

## Resins and Intermediates Selection Guide

Silicone resins for high-performance decorative and protective coatings

**S**ilicon-based chemistry from the XIAMETER<sup>®</sup> brand helps you solve tough performance challenges and gain a competitive edge in the coatings marketplace.

XIAMETER brand silicone resins and resin intermediates feature resistance to temperature extremes, moisture, corrosion, electrical discharge, and weathering. They are compatible with many organic resins, and many combinations of silicone resins can be formulated for specific applications and film properties.

### Product Choice

The XIAMETER brand from Dow Corning offers a diverse line of silicone resins and intermediates for formulating high-performance decorative and protective coatings. Solvent-based, solventless liquid and solid flake options ranging in silicone content from 50 to 100 percent, by weight, are available. This variety allows formulators to fulfill a wide range of performance and regulatory requirements and to achieve the best combination of performance and economy for each application. Tables 2 through 6 provide general guidelines for the selection of appropriate resins and intermediates.

### Innovative Technology

The use of silicones in coatings

markets has evolved over the decades, allowing formulators to create differentiated, high-performance product offerings. Hybrid resin systems include cold-blended interpenetrating resin networks and copolymerized “true” resin hybrids. Silicone resins and intermediates found utility in silicone alkyd maintenance paints (1950s), silicone polyester coil coatings (1970s) and most recently, silicone epoxy industrial and marine maintenance coatings (1990s). Gloss and color retention, along with corrosion, moisture, weather, and heat resistance are achieved via the incorporation of silicon-based materials into a wide array of paints, finishes, and coatings.

The level of silicone modification is dictated by the severity of the application performance requirements (See Table 1) and can range from a minimum of 15 to 90 percent silicone incorporation into the organic resin. Higher levels of silicone resin (90 to 100 percent of resin binder) provide the highest level of thermal and ultra-violet radiation resistance, but benefit from the inclusion of small portions of organic resins to improve physical properties such as hardness (phenolics and melamines), air dry (acrylics), corrosion resistance (epoxies), and toughness (alkyds).

### Temperature and Hardness

Silicone resin choice is heavily influenced by the environmental temperatures to which the end application will be exposed. Film hardness is another important consideration. Optimum coating performance is achieved by balancing these two parameters. Softer, more flexible resins are recommended for coating formulations intended for the highest temperature ranges. Rigid resins with excellent hot hardness are recommended for mid-range temperature applications.

See Tables 1, 3, and 4 for temperature and resin hardness information.

### Pigments

When formulating silicone or silicone modified organic binder systems, the performance requirements of the application determine pigment suitability. Standard pigments used with organic binder systems can be employed for those coatings intended for applications exposed to low or moderate temperatures (121 to 204°C [250 to 400°F]). For higher temperatures, only heat-stable inorganic pigments should be utilized. Consideration should also be given to coatings exposed to weather or chemical attack. Aluminum pastes and metal oxides, in particular iron

Table 1. Using Resins for Cost-Effective High-Temperature Performance

Performance Temperature Range <sup>1</sup>	Resin Type	Pigment
121-204°C (250-400°F)	Silicone-modified organic <sup>2</sup>	All pigments
204-316°C (400-600°F)	Silicone-modified organic <sup>2</sup>	Aluminum
	Organic-modified silicone <sup>3</sup>	Colored
316-427°C (600-800°F)	Organic-modified silicone <sup>3</sup>	Black, aluminum
	Silicone	Colored
427-538°C (800-1000°F)	Silicone	Black, aluminum
538-760°C (1000-1400°F)	Silicone	Ceramic

<sup>1</sup> 1000 hours, minimum. <sup>2</sup> 15-50 percent silicone. <sup>3</sup> 51-90 percent silicone.

and titanium, are useful. Hydroxyl reactivity on the surface of the pigment allows direct interaction of the pigment with the silicone binder. At elevated temperatures, thermally stable metalo-silicon ceramics are formed. Non-reactive pigments, such as carbon black, or graphite can be used to achieve color shading, but should be minimized in the formulation.

### Thinners

The resins described in this selection guide can be thinned with aromatic hydrocarbon solvents and hydrocarbon blends. They can also be thinned with most ketones, esters, chlorinated solvents, glycol ethers, and butanol. In selected situations, volatile methylsiloxanes (VMS) can be used as a diluent to reduce viscosity without increasing volatile organic compound (VOC) content. (Note: Exempt status of VMS must be approved by the state in which VMS is used.)

### Catalysts

The addition of metallic driers such as zinc or cobalt octoate will improve the rate of cure of XIAMETER® silicone resins. Suggested amounts are 0.1 to 0.2 percent metal based on the resin solids. Lead catalysts should not be used with these silicone resins. Containers with soldered seams may cause gelation.

### Curing

Coatings formulated with silicone-based resins or intermediates generally require a bake or cure at elevated temperatures to achieve optimum film properties. This is especially true if the coating is to be exposed to extreme temperatures or to thermal cycling and shock. With silicone-based coatings, there is a greater danger of under-curing than over-curing. Under-cured films are relatively soft and have poor adhesion.

Curing cycles are primarily determined by the silicone content of the resin vehicle. The typical cure for a coating based on a 100 percent silicone resin is 30 minutes at 232°C (450°F). A satisfactory cure time for a 50 to 80 percent silicone resin is 15 to 30 minutes at 218°C (425°F). For blends or copolymers of silicone and organic resins in which silicone is not the primary component, follow the cure recommendation for the primary resin.

### Corrosion Resistance

Properly cured, XIAMETER silicone resins have good resistance to water and most dilute acids. The degree of corrosion resistance is dependent on several variables such as type of silicone resin, cure conditions, film thickness, pigmentation, if used, and the application environments.

### Intercompatibility of Silicone Resins

In general, XIAMETER silicone resins have good intercompatibility. Resins with a phenyl/methyl ratio lower than 1.0/1 tend to be less compatible. Laboratory testing of resin mixtures should be done before commercial use.

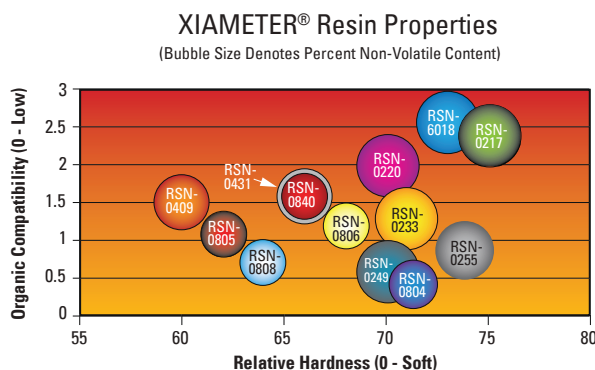


Table 2. Characteristics and Typical Properties

Specification Writers: Please contact your local sales office before writing specifications on this product.

XIAMETER brand Product	Liquid						
	RSN-0409 HS Resin	RSN-0431 HS Resin	RSN-0804 Resin	RSN-0805 Resin	RSN-0806 Resin	RSN-0808 Resin	RSN-0840 Resin
Characteristics							
Physical Form	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution	Solvent solution
Functionality	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol
Silicon Dioxide Content <sup>1</sup>	52	52	64	52	52	57	52
Silanol Content <sup>1</sup>	1	3	3	1	1	1	3
Degree of Crosslinking, percent <sup>2</sup>	60	66	68	60	66	63	66
Phenyl/Methyl Ratio	1.1/1	1.2/1	0.4/1	1.1/1	1.2/1	0.7/1	1.2/1
Molecular Weight <sup>3</sup>	2000 - 7000	2000 - 7000	2000 - 7000	200,000 - 300,000	200,000 - 300,000	200,000 - 300,000	2000 - 7000
Typical Properties							
Resin Solids, percent							
by weight <sup>4</sup>	80	80	60	50	50	50	60
by volume	74	74	51	42	41	42	51
Solvent	Xylene	Toluene	Toluene	Xylene	Toluene/Xylene	Xylene	Toluene
Specific Gravity	1.12	1.14	1.07	1.01	1.02	1.01	1.06
VOC <sup>5</sup> , g/L (lb/gal)	228 (1.9)	228 (1.9)	431 (3.6)	503 (4.2)	515 (4.3)	503 (4.2)	431 (3.6)
Viscosity (centipoise)	200	800	30	125	150	125	20
Flash Point, closed cup, °C (°F)	27 (81)	7 (45)	7 (45)	27 (81)	7 (45)	27 (81)	7 (45)

XIAMETER brand Product	Flake Resins					Resin Intermediates			
	RSN-0217 Flake Resin	RSN-0220 Flake Resin	RSN-0233 Flake Resin	RSN-0249 Flake Resin	RSN-0255 Flake Resin	RSN-6018 Intermediate	RSN-3037 Intermediate	RSN-3074 Intermediate	RSN-5314 Intermediate
Characteristics									
Physical Form	Solid flake	Solid flake	Solid flake	Solid flake	Solid flake	Solid flake	Liquid	Liquid	Liquid
Functionality	Silanol	Silanol	Silanol	Silanol	Silanol	Silanol	Methoxy	Methoxy	Methoxy
Silicon Dioxide Content <sup>1</sup>	47	52	52	63	62	51	65	54	46
Silanol Content <sup>1</sup>	6	6	5	5	5 <sup>6</sup>	6	15-18 <sup>7</sup>	15-18 <sup>7</sup>	35 <sup>7</sup>
Degree of Crosslinking, percent <sup>2</sup>	75	70	71	71	74	75	58	67	68
Phenyl/Methyl Ratio	n/a	2.0/1	1.3/1	0.6/1	0.84	2.7/1 <sup>8</sup>	0.5/1	1.0/1	3.3/1
Molecular Weight <sup>3</sup>	1500 - 2500	2000 - 4000	2000 - 4000	2000 - 4000	2500 - 4500	1500 - 2500	800 - 1300	1000 - 1500	Monomer blend
Typical Properties									
Resin Solids, percent									
by weight <sup>4</sup>	99	99	99	99	>98	99	100 (actives)	100 (actives)	100 (actives)
by volume	-	-	-	-	-	-	-	-	-
Solvent	-	-	-	-	-	-	-	-	-
Specific Gravity	1.34	1.33	1.32	1.30	1.22	1.31	1.07	1.16	1.04
VOC <sup>5</sup> , g/L (lb/gal)	-	-	-	-	-	-	-	-	-
Viscosity (centipoise)	-	-	-	-	-	-	14	120	1.87
Flash Point, closed cup, °C (°F)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	138 (280)	28 (83)
Glass Transition Temperature (Tg) °C (°F)	65 (149)	49 (120)	47 (117)	41 (106)	56 (133)	-	-	-	-

<sup>1</sup> Percent by weight.

<sup>2</sup> Silica (SiO<sub>2</sub>) – 100% crosslinked; dimethyl silicone fluids [(CH<sub>3</sub>)<sub>2</sub>SiO]<sub>x</sub> – 50% crosslinked.

<sup>3</sup> Weight average.

<sup>4</sup> 1.5 g, 3 hr at 135°C (275°F).

<sup>5</sup> Volatile Organic Compound, EPA Reference Method 24.

<sup>6</sup> Hydroxyl content.

<sup>7</sup> Methoxy content.

<sup>8</sup> Propyl.

Table 3. Silicone Liquid Resin Guide

	Product Name	Hardness	Finished Paint Temperature Performance Range, °C (°F)	Resin System (Solids Content, wt%)	Typical Applications
High Solids	XIAMETER® RSN-0409 HS Resin	Soft, flexible	To 538 (1000); short term: 650 (1200)	Solvent-based (80)	High-performance coatings; high-temperature applications where low VOC content is required. Used alone or blended with a variety of solvent-based silicone and organic resins. Similar to XIAMETER® RSN-0805 Resin except for solids content.
	XIAMETER® RSN-0431 HS Resin	Medium-hard	To 427 (800)	Solvent-based (80)	Same as XIAMETER® RSN-0840 Resin; when reduced VOC content is desired.
Standard	XIAMETER® RSN-0804 Resin	Hard, brittle	To 315 (600)	Solvent-based (60)	Maintenance paints, colored baking enamels, decorative finishes. As an additive to improve paint flow-out.
	XIAMETER® RSN-0805 Resin	Soft, flexible	To 650 (1200)	Solvent-based (50)	Maintenance paints, colored baking enamels, decorative finishes; primarily with metallic pigments. Used alone or blended with XIAMETER® RSN-0806 Resin to promote intermediate hardness.
	XIAMETER® RSN-0806 Resin	Medium-hard	To 538 (1000)	Solvent-based (50)	Colored baking enamels for space heaters, stoves, etc. Used alone or blended with XIAMETER® RSN-0805 Resin to promote intermediate hardness.
	XIAMETER® RSN-0808 Resin	Medium-soft	To 538 (1000); short term: 650 (1200)	Solvent-based (50)	Similar to XIAMETER® RSN-0805 Resin
	XIAMETER® RSN-0840 Resin	Hard to medium-hard	To 538 (1000)	Solvent-based (60)	Maintenance paints, colored baking enamels, decorative finishes. Improves heat resistance, weathering of organic resins. As an additive to improve flow-out of epoxy paints, initial gloss.

Table 4. Silicone Flake Resin Selection Guide

	XIAMETER® brand Product	Hardness	Finished Paint Temperature Performance Range, °C (°F)	Resin System (Solids Content, wt%)	Typical Applications
Flake Resins	RSN-0217 Flake Resin	Hard, brittle	To 260 (500)	Solid flake (100)	As a powder coating binder and liquid coating binder to improve thermal stability and weatherability.
	RSN-0220 Flake Resin	HardT	To 315 (600)	Solid flake (100)	As a powder coating binder or co-binder to improve heat stability and weatherability; for blending with other silicone resins to reduce VOC content; in solvent-based organic coatings to improve film properties; in copolymerization with carbinol-functional organic monomers or polymers.
	RSN-0233 Flake Resin	HardT	To 427 (800)	Solid flake (100)	As a powder coating binder or co-binder to improve heat stability and weatherability; colored baking enamels, decorative finishes; to increase hardness of other liquid silicone resins.
	RSN-0249 Flake Resin	HardT	To 427 (800)	Solid flake (100)	As a powder coating binder to improve heat stability and weatherability; for blending with solvent-based silicone resins to reduce VOCs; for blending with solvent-based organic resins to improve heat stability and weatherability.
	RSN-0255 Flake Resin	Hard, rigid	To 427 (800)	Solid flake (100)	As a coatings binder to improve heat stability and weatherability; as a blending resin with solvent-based silicone resins to reduce volatile organic compound (VOC) content; as a blending resin in solvent-based organic resins to improve heat stability and weatherability.

Table 5. Silicone Resin Intermediate Selection Guide

	Product Name	Physical Form (Solids Content, wt%)	Functionality	Reactivity	Typical Applications
Resin Intermediates	XIAMETER® RSN-6018 Intermediate	Flaked solid (100)	Silanol	Reacts with alkyds, phenolics, epoxies, polyesters and other organic resins containing hydroxyl groups.	Reactive silicone intermediate in colored maintenance and architectural finishes, appliance finishes, coil coatings and high temperature finishes. Blended with other silicone resins to improve hardness. Blended with organic resins to improve weatherability and heat resistance.
	XIAMETER® RSN-3037 Intermediate	Liquid (90)	Methoxy	Reacts with organic systems containing active hydroxyl groups.	Reactive silicone intermediate for coil coatings, appliance finishes and other finishes where improved heat or weathering resistance is needed. Typically reacted with saturated polyesters or oil-free alkyds to form a silicone polyester copolymer.
	XIAMETER® RSN-3074 Intermediate	Liquid (90)	Methoxy	Reacts with organic resins containing active hydroxyl groups.	Reactive silicone intermediate for coil coatings, appliance finishes and other finishes where improved heat or weathering resistance is needed. Typically reacted with saturated polyesters to form silicone-modified copolymers with 20 to 50 percent silicone content.
	XIAMETER® RSN-5314 Intermediate	Liquid (100, actives)	Methoxy	Reacts with organic resins containing active hydroxyl groups.	Reactive silicone intermediate for upgrading the weatherability of acrylic emulsions. Should work equally well with other emulsion systems that are stable at an alkaline pH.

Table 6. Compatibility of Selection Silicone Resins with Selected Organic Resins<sup>1</sup>

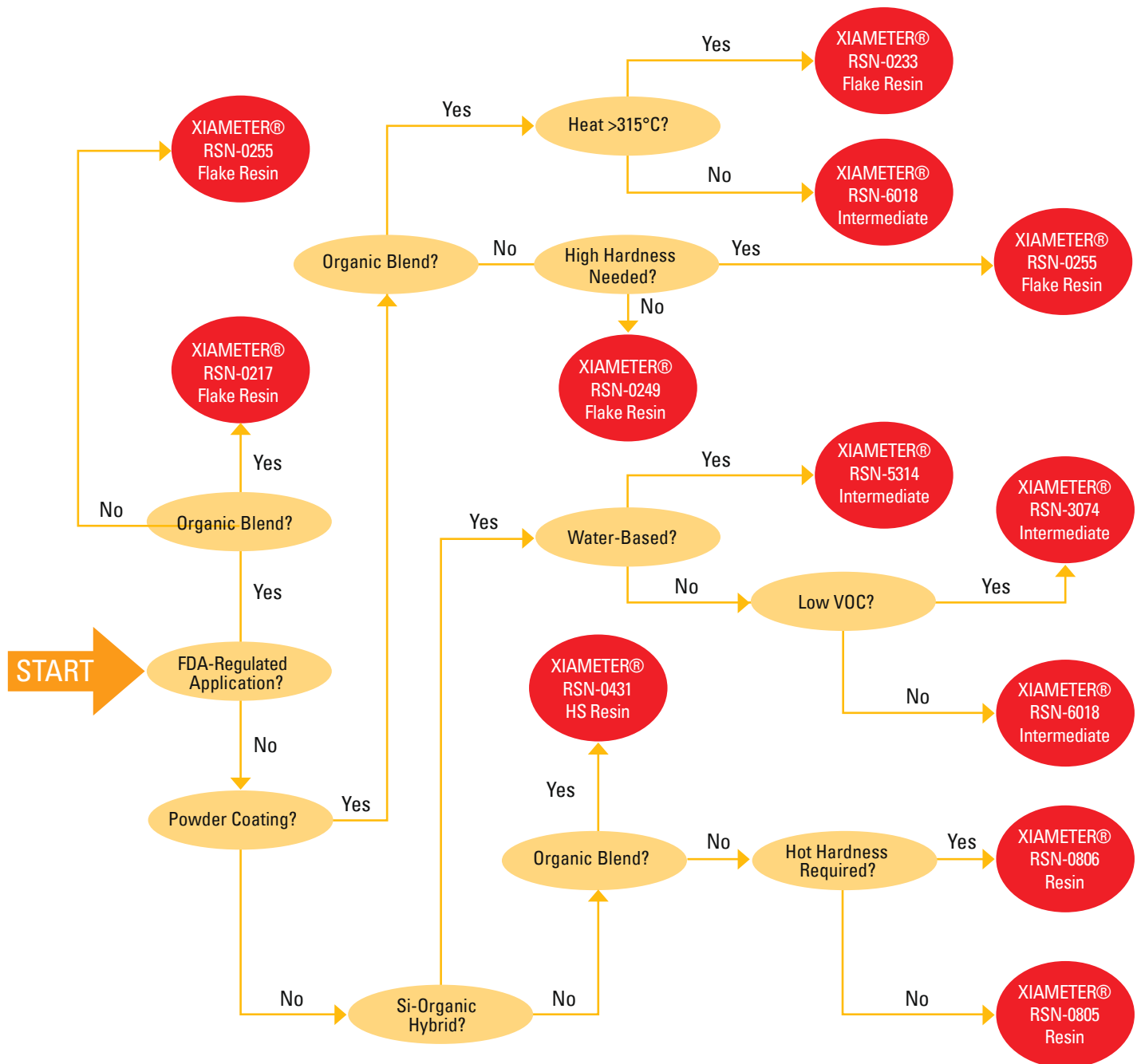
Resin Type	Brand <sup>2,3</sup>	XIAMETER brand Product					
		RSN-431 HS and RSN-0840 Resins		RSN-6018 Intermediate		RSN-0233 Flake Resin	
		10%	50%	10%	50%	10%	50%
Acrylic (Thermoplastic)	<i>Paraloid A-10S</i>	C	SI	C	C	C	C
	<i>Paraloid B-44</i>	SI	I	I	I	SI	I
	<i>Paraloid B-48S</i>	C	C	C	C	C	C
	<i>Paraloid B-66</i>	C	C	C	SI	C	C
	<i>Paraloid B-72</i>	C	C	C	I	C	C
	<i>Paraloid B-82</i>	C	SI	I	I	SI	SI
Acrylic (Thermosetting)	<i>Paraloid AT-63</i>	C	C	C	C	C	C
	<i>Paraloid AT-400</i>	C	C	C	C	C	C
Alkyd (Long oil) (Medium oil) (Short oil) (Oil-free)	<i>Duramac 50-5060</i>	SI	SI	SI	I	SI	I
	<i>Duramac 204-2768</i>	C	C	C	C	C	C
	<i>Duramac 57-5720</i>	C	SI	C	C	C	C
	<i>Polymac 57-5776</i>	SI	SI	C	SI	C	SI

C – Compatible  
 SI – Slightly incompatible  
 I – Incompatible

<sup>1</sup> As determined by dry film on glass slides. This is meant to be representative only. The possible combinations of silicone and organic resins are unlimited.

## Selecting a XIAMETER® brand Resin

Is the intended coating...



# Important information on storage, handling, and flammability

## Storage and Shelf Life

XIAMETER silicone resins should be stored at room temperature in sealed containers away from heat and open flame. XIAMETER® solid flake products should be stored below 22°C (72°F). Refer to the product pages on [www.xiameter.com](http://www.xiameter.com) for the shelf life from date of manufacture of the resins and intermediates discussed in this brochure.

## Handling Precautions

Product safety information required for safe use is not included. Before handling, read product and safety data sheets and container labels for safe use, physical and health hazard information. The material safety data sheet is available on [www.xiameter.com](http://www.xiameter.com).

When working with XIAMETER® silicone paint resins formulated with flammable solvents, the following safety precautions should be taken:

- Keep away from heat and open flame
- Use only with adequate ventilation
- Avoid prolonged breathing of vapor
- Avoid prolonged or repeated skin contact
- Avoid eye contact

XIAMETER® solid flake resins are electrically nonconductive and, like plastic in particle form, can generate static charges during transfer operations. For this reason, proper precautions should be taken to safely dissipate any charges possibly generated, particularly when solvents or solvent vapors are present. These two important cautions are detailed as follows:

1. The flake itself will generate an electrical potential, and the user should maintain adequate safeguards to properly handle it. The vessel into which the flake is being poured should be grounded along with the platform on which the operator stands.
2. Avoid the presence of ignitable materials during the transfer operation. If possible, have an inert atmosphere in the kettle and keep the solvent vapor content of the surrounding area at safe levels by providing adequate building area ventilation.

## Limitations

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

## Flammability

XIAMETER silicone resins in organic solvent have a closed cup flash point from 7 to 27°C (45 to 80°F). The flake resins have a closed cup flash point of approximately 138°C (280°F).

## Product Information and Technical Support

Visit [www.xiameter.com](http://www.xiameter.com) for:

- Product technical data sheets
- Customer service & limited technical support
- The name of a XIAMETER brand distributor near you

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