Information About High Technology Silicone Materials

DOW CORNING

DESCRIPTION

DOW CORNING® 997 varnish is a silicone impregnating varnish that offers processing ease and versatility, and features good dielectric properties and moisture resistance. In service, it exhibits good retention of bond strength. Its reliability has been proved by years of extensive use throughout the electrical equipment industry.

Other outstanding features of DOW CORNING 997 varnish include:

- Long service life – reliable even at 220 C (428 F) hottest spot temperature
- Ease of use – varnish is readily thinned to meet specific application requirements
- Little tendency to bubble during cure
- Flexible cure schedules
- Designed to meet requirements of MIL-I-24092B

USES

DOW CORNING 997 varnish is typically used as an electrical insulating impregnant for a variety of insulation systems. Motor stator coils, generator coils, solenoids and transformer windings are common application areas.

HOW TO USE

General

Prior to impregnation with DOW CORNING 997 varnish, equipment should be thoroughly cleaned and prebaked at 150-200 C (302-392 F) to drive out moisture and to cure new insulating components.

After prebaking, the equipment should be allowed to cool to 80 C (176 F).

DOW CORNING® 997 VARNISH

Type	Silicone resin in solvent
Physical Form	Dark brown liquid
Special Properties	Easy to use; excellent electrical properties; good bond strength retention; moisture resistance; designed to meet MIL-I-24092B
Primary Uses	Impregnant and coating material for various electrical coils – including transformers, motors and generators

It should then be dipped in DOW CORNING 997 varnish for 3 to 5 minutes (or until most of the bubbling stops). *Immersion time should be no longer than 10 minutes.*

The first coat of varnish must be air-dried, partially cured and then cooled to about 80 C (176 F) before any further impregnation. Two dips will usually give sufficient build-up of varnish.

Thinning

Several solvents are satisfactory for DOW CORNING 997 varnish. Any thinner used to reduce the viscosity of DOW CORNING 997 varnish should meet the following requirements:

- Kauri-Butanol Value – greater than 50
- Initial Boiling Point – higher than 104 C (220 F)
- Final Boiling Point – lower than 169 C (335 F)
- Corrosion – none

When using thinning solvents, follow handling instructions noted on solvent container label. Always provide adequate ventilation.

Maintaining Proper Viscosity

If the viscosity of DOW CORNING 997 varnish is allowed to exceed 200 centistokes, the varnish may not penetrate the windings, and air spaces (voids) may be left.

Excessive varnish build-up may lead to crazing. If the varnish in the dip tank becomes too thick, deterioration may occur and the varnish should be discarded.

Curing

Curing time and temperature vary with the size and complexity of the equipment, the properties desired in the varnish film and the characteristics of the curing oven. Typical curing schedules, which should be suitable for motors and transformers varying widely in size and weight, are described in Table I.

Curing time should be measured from the time both the oven and the impregnated equipment reach the curing temperature. When establishing curing schedules for specific equipment, follow these general rules:

1. Final cure temperature should be at least 20 C (68 F) above the maximum operating temperature of the impregnated equipment.
2. When maximum bond strength is required, equipment should be given a final cure at 250 C (482 F) for at least 6 hours. The effect of

curing temperature and heat aging on bond strength is illustrated in Table II.

3. Equipment impregnated with DOW CORNING 997 varnish can usually be placed in ovens at temperatures between 150-200 C (302-392 F) without the appearance of bubbles in the varnish film. Equipment that is to be cured at 250 C (482 F), however, should be given an initial bake of 2 to 4 hours at 150-200 C (302-392 F). Small or complex equipment that will be cured at temperatures above 150 C (302 F) should be given a preliminary bake of 1 hour at 100-150 C (212-302 F).
4. Immersion time must be kept to a minimum to prevent solvent damage to insulating components.

Maintaining Cleanliness

If dirt is allowed to accumulate in the dip tank, it can seriously affect the dielectric properties of DOW CORNING 997 varnish.

Dip tanks should be of welded black iron and fitted with tight covers to exclude dust and minimize evaporation. Tanks with soldered joints are not recommended because silicone varnish has a tendency to gel after contact with solder or soldering flux.

Dip tanks should be cleaned at least twice a year. Drain the varnish from the tank into a clean container. Remove sludge or dirt by straining the varnish through several layers of cheese cloth before it is returned to the tank. Check viscosity of the varnish and add thinner if necessary.

Rewinds

Electrical equipment should be thoroughly cleaned before it is rewound. Motors baked overnight at 540-650 C (1004-1202 F) in "roasting out" ovens are more easily stripped and cleaned. Sandblasting and vapor-cleaning tanks are also effective methods to clean stripped electrical machines.

HANDLING

Caution

DOW CORNING 997 varnish contains xylene, a flammable solvent. Keep away from heat and open flame. Avoid prolonged breathing of vapor. Avoid prolonged or repeated skin contact and avoid eye contact.

Ovens: In curing ovens, the solvent evaporates rapidly and explosive vapor concentrations may accumulate in the absence of proper ventilation. Use only a well-ventilated air-circulating oven. Air should be changed 3 times per minute in ovens of 20 cubic feet inside volume, and once or twice per minute in ovens of 250 cubic feet inside volume.

Flammability

When cured, DOW CORNING 997 varnish meets or exceeds Underwriters Laboratories (UL) 94 V-O flammability tests as tested by the Dow Corning Corporation. This does not imply UL recognition.

TYPICAL PROPERTIES

These values are not intended for use in preparing specifications.

As Supplied		
CTM 0176	Color	Dark brown
CTM 0208	Nonvolatile Content, after 3 hrs at 135 C (275 F), percent	50
CTM 0001A	Specific Gravity at 25 C (77 F)	1.00
CTM 0050	Viscosity at 25 C (77 F), cps	90-120
CTM 0021A	Flash Point, closed cup, ° C (° F)	27 (80)
	Drying Time at 200 C (392 F), hrs	3
	Solvent	Xylene

As Cured – 6 hours at 200 C (392 F)		***Condition A[1]***	***Condition D[1]***
CTM 0114	Dielectric Strength, 2" electrodes, volts/mil	2000	1500
CTM 0112	Dissipation Factor at 25 C (77 F),		
	tested at 100 Hz	0.010	0.020
	tested at 100 kHz	0.007	0.010
CTM 0112	Dielectric Constant at 25 C (77 F),		
	tested at 100 Hz	3.10	3.20
	tested at 100 kHz	2.98	3.10
CTM 0249	Surface Resistivity, ohms	1×10^{14}	1×10^{13} (C^1)
CTM 0249	Volume Resistivity, ohm-cm	2×10^{14}	1×10^{14} (C^1)
	Weight Loss[2], after 3 hrs at 250 C (482 F), percent	6.4	–
CTM 0224	Thermal Conductivity, cal/sec (cm) °C	0.35×10^{-3}	–
	Moisture Vapor Transmission, g/m^2/day	4.6	–
CTM 0226	Thermal Life, curved electrodes method,[3]		
	at 300 C (572 F), hrs	350	–
	at 275 C (527 F), hrs	1500	–
	at 250 C (482 F), hrs	4000	–

[1]Condition A – as supplied; Condition D – after 24 hrs immersion in distilled water; Condition C – after 96 hrs at 23 C (73 F) and 96 percent RH.

[2]Solvent-free varnish.

[3]Hours aging necessary to reduce the dielectric strength of glass cloth impregnated with DOW CORNING 997 varnish to 300 volts per mil when the varnish film is elongated 2 percent.

Specification Writers: Please contact Dow Corning Corporation, Midland, Michigan, before writing specifications on this product.

Also, DOW CORNING 997 varnish has a rating of 39 when coated over Arimid Paper and tested in accordance with ASTM D 2863 – limited oxygen index test (39 percent oxygen atmosphere necessary to maintain combustion).

SHIPPING LIMITATIONS

DOT Classification: Flammable.

STORAGE

When stored at or below 25 C (77 F), DOW CORNING 997 varnish has a shelf life of 12 months from date of shipment from Dow Corning.

PACKAGING

DOW CORNING 997 varnish is supplied in 1-, 5- and 55-gal (8.4-, 42- and 462-lb) containers, net weight.

Attention! Containers will have vapor and/or product residues when emptied. All hazard precautions on labels must be observed when handling empty containers. DO NOT CUT OR WELD CONTAINERS. DO NOT REUSE CONTAINERS.

MSDS INFORMATION

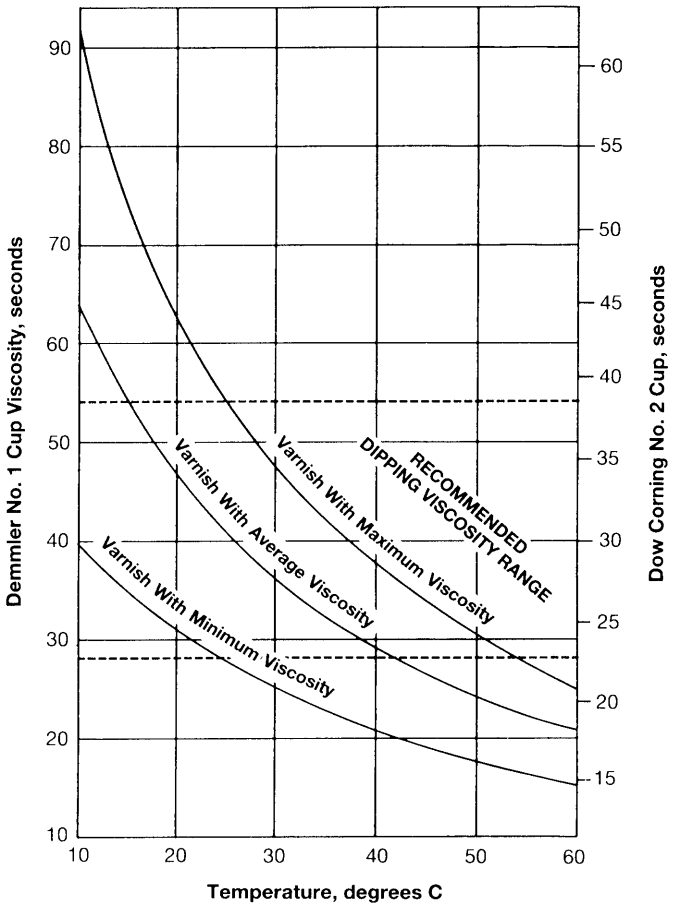
ATTENTION: PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY WRITING TO DOW CORNING CUSTOMER SERVICE, OR BY CALLING (517) 496-6000.

WARRANTY INFORMATION – PLEASE READ CAREFULLY

Dow Corning believes that the information in this publication is an accurate description of the typical characteristics and/or uses of the product or products, but it is your responsibility to thoroughly test the product in your specific application to determine its performance, efficacy and safety.

Unless Dow Corning provides you with a specific written warranty of fitness for a particular use, Dow Corning's sole warranty is that the product or products will meet Dow Corning's

EFFECT OF TEMPERATURE ON THE VISCOSITY OF DOW CORNING 997 VARNISH



GALLONS OF THINNER TO BE ADDED PER 100 GALLONS OF DOW CORNING 997 VARNISH TO MAINTAIN PROPER DIPPING CONSISTENCY

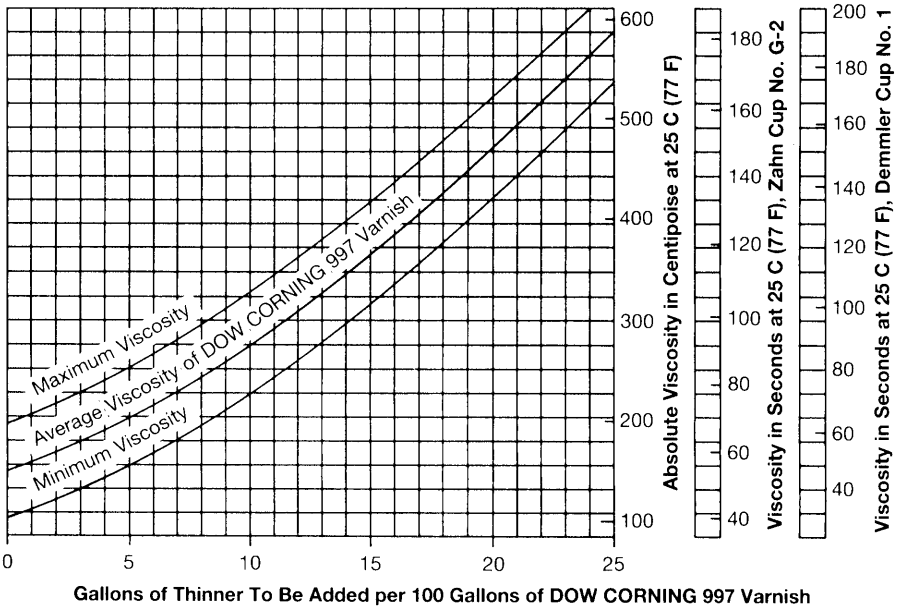


TABLE I: TYPICAL CURING SCHEDULE

The following schedule was developed by Dow Corning for impregnating and curing a 5-horsepower, 3-phase induction motor wound on a 254 frame. This schedule should be suitable for motors and transformers varying widely in size and weight. Some modifications may be desirable to accommodate very small or very large equipment, or equipment with components unable to withstand cure temperatures above 180 C (356 F).

1. Prebake 4 hours at 175 C (347 F) to drive out moisture and cure all components.
2. Cool to about 80 C (176 F). Dip in DOW CORNING 997 varnish until most bubbling stops (about 3 minutes). Drain and air-dry for 30 minutes.
3. Bake for 2 hours at 200 C (392 F).
4. Cool to 80 C (176 F). Dip in DOW CORNING 997 varnish for 1 minute. Drain and air-dry for 30 minutes.
5. Any of the following final cures may be used:
   A. 4 to 8 hours at 200 C (392 F).
   B. 2 hours at 200 C (392 F), followed by 3 to 7 hours at 225 C (437 F).
   C. 2 hours at 200 C (392 F), followed by 2 to 6 hours at 250 C (482 F).

TABLE II: EFFECT OF CURE TEMPERATURE AND HEAT AGING ON BOND STRENGTH

Helical wound coils of No. 18 AWG aluminum wire were impregnated with DOW CORNING 997 varnish. The bond strength was determined as the number of pounds required to break this coil as a simple beam. This test is a functional measure of the varnish film strength.

Cure, 6 hrs at:	*Bond Strength, lbs when tested at 25 C (77 F)*	*Bond Strength, aged coils, when tested at 25 C (77 F)*[1]
150 C (302 F)	9	22.0
200 C (392 F)	16	22.4
250 C (482 F)	25	22.2

[1]Coils aged 20 weeks at 250 C (482 F).

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AGP1876

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Printed in U.S.A. Form No. 10-027C-91

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