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TSR117

Silicone Coating and Electrical Insulation

MARKETING BULLETIN

SILANES - COATINGS ADDITIVES

TSR117 silicone resin may be considered for use as an insulation varnish and/or as a vehicle in paints to help impart heat, chemical and weather resistance properties. It may also be considered for use in the electrical industry as an insulating varnish for making flexible mica and glass mica tapes and sheets for Class H insulation of electrical devices. TSR117 silicone resin is a methylphenyl silicone solution in xylene. A film of TSR117 silicone resin is of medium hardness.

Key Features and Typical Benefits

- Excellent thermal resistance
- Meets class H insulation requirements for electrical devices
- Low temperature cure and room temperature drying, upon addition of catalysts

Typical Physical Properties

Property	Value
Appearance	Transparent, light yellow liquid
Specific Gravity at 25 °C	1.01
Viscosity at 25 °C, mPa•s	140
Solid Content, %	50
Diluent	Xylene

Typical properties are average data and are not to be used as or to develop specifications.

TSR117 Silicone Resin in Coatings

Mechanical Film Test Properties

TSR117 silicone resin was coated on steel sheets (SPC-1 50mm x 50mm x 1.0mm in thickness) with a film thickness of 30-40 μm and cured at 150 °C and 250 °C for one hour. The physical properties of the films were evaluated as shown in the table below. Typical recommended cure condition is 250 °C for 1 hour to achieve maximum mechanical film properties.

Property	Cured Film at 150 °C, 1 hour	Cured Film at 250 °C, 1 hour
Film Hardness (Sward rocker test)	34	50
Erichsen Indication, mm	2	8
Drawing Test20/20 (no flaking)	20/20 (no flaking)	
Cross Cut Adhesion Test	No coating flakes	No coating flakes
Impact Test (drop weight: 300g with diameter of 0.5", drop height: 40 cm)	Film cracked	No change
Bend Test (bent over a 3 mm in diameter mandrel)	Yes (flexible)	Yes (flexible)

Alternatively, TSR117 silicone resin can be cured at low temperatures (100-150 °C) or at room temperature. Low temperature cure is achieved by adding CR 13 curing catalyst. Typically, a mixture of 10 g of CR 13 curing catalyst and 100 g of n-butanol is added to 1 kg of varnish. The pot life of the varnish is about 1 month, at room temperature, after the addition of CR 13 curing catalyst. The recommended drying time at various low temperature cures are shown in the table below. The drying times to achieve non-tacky coatings are also included.

Drying Temperature, °C	70 °C	90 °C	110 °C	130 °C	150 °C
Drying Time, mins	150	40	15	5	< 5
Drying Time with Non-Tackiness Film, hrs	–	–	3	1	0.5

The room temperature cure of TSR117 silicone resin is achieved by adding CR 15 curing catalyst. The cure time and pot life of varnish formulations are shown in the table below.

Composition / Physical Property	Formulation 1	Formulation 2
TSR117 silicone resin	100 parts	100 parts
CR 15	2 parts	2 parts
Xylene (diluent)	–	70 parts
Curing Time at 25 °C	7 hrs	7 hrs
Pot Life at 25 °C	1-2 hrs	8-16 hrs

Note: Test data. Actual results may vary.

TSR117 Silicone Resin in Coatings (continued)

Other effective catalysts for TSR117 silicone resin are metal soaps of Fe, Co, Mn and Zn-, which typically impart characteristics that allow painting film at 150-200 °C. The effectiveness of catalytic activity is listed below.

Strong	Fe > Mn > Zn	Weak
The typical use levels of metal catalysts on solid resin are		
Fe 0.01-0.05%		
Co 0.1-0.5%		
Mn 0.1-0.5%		
Zn 0.5%		

Note: For aluminum paint, the use of 0.05%-0.1% of Co or 0.01% of Fe is preferred.
Zn cannot be used as a catalyst.

Formulating with TSR117 silicone resin

White enamel with heat resistance of 200 °C

Ingredient	Parts by Weight
TSR117 silicone resin	72.5
TiO_2 R-820 (from Ishihara Sangyo Co.)	25.5
1% SF96-1000 in xylene	1.0
Manganese naphthenate (6% metal)	0.7
Ferric octoate (6% metal)	0.5

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

TSR117 Silicone Resin in Electrical Insulation-Coil Impregnation and Mica Bonding

TSR117 silicone resin based varnishes may be considered for use as a coil impregnating material for Class H insulation (maximum operating temperature of 180 °C). This product may also be considered for use in making flexible mica and glass mica tapes and sheets for Class H insulation of electrical devices.

Typical Properties

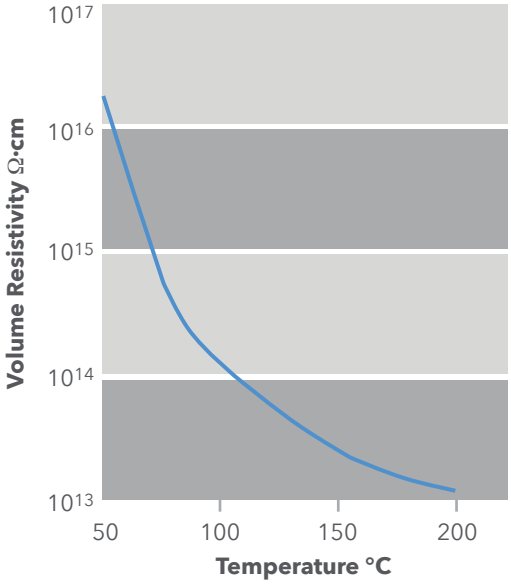
Test Item		TSR117 silicone resin
Appearance	Varnish	Pale yellow, clear
	Cured Film	Smooth, luster
Solid Content, %		50
Viscosity (25 °C), P (Pa•s)		1.4 (0.14)
Specific Gravity (25 °C)		1.01
Acid Value		2.5
Film Thickness	Center mm	0.031
Lower Part %	116	
Volume Resistivity (ohm-cm)	Normal	5.4×10^{16}
	After wetted	5.4×10^{16}
	High temperature (180 °C)	7.2×10^{13}
Dielectric Strength kV (per 0.1mm)	Normal	7.9
	After wetted	7.9
	High temperature (180 °C)	7.6
Bending (3 mm in diameter) 250 °C, 70 hours	No change	
Heat Resistance (glass cloth) 250 °C, 2000 hours	No change	
Thermal Weight Loss (250 °C, 72 hours), %	4.8	
Solvent Resistance (25 °C, 60 second immersion in xylene)	Passed	
Diluent	Xylene	

Note: Test data. Actual results may vary.

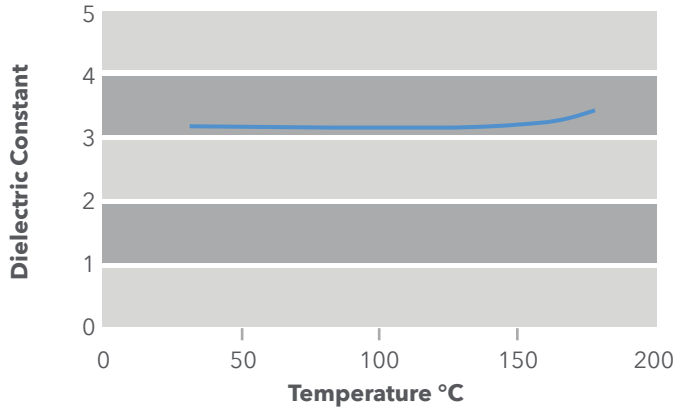
Electrical Properties

Electric Properties of TSR117 Silicone Resin

Volume Resistivity vs. Temperature



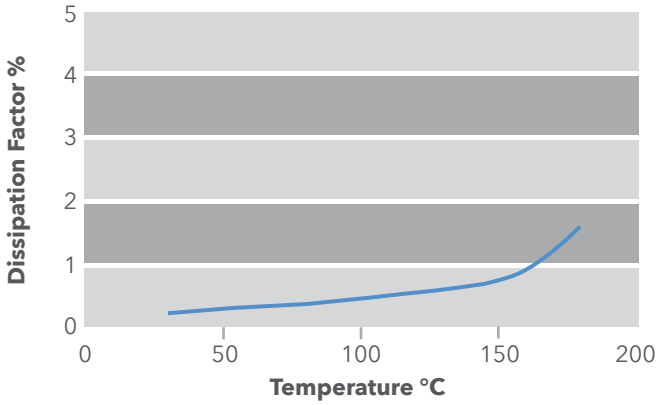
Dielectric Constant vs. Temperature (60Hz)



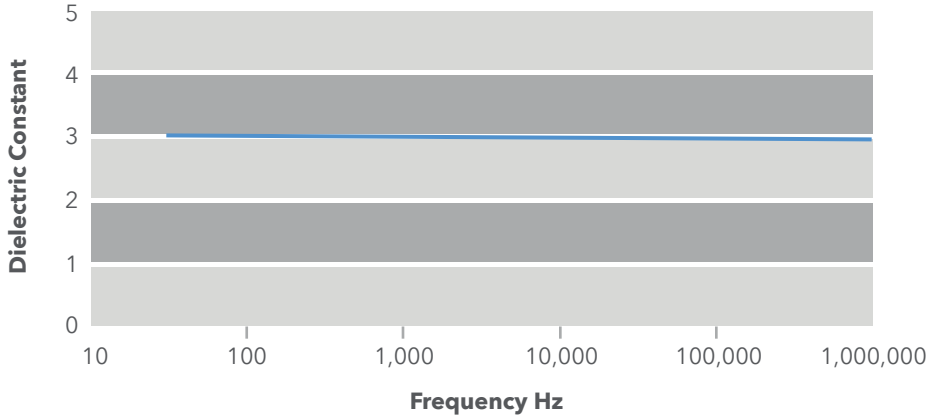
Note: Test data. Actual results may vary.

Electrical Properties (continued)

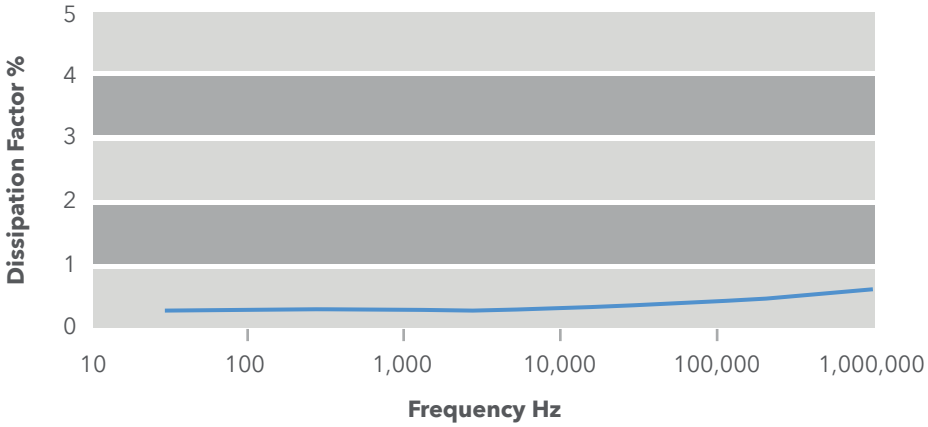
Dissipation Factor vs. Temperature (60Hz)



Dielectric Constant vs. Frequency (25°)



Dissipation Factor vs. Frequency (25°)



Note: Test data. Actual results may vary.

Sample Application Procedure for Coil Impregnation

1) Preliminary drying:

Remove any dust, oil or other contaminants from the materials to be treated. Pre-bake for several hours between 80 and 150 °C to eliminate any water or moisture.

2) First Immersion:

Cool the material to 50 °C or below before immersing it in the varnish. Hold the material until bubbling has ceased to allow the varnish to impregnate the material. This process is usually carried out under reduced pressure conditions.

3) Air Drying: Remove the material and drain any excessive varnish. Keep at room temperature for several hours to allow the solvent to evaporate.

4) First Baking: Place the air-dried material in an oven and gradually increase the temperature. Keep the material in the oven for several hours between 80 and 120 °C until the solvent has completely evaporated.

5) Second Immersion:
Cool the coated material to room temperature and immerse again in the varnish. It is recommended that the second immersion must be completed within 5 minutes in order to avoid silicone film damage.

6) Air Drying:
Repeat the air-drying process (3) as after the first immersion.

7) Final Baking:
Repeat the baking process (4) as with the first baking. Increase the temperature for the final baking as with the first baking. Gradually cool the finished material to room temperature.

Typical Examples of Silicone Insulation Procedures for Coil Impregnation

Dry type transformer (3 phase, 20kVA, 6.6kV/220V) with TSR117 silicone resin

1) Preliminary Drying:	130 °C, 3 hours
2) First Immersion:	15 minutes
3) Air-Drying:	60 minutes
4) First Baking:	Room Temperature to 80 °C: for 2 hours, keep for 2 hours, 80 to 100 °C: for 1 hour, keep for 2 hours, 100 to 120 °C: for 1 hour, keep for 2 hours 120 to 150 °C: for 1 hour, keep for 3 hours
5) Second Immersion:	Less than 5 minutes.
6) Air-Drying:	60 minutes.
7) Final Baking:	Same procedure as (4) and 150 to 200 °C: 1 hour, keep for 5 hours

Sample Application Procedure for Mica Bonding

TSR117 silicone resin can be applied by dipping, brushing or spraying. The recommended curing temperature is between 150-180 °C, for flexible mica tape.

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