2 | poly(2-Bromoethylsilsesquioxane) | | | | |
| | converts to $SiO_2$ by UV | 1200-2000 | 2.0-4.0 | 14-16% sol'n in methoxypropanol | $110.00 |

## 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.

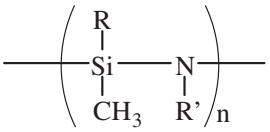
[1] Feher, F.; et al, J. Am. Chem. Soc., **1989**, *111*, 1741.
[2] Lichtenhan, J.; et al, Macromolecules, **1995**, *28*, 8435.
[3] Lichtenhan, J.; Comments Inorg. Chem. **1995**, *17*, 115.

**Specialty polySilsesquioxanes**

| Code | Name | M.W. (approximate) | Solubility | Price/10g |
|---|---|---|---|---|
| POSS materials | | | | |
| SST-A8C42 | Allyl substituted poly(Isobutylsilsesquioxane)<br>T8 cube with single substitution, employed in epoxy nanocomposites | 851.55 | THF, hexane | $72.00 |
| SST-R8C42 | Methacryloxypropyl substituted poly(Isobutylsilsesquioxane)<br>T8 cube with single substitution with polymerizeable functionality [307531-94-8] | 943.64 | THF, hexane | $96.00 |
| SST-H8H01 | poly(Hydridosilsesquioxane) - polymeric T8 with all silicons hydride substituted<br>T8 cube [137125-44-1] | 3000-5000 | 17-20% hazy solution in methylisobutylketone; density 0.88 | $215.00 |
| SST-H8HS8 | poly(Hydridosilsesquioxane) - T8 with all silicons dimethylsiloxy ($HSiMe_2O$) substituted<br>T8 cube [125756-69-6] | 1017.98 | see also HQM-107 p.16. | $126.00 |
| SST-V8V01 | poly(Vinylsilsesquioxane) - T8 with all silicons vinyl substituted<br>T8 cube [69655-76-1] | 633.04 | | $272.00 |

PLEASE INQUIRE ABOUT BULK QUANTITIES

# Polysilazanes and Polysilanes




## 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/$180.00

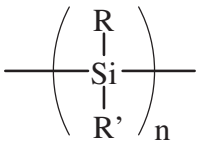
PSN-2M01
poly(1,1-DIMETHYLSILAZANE) telomer
[89535-60-4] Tg: -82° >50 cSt. M.W.: 500-900 $D_4^{20}$: 1.04 10g/$130.00

PSN-2M02
poly(1,1-DIMETHYLSILAZANE) crosslinked
>1000 cSt. % char, 700°: 15-20% 10g/$165.00

PSN-2M11
poly(1,2-DIMETHYLSILAZANE)
100-300 cSt. $D_4^{20}$: 0.99 10g/$175.00

---

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




## 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/$180.00

PSS-1H01
poly(DIHEXYLSILANE)
[207925-46-0] solid 1.0g/$90.00

PSS-1K02
poly(PERCHLOROSILANE) oligomer
4 or more silicon atoms solid 10g/$220.00

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]
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/$36.00 100g/$115.00

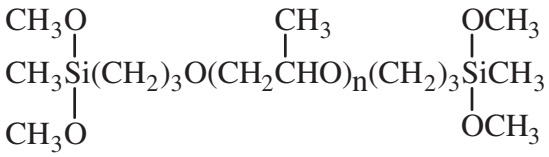
PSS-1P01
(50% DIMETHYLSILANE)(50% PHENYLMETHYLSILANE) copolymer
[143499-71-2]] solid 10g/$110.00

PSS-1P11
poly(PHENYLMETHYL)SILANE Density: 1.12
[146088-00-8] Tg: 112-122° fluorescent emission: 360nm 10g/$140.00

# Sibrid® Silicone-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 dibutylbispentane-dionatetin, 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**



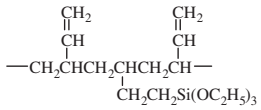
Sibrid® SIB1660.0
BIS[3-METHYLDIMETHOXYSILYL)PROPYL]POLYPROPYLENE OXIDE
visc: 6000-10,000 cSt. M.W. 600-800 density: 1.00
base resin for tin catalyzed moisture-cure RTVs
[75009-80-0] HMIS: 3-1-1-X 100g/$19.00 2kg/$228.00

---

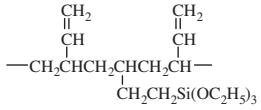
# Multi-Functional and Polymeric Silanes

| name | MW | bp/mm (mp) | $D_4^{20}$ | $n_D^{20}$ |
|---|---|---|---|---|

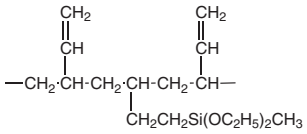
## Polybutadiene



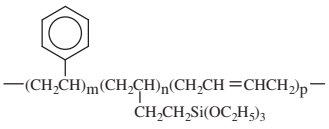
SSP-055
TRIETHOXYSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in toluene — 3500-4500 — 0.90
viscosity: 75-400 cSt.
coupling agent for EPDM resins
[72905-90-9] TSCA HMIS: 2-4-1-X store <5° — 100g/$70.00 — 2.0kg/$780.00



SSP-056
TRIETHOXYSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in volatile silicone — 3500-4500 — 0.93
viscosity: 600-1200 cSt.
primer coating for silicone rubbers
[72905-90-9] TSCA HMIS: 2-3-1-X store <5° — 100g/$80.00 — 2.0kg/$900.00

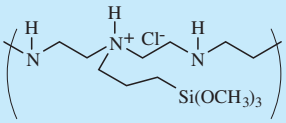


SSP-058
DIETHOXYMETHYLSILYL MODIFIED POLY-1,2-BUTADIENE, 50% in toluene — 3500-4500 — 0.90
viscosity: 75-150 cSt.
water tree resistance additive for crosslinkable HDPE cable cladding
HMIS: 2-4-1-X store <5° — 100g/$86.00 — -

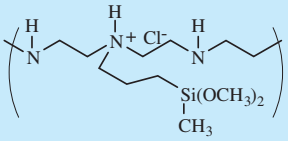


SSP-255
(30-35%TRIETHOXYSILYLETHYL)ETHYLENE-(35-40% 1,4-BUTADIENE) - (25-30% STYRENE) terpolymer, 50% in toluene — 4500-5500
viscosity: 20-30 cSt.
HMIS: 2-3-1-X — 100g/$95.00

## Polyamine

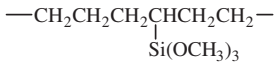


SSP-060
TRIMETHOXYSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol — 1500-1800 — 0.92
visc: 125-175 cSt — ~20% of nitrogens substituted
employed as a coupling agent for polyamides.[1]
in combination with glutaraldehyde immobilizes enzymes.[2]
1. Arkles, B; et al, SPI 42nd Composite Inst. Proc., 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/$28.00 — 2.0kg/$364.00



SSP-065
DIMETHOXYMETHYLSILYLPROPYL MODIFIED (POLYETHYLENIMINE), 50% in isopropanol — 1500-1800 — 0.92
visc: 100-200 cSt — ~20% of nitrogens substituted
primer for brass
[1255441-88-5] TSCA HMIS: 2-4-1-X — 100g/$42.00 — 3.0kg/$855.00

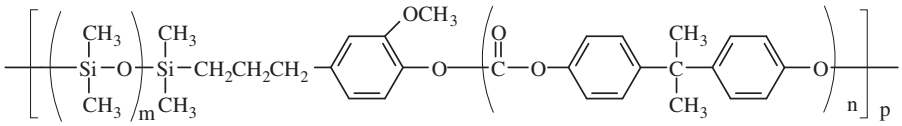
## Polyethylene



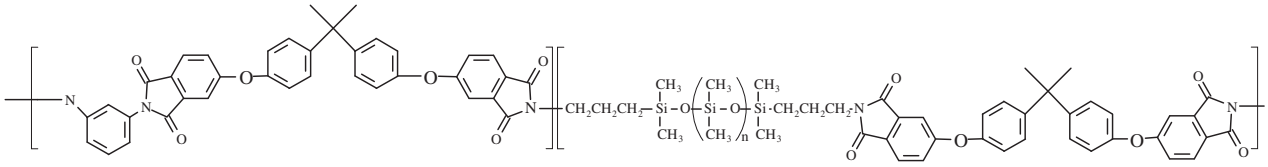
SSP-050
TRIMETHOXYSILYL MODIFIED POLYETHYLENE — 0.927
0.5-1.2 mole % vinyltrimethoxysilane - ethylene copolymer
moisture crosslinkable thermoplastic — melt process temp: 170 - 200°
[35312-82-4] TSCA HMIS: 1-1-1-X — 100g/$36.00 — 2.0kg/$432.00

Developmental

# Thermoplastic Resins for Melt Processing or Solution Casting

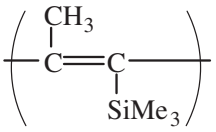


SSP-080
(DIMETHYLSILOXANE)(BISPHENOL -A CARBONATE) copolymer
(15 - 20% polydimethylsiloxane)
thermoplastic; tensile strength: 50MPa Vicat mp: 145° density: 1.19
[202483-49-6] TSCA HMIS: 1-1-0-X 100g/$120.00



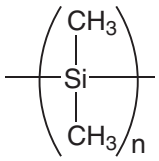
SSP-085
(DIMETHYLSILOXANE)(ETHERIMIDE) copolymer
(35-40% polydimethylsiloxane)phenylenediaminepolyetherimide
thermoplastic; tensile strength: 2800psi Tg: 168°C density: 1.18
[99904-16-2] TSCA HMIS: 1-1-0-X 100g/$120.00

SSP-070
POLY(TRIMETHYLSILYL)PROPYNE

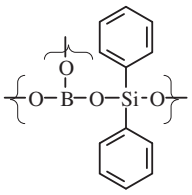


forms viscous 5% solutions in toluene/tetrahydrofuran
high oxygen permeability[1,2,3]; $PO_2/PN_2$ = 1.7
1. Masuda, T.; et al, *J. Am. Chem. Soc.*, **1983**, *105*, 7473.
2. Claes, S. et al, *J. Membrane Sci.*, **2012**, *389*, 459.
3. Claes, S. et al, *Macromolecules*, **2011**, *44*, 2766.
[87842-32-8] HMIS: 1-1-0-X 10g/$190.00

## Pre-Ceramic Polymers



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]
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/$3600 100g/$115.00



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/$72.00 100g/$234.00

## 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/$60.00 25g/$240.00

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/$49.00 25g/$196.00

SIP6831.2
PLATINUM - DIVINYLTETRAMETHYLDISILOXANE COMPLEX in xylene
2.1-2.4% platinum concentration flashpoint: 38°C (100°F) density: 0.90
"hot" catalyst employed in room temperature curing silicones
[68478-92-2] TSCA 2-3-0-X 5.0g/$60.00 25g/$240.00

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/$160.00

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/$55.00 25g/$210.00

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/$44.00 25g/$176.00

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/$119.00 25g/$476.00

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<br>1,3-DIVINYLTETRAMETHYLDISILOXANE<br>$C_8H_{18}OSi_2$<br>[2627-95-4] TSCA HMIS: 2-4-0-X | 186.40<br>TOXICITY- orl rat, LD50 >12,500mg/kg<br>flashpoint: 24°C(76°F)<br>50g/$20.00 | 139° | 0.811<br>500g/$152.00 | 1.4123 |
| SIT7900.0<br>1,3,5,7-TETRAVINYL-1,3,5,7-TETRA-METHYLCYCLOTETRASILOXANE<br>$C_{12}H_{24}O_4Si_4$<br>[27342-69-4] TSCA HMIS: 2-1-0-X | 344.66<br>flashpoint: 112°C (234°F)<br>25g/$18.00 | 110°/10<br>(-43°)mp | 0.998<br>2kg/$390.00 | 1.4342 |

Adhesion Promoters

| | | | | |
|---|---|---|---|---|
| SIA0540.0<br>ALLYLTRIMETHOXYSILANE<br>$C_6H_{14}O_3Si$<br>[2551-83-9] TSCA HMIS: 3-2-1-X | 162.26<br>flashpoint: 46°C(115°F)<br>10g/$28.00 | 146-8° | $0.963^{25}$<br>50g/$112.00 | $1.4036^{25}$ |

Special Crosslinkers

| | | | | |
|---|---|---|---|---|
| SIP6826.0<br>PHENYLTRIS(DIMETHYLSILOXY)SILANE<br>$C_{10}H_{26}O_3Si_4$<br>crosslinker for medium refractive index vinyl addition silicone elastomers<br>[18027-45-7] TSCA HMIS: 2-1-1-X | 330.68<br>flashpoint: 87°C(190°F)<br>25g/$26.00 | 91°/2 | 0.942<br>2kg/$752.00 | $1.440^{25}$ |
| SIT7278.0<br>TETRAKIS(DIMETHYLSILOXY)SILANE<br>$C_8H_{28}O_4Si_5$<br>crosslinker for Pt cure 2-component RTVs<br>[17802-47-2] TSCA HMIS: 2-2-1-X | 328.73<br>flashpoint: 67°C(153°F)<br>25g/$40.00 | 188-90° | 0.886<br>100g/$130.00 | 1.3841 |
| SIT8372.4<br>TRIFLUOROPROPYLTRIS(DIMETHYLSILOXY)-SILANE<br>$C_9H_{25}F_3O_3Si_4$ | 350.63 | 98-9°/40<br>25g/$78.00 | 0.962 | 1.3753 |

Diluent Fluids for Gel Hardness and Tactile Response

| | | |
|---|---|---|
| DMS-T31<br>polyDIMETHYLSILOXANE, 1000 cSt. | 100g/$11.00 | 3kg/$105.00 |
| ALT-143<br>polyOCTYLMETHYLSILOXANE, 600-1000 cSt. | 100g/$15.00 | 1kg/$108.00 |

**PLEASE INQUIRE ABOUT BULK QUANTITIES**

# Crosslinking Agents for Condensation Cure Silicones

Acetoxy Crosslinkers

| Code | | M.W. | density |
|---|---|---|---|
| SID2790.0 | | | |
| DI-t-BUTOXYDIACETOXYSILANE | | 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/$21.00 | 3kg/$216.00 | |

---

| | | | |
|---|---|---|---|
| SIE4899.0 | | | |
| ETHYLTRIACETOXYSILANE | | 243.28 | 1.143 |
| $C_8H14O_6Si$ | | (7-9°)mp | |
| flashpoint: 106°C(223°F) | | | |
| liquid crosslinker for silicone RTVs | | | |
| [17689-77-9] TSCA HMIS: 3-1-1-X | 25g/$10.00 | 2kg/$148.00 | |

---

| | | | |
|---|---|---|---|
| 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/$19.00 | 2kg/$200.00 | |

---

| | | | |
|---|---|---|---|
| SIM6519.2 | | | |
| METHYLTRIACETOXYSILANE-ETHYLTRIACETOXYSILANE 80:20 BLEND | | | |
| liquid crosslinker blend for silicone RTVs | | | |
| [4253-34-3] | 100g/$25.00 | 1kg/$178.00 | |

---

| | | | |
|---|---|---|---|
| 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/12.00 | 2kg/$164.00 | |

---

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-S HMIS: 3-1-1-X | 25g/$15.00 | 2kg/$360.00 | |

---

| | | | |
|---|---|---|---|
| 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/$10.00 | 2kg/$100.00 | |

---

| | | | |
|---|---|---|---|
| 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/$10.00 | 2kg/$70.00 | |

---

| Code | | M.W. | density |
|---|---|---|---|
| SIT7110.0 | | | |
| TETRAETHOXYSILANE | | 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/$11.00 | 3kg/$66.00 | |

---

| | | | |
|---|---|---|---|
| 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/$14.00 | 2kg/$138.00 | |

---

| | | | | |
|---|---|---|---|---|
| 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: 23°C (73°F) | | | |
| [2768-02-7] TSCA HMIS: 3-4-1-X | 25g/$10.00 | 2kg/$96.00 | | |

---

Oxime Crosslinkers

| | | | |
|---|---|---|---|
| SIM6590.0 | | | |
| METHYLTRIS(METHYLETHYLKETOXIMINO)-SILANE *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/$16.00 | 2kg/$140.00 | |

---

| | | | |
|---|---|---|---|
| SIV9280.0 | | | |
| VINYLTRIS(METHYLETHYLKETOXIMINO)-SILANE | | 313.47 | 0.982 |
| $C_{14}H_{27}N_3O_3Si$ | | | |
| [2224-33-1] TSCA HMIS: 3-3-1-X | 50g/$15.00 | 2kg/$180.00 | |

---

Enoxy (Acetone) Crosslinkers

| | | | |
|---|---|---|---|
| SIV9209.0 | | | |
| VINYLTRIISOPROPENOXYSILANE | | 226.35 | 0.934 |
| $C_{11}H_{18}O_3Si$ | | | |
| [15332-99-7] TSCA HMIS: 3-1-1-X | 25g/$19.00 | 100g/$62.00 | |

---

Amino and Benzamido Crosslinkers

| | | |
|---|---|---|
| SIB1610.0 | | |
| BIS(N-METHYLBENZAMIDO)ETHOXYMETHYL-SILANE, 90% | | 356.50 |
| $C_{19}H_{24}N_2O_3Si$ | | |
| [16230-35-6] TSCA HMIS: 2-1-1-X | 25g/$27.00 | 100g/$88.00 |

---

| | | | |
|---|---|---|---|
| SIT8710.0 | | | |
| TRIS(CYCLOHEXYLAMINO)METHYLSILANE | | 337.62 | |
| $C_{19}H_{39}N_3Si$ | flashpoint: 110°C(230°F) | | |
| [15901-40-3] TSCA HMIS: 3-2-1-X | 25g/$56.00 | 100g/$182.00 | |

---

# Tin Catalysts for Silicone Condensation Cure

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/$12.00 2.5kg/$118.00

---

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/$10.00 1kg/$76.00

---

SNB1710
BIS(NEODECANOATE)TIN tech-85 461.23 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/$19.00 250g/$76.00

---

SND2930
DI-n-BUTYLBIS(2-ETHYLHEXYLMALEATE)TIN 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/$10.00 250g/$40.00

---

SND2950
DI-n-BUTYLBIS(2,4-PENTANEDIONATE)TIN 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/$10.00 2kg/$220.00

---

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/$26.00 100g/$84.00

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/$10.00 2.5kg/$198.00

---

SND3260
DI-n-BUTYLDILAURYLTIN 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/$12.00 2.5kg/$128.00

---

SND4220
DIMETHYLDINEODECANOATETIN, 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/$12.00 4kg/$336.00

---

SND4240
DIMETHYLHYDROXY(OLEATE)TIN tech-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/$12.00 100g/$40.00

---

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/$10.00 2kg/$184.00

---

SNT7955
TIN II OLEATE, tech-85 581.71 1.06
$C_{36}H_{66}O_4Sn$ contains free oleic acid
[31912-84-1] HMIS: 2-1-0-X 100g/$48.00

**PLEASE INQUIRE ABOUT BULK QUANTITIES**

## Titanate Catalysts for Alkoxy and Oxime Neutral Cure RTVs

| name | MW | b.p./mm(m.p.) | $d^{20}$ | $n^{20}$ |
|---|---|---|---|---|
| AKT853<br>TITANIUM DI-n-BUTOXIDE (BIS-2,4-PENTANEDIONATE)<br>$C_{18}H_{32}O_6Ti$<br>[16902-59-3] TSCA HMIS: 2-3-1-X | 392.32<br>flashpoint: 33°C(91°F)<br>100g/$30.00 | | 0.995<br>500g/$120.00 | |
| AKT855<br>TITANIUM DIISOPROPOXIDE(BIS-2,4-PENTANEDIONATE), 75% in isopropanol<br>$C_{16}H_{28}O_6Ti$ *TIACA*<br>miscible: aqueous acetone, most organics<br>[17927-72-9] TSCA HMIS: 2-3-1-X | 364.26<br>TOXICITY- oral rat, LD50: 2,870mg/kg<br>flashpoint: 12°C (54°F)<br>viscosity, 25°: 8-11 cSt<br>100g/$12.00 | | 0.992<br>2kg/$84.00 | 1.4935 |
| AKT865<br>TITANIUM DIISOPROPOXIDE BIS(ETHYL-ACETOACETATE), 95%<br>$C_{18}H_{32}O_8Ti$ 11.0 - 11.2% Ti<br>[27858-32-8] TSCA HMIS: 2-3-1-X | 452.02<br>TOXICITY - oral rat, LD50: 23,020 mg/kg<br>viscosity, 25°: 45-55 cSt<br>flashpoint: 27°C (80°F)<br>100g/$16.00 | | 1.05<br>500g/$48.00 | |
| AKT867<br>TITANIUM 2-ETHYLHEXOXIDE<br>*TETRAOCTYLTITANATE* 8.4-8.6% Ti<br>$C_{32}H_{68}O_4Ti$<br>catalyst for silicone condensation RTVs<br>[3061-42-5] TSCA HMIS: 2-2-1-X | 564.79<br>viscosity, 25°: 120-130 cSt.<br>flashpoint: 60°C (140°F)<br>100g/$10.00 | 194°/0.25 | 0.937<br>2kg/$84.00 | 1.482 |
| SIT7305.0<br>TITANIUM TRIMETHYLSILOXIDE<br>*TETRAKIS(TRIMETHYLSILOXY)TITANIUM*<br>$C_{12}H_{36}O_4Si_4Ti$<br>[15990-66-6] HMIS: 2-2-1-X | 404.66<br>flashpoint: 51°C (124°F)<br>25g/$36.00 | 110°/10 | 0.900<br>100g/$117.00 | 1.4278 |

## Peroxide Catalysts for Heat-Cured Silicone Rubber

| | | |
|---|---|---|
| SID3352.0<br>2,4-DICHLOROBENZOYL PEROXIDE, 50% in polydimethylsiloxane paste consistency<br>silicone compounding temp. <50°; cure temp. >90°; recommended cure temp: 105-120°<br>[133-14-2] TSCA HMIS: 3-4-1 | MW: 380.00<br>100g/$37.00 | density: 1.26<br>500g/$148.00 |
| SID3379.0<br>DICUMYL PEROXIDE, 25% in polydimethylsiloxane, 40% w/ calcium carbonate, 35%<br>silicone compounding temp. <60°; cure temp. >125°; recommended cure temp: 155-175°<br>$C_{18}H_{11}O_2$<br>[80-43-3] TSCA HMIS: 2-3-2-X | MW: 259.29<br>100g/$39.00 | <br>500g/$156.00 |

## 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 | $35.00 | $210.00 |
| PGRED01 | Red | 50% | cadmium sulfoselenide | $35.00 | $210.00 |
| PGORR01 | Orange-Red | 45% | iron oxide | $35.00 | $210.00 |
| PGORA01 | Orange | 15-25% | diarylide pyrazolone | $35.00 | $210.00 |
| PGYLW01 | Yellow | 55% | bismuth vanadate | $35.00 | $210.00 |
| PGGRN01 | Green | 30-40% | cobalt titanate | $35.00 | $210.00 |
| PGBLU01 | Blue | 45% | sodium aluminosulfosilicate | $35.00 | $210.00 |
| PGFLS01 | Beige | 50-60% | mixed Fe-Mg-Ti oxides | $35.00 | $210.00 |
| PGBRN01 | Brown | 55% | mixed Fe-Cr-Cu oxides | $35.00 | $210.00 |
| PGBLK01 | Black - nonconductive | 55% | manganese ferrite | $35.00 | $210.00 |
| PGBLK02 | Black - conductive | 45% | carbon | $35.00 | $210.00 |
| PGXRA01 | X-Ray Opaque | 35% | barium sulfate | $35.00 | $210.00 |

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/$20.00 | 1kg/$75.00 |
| DMS-T21RED (Red dye in 100cSt. silicone) | 100g/$20.00 | 1kg/$75.00 |

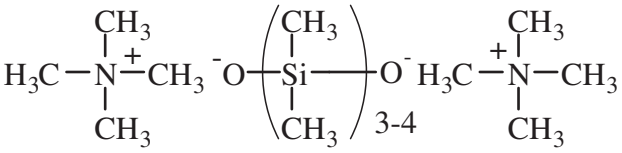
## Fillers and Reinforcements

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 | 2.9 | |
| *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/$15.00 | |
| SIS6962.0 | | | |
| SILICON DIOXIDE, AMORPHOUS | 60.09 | 2.2 | |
| HEXAMETHYLDISILAZANE TREATED | | | |
| *FUMED SILICA, HMDZ TREATED* | surface area, 200$m^2/g$ | | |
| $SiO_2$ | ultimate article size: 0.02m | | |
| reinforcing filler for high tear strength silicone rubbers | | | |
| [68909-20-6] TSCA HMIS: 2-0-0-X | | 500g/$48.00 | 2kg/$156.00 |
| 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/$10.00 | 10kg/$64.00 |

**PLEASE INQUIRE ABOUT BULK QUANTITIES**

## Polymerization Catalysts

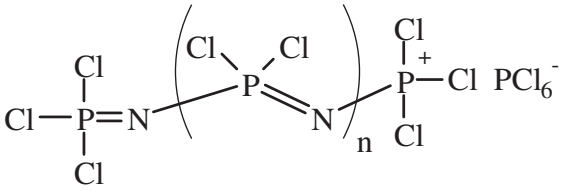



nominal structure

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/$34.00 100g/$110.00

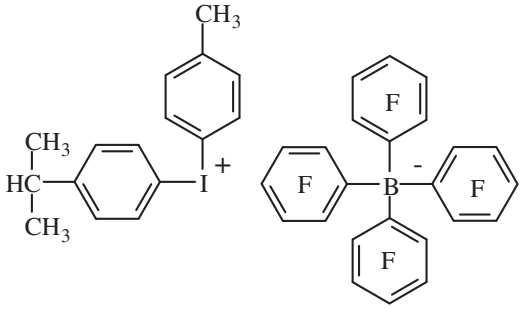



INPH055
POLYPHOSPHONITRILIC CHLORIDE, 95% mp 60-80°
$Cl_3(NPCl_2)_nNOCl_3 \cdot PCl_6$

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/$124.00




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/$48.00 25g/$192.00

# 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 = Trimethylsily
- U = Acrylate (UV) or UV stabilizer
- V = Vinyl
- X = MethoXy or EthoXy
- Y = Polar Aprotic (cYano, pYrrolidone)
- Z = Anhydride

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

Others:

MCR = Macromer Asymmetric
MCS = Macromer Symmetric
SLT = Silsesquioxane Liquid T-Resin
SST = Silsesquioxane Solid T-Resin

## 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 block
- E = Ethylene oxide block
- P = Propylene oxide block
- S = Silanol
- V = Vinyl

Suffix:
1st 2 characters = mole % non-dimethyl monomer

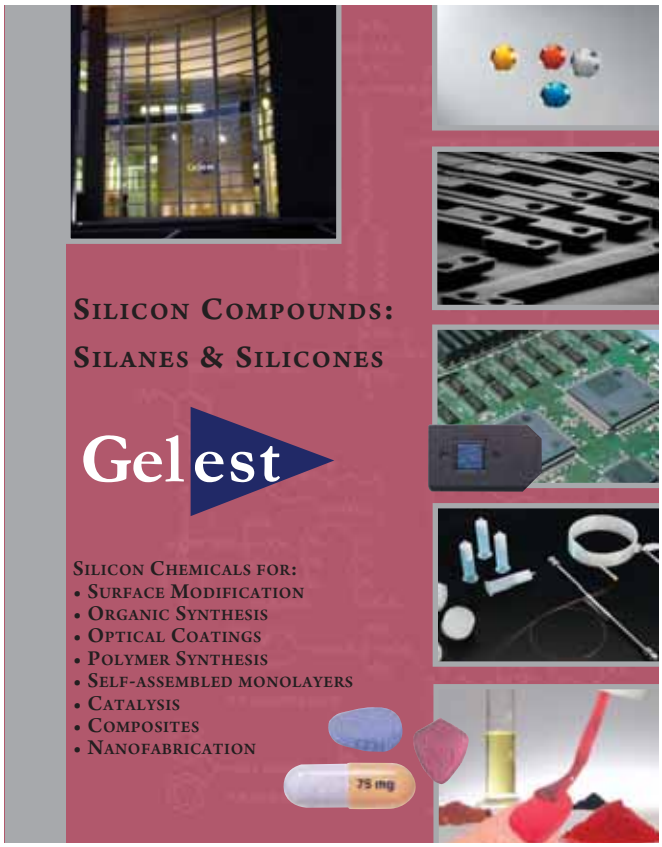
3rd character = viscosity in decades, i.e. 10x
4th character = viscosity to 1 significant figure

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,
Silanol Teminated, 50 cSt.




***Silicon Compounds: Silanes & Silicones***
Detailed chemical properties and reference articles for over 2000 compounds.

The 592 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.


**For additional information on Gelest's products and services or to inquire on how we may assist in *Enabling Your Technology,* please contact:**

**Stroofstrasse 27 Geb. 2901**
**65933 Frankfurt am Main,**
**Germany**
**Phone (DE): 49(0)69-3800-2150**
**Fax (DE): 49(0)69-3800-2300**
**info@gelestde.com**

**11 East Steel Rd.**
**Morrisville, PA 19067 USA**
**Phone (USA): 215-547-1015**
**Fax (USA): 215-547-2484**
**Phone (UK): 44(0)1622 741115**
**info@gelest.com**

Gelest, Inc.
11 East Steel Rd.
Morrisville, PA 19067
Phone: (215) 547-1015
FAX: (215) 547-2484
www.gelest.com

## For further information consult our web site at: www.gelest.com

**In Europe:**

For commercial and
bulk quantities contact:

**Gelest Ltd.**
46 Pickering Street
Maidstone
Kent ME15 9RR
United Kingdom
Tel: +44(0)-1622-741115
Fax: +44(0)-8701-308421
e-mail: europe@gelest.com

For research quantities 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

**In China:**
For commercial and
research quantities contact:

**Meryer Chemical Technology**
No. 3636 Jiangcheng Road
Minhang District
Shanghai 200245
Tel: +86-(0)-21-61259170
Fax: +86-(0)-21-61259169
e-mail: pur02@meryer.com
internet: www.meryer.com

**In South-East Asia:**

For commercial and
research quantities contact:

**Gulf Chemical**
39 Jalan Pemimpin
Tai Lee Industrial Building #04-03
Singapore 577182
Tel: 65-6358-3185
Fax: 65-6353-2542
e-mail: support@gulfchem.com.sg

**In Japan:**

For commercial and
research quantities contact:

**AZmax Co. Ltd. Tokyo Office**
Matsuda Yaesudori, Bldg F8
1-10-7 Hatchoubori, Chuo-Ku
Tokyo 104-0032
Tel: 81-3-5543-1630
Fax: 81-3-5543-0312
e-mail: sales@azmax.co.jp
on-line catalog: www.azmax.co.jp