

WACKER

CREATING TOMORROW'S SOLUTIONS

SILRES®

SILRES® H62 C IMPREGNATING
RESIN FOR VACUUM PRESSURE
IMPREGNATION (VPI)



WACKER has developed the high-performance SILRES® H62 C silicone resin especially for impregnating the windings of electrical motors. Applied by vacuum pressure impregnation, it reliably protects the windings against moisture by completely filling the spaces and coating the surfaces. The liquid silicone resin is free of solvents and reactive diluents. When cured, it meets all the requirements of insulation classes H and C.

PERMANENT PROTECTION WITH HIGH-PERFORMANCE SILICONE RESIN

WACKER SILRES® H62 C impregnating resin is a solvent-free, liquid silicone resin which is cured by heat.

Characteristics

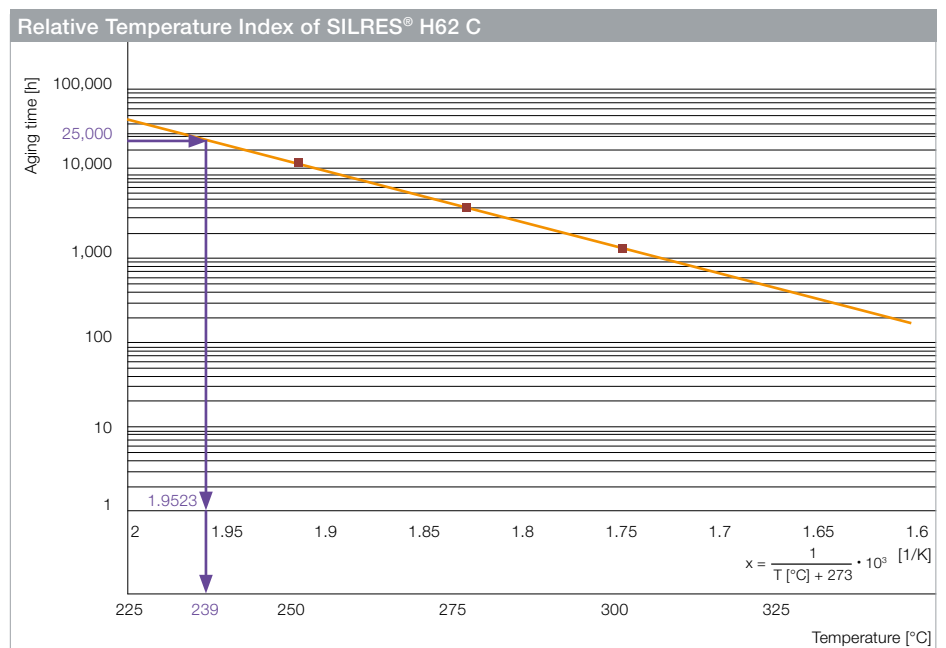
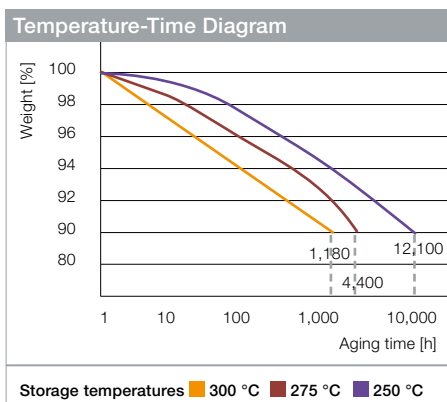
- Ready-to-use, solvent-free
- Addition-curing, one-component phenyl silicone resin
- Very low content of volatile organic compounds (VOC)
- Physiologically inert
- Should be processed at max 80 °C and is usually cured between 170 °C – 200 °C
- Cures without byproducts
- Long-lasting and thermally stable (RTI: 25,000 h at 230 °C)
- Once completely cured, fulfills all insulation class H and C requirements

Applications

WACKER SILRES® H62 C is used for impregnation in a wide range of industries and applications, including:

- Traction motors for
 - The railway industry (e.g. high-speed trains, subways, tramways)
 - Ships
 - Heavy duty vehicles
 - Mining vehicles
- Electric drives for
 - Passenger cars
 - Buses
 - Agricultural machinery
- Smoke-extraction motors
- Generators and turbines

WACKER SILRES® H62 C is used worldwide by all major manufacturers of traction motors. It is also a component of the VERIDUR® insulation system.



SILRES® is a registered trademark of Wacker Chemie AG.

Properties before Curing

WACKER Impregnating Resin		SILRES® H62 C	
Appearance			Yellowish, slightly cloudy ¹
Density	at 25 °C	[g/cm ³]	1.12
Viscosity, dynamic	at 25 °C	mPa·s	1,000
DIN EN ISO 3219/DIN 53019	at 80 °C	mPa·s	95
Refractive index	at 25 °C		1.50
Volatile contents	1h, 150 °C	[%]	< 0.75
	1h, 200 °C		< 1.50
Gel time	200 °C	[min] ³	26

These figures are intended as a guide and should not be used in preparing specifications.

¹ The cloudiness is not a qualitative deficiency and does not impair the efficacy.

² Kinematic viscosity can be calculated from dynamic viscosity (dynamic viscosity = kinematic viscosity x density).

³ Gel time is determined according to DIN 16945 with GELNORM® gellimers made by Gel Instrumente AG (aluminum test stamp, test tubes 160 x 15.75 mm, 13 g sample).

Safety Instructions

The components described have so far not shown any known toxic effects. Nevertheless, we recommend that the usual precautions for handling chemicals be observed, e.g. avoiding contact with the skin, foodstuffs and beverages, and also avoiding inhalation of the vapors produced when the substances are overheated. Comprehensive instructions are given in the corresponding material safety data sheets, which are available on request from WACKER subsidiaries.

Properties after Curing

Thermal and Mechanical Properties				SILRES® H62 C
Hardness, Shore D	DIN 53505	Cylindrical specimen		65
Flexural strength	DIN EN ISO 178	At 25 °C	[N/mm ²]	30
Tensile modulus E	DIN 53457	At 80 °C	[N/mm ²]	950
Tensile strength	DIN 53455	At 25 °C	[N/mm ²]	20
Coefficient of linear thermal expansion		30 – 80 °C	[1/K]	125 x 10 ⁻⁶
		80 – 200 °C	[1/K]	180 x 10 ⁻⁶
Thermal conductivity	DIN 52612	At 50 °C	[W/(m·K)]	0.2
Specific heat		0 – 100 °C	[J/g·K]	1.45
Vertical flammability test (conformity to the fire safety requirements defined in UL 94)				V 0
Temperature index (see charts on previous page)	IEC 60216-1		[°C]	239
Electrical Properties				
Dielectric constant ϵ_r (50 Hz – 1 MHz)	IEC 60250	At 23 °C		2.5 – 2.6
Dielectric dissipation factor tan δ	IEC 60250	At 23 °C		10 x 10 ⁻⁴
				12 x 10 ⁻³
Volume resistivity ρ	IEC 60093	At 23 °C	[Ohm·cm]	1.8 x 10 ¹⁷
Surface resistance σ	IEC 60093	At 23 °C	[Ohm]	3.3 x 10 ¹⁵
Dielectric strength (50 Hz),	IEC 60243-1	At 23 °C		27
				82
Tracking resistance	IEC 60587	At 23 °C	[kV]	2.5

These figures are intended as a guide and should not be used in preparing specifications.

Powerful machines
require powerful protection:



Kindly provided by ABB.



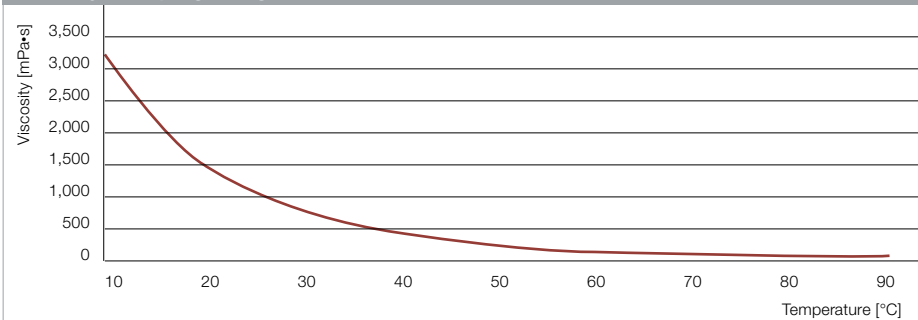
DEVELOPED FOR WINDING IMPREGNATION



Kindly provided by ABB.

Silicone resin SILRES® H62 C was developed for the vacuum pressure impregnation (VPI) of traction motor coils, though it is equally applicable for trickle and dip-impregnation of any wire-wound electrical component with insulation classes H and C. The VPI process, using solvent-free thermally curing impregnation resins, is the most efficient technology for the insulation of electric motors. The four steps involved in the process are illustrated on the opposite page.

Viscosity of Impregnating Resin SILRES® H62 C



Indication of Shelf Life¹ of Impregnation Resin SILRES® H62 C at Various Temperatures

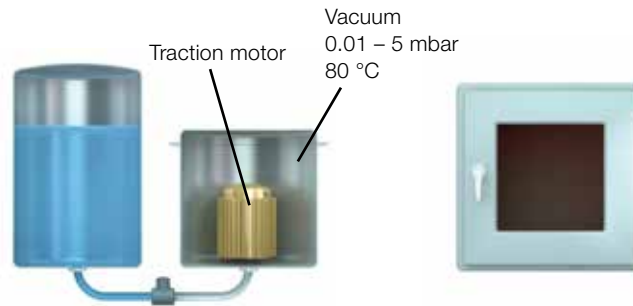
	Temperature
1 – 2 weeks (guide figure) (guaranteed shelf life: 5 days)	80 °C
2 – 3 weeks (guide figure)	70 °C
7 – 8 weeks (guide figure)	60 °C
15 – 20 weeks (guide figure)	50 °C
6 months (guaranteed shelf life)	23 °C

¹ A viscosity increase of up to double the initial value is permissible.

Vacuum Pressure Impregnation Process

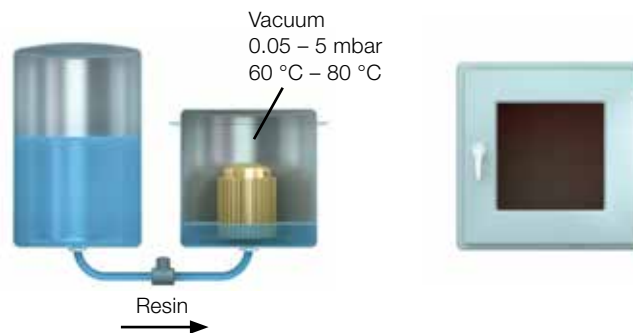
1. Vacuum Phase

The stator (or rotor) is dried under reduced pressure.



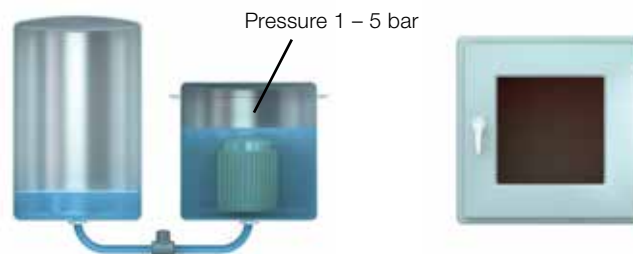
2. Impregnating Phase

The resin, heated to approximately 60 °C, is introduced under vacuum (0.5 – 5 mbar) from the storage tank into the inserts of the impregnation autoclave. The shape of the inserts should correspond as closely as possible to that of the rotor or stator. To facilitate impregnation, the viscosity can be reduced by heating the resin to a maximum of 80 °C (see graph opposite). The shelf life of the impregnating resin at various temperatures is of particular interest (see table on opposite page). In our experience, a resin temperature of 60 °C during impregnation will yield good results.



3. Pressure Phase

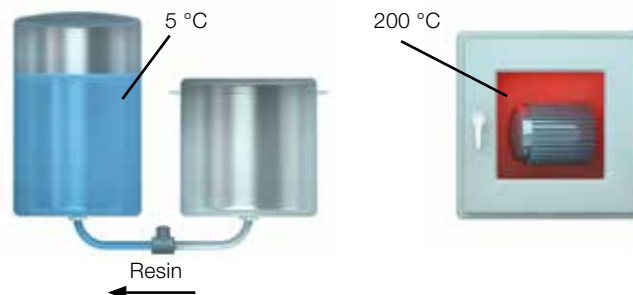
Impregnation is optimized by applying a pressure of 1 – 5 bar. The impregnation rate can be monitored by means of capacitance measurements.



4. Curing

The motor is transferred to the curing oven, in which it is cured under rotation at 170 – 200 °C.

Until the next impregnation cycle, and in particular for idle times, we recommend keeping the resin at 5 °C in its storage container.



SILRES® H62 C CURES TACK-FREE EVEN IN CONTACT WITH AIR

By virtue of its curing mechanism, WACKER impregnating resin SILRES® H62 C will even cure to a tack-free film in air. The reaction is not inhibited by oxygen, which in the case of free-radical polymerization would result in a tacky surface.

However, contamination with catalyst poisons such as tin, lead, nitrogen and sulfur compounds must be avoided. Under certain conditions the reaction can also be inhibited by zinc naphthenate, which is used as a catalyst in some kinds of glass-mica tape with epoxy-resin binders.

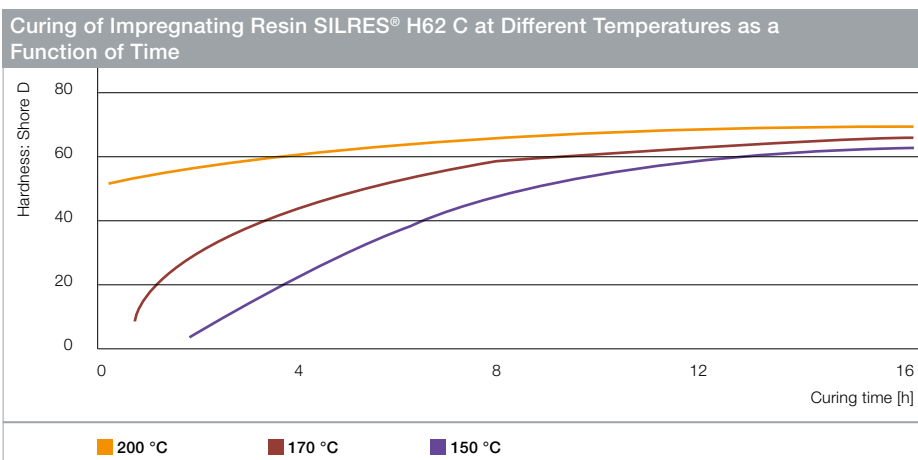
While the resin is being heated up to curing temperature, its viscosity initially decreases. To minimize losses due to dripping, we recommend rotating the motor during the curing stage. As a

guide, the table below shows the gel time – determined according to DIN 16 945 with GELNORM® geltimers made by Gel Instrumente AG – for SILRES® H62 C at different temperatures.

The resin is fully cured when the hardness level exceeds 60 – 70 Shore D. Since it can take a long time to heat the machines to curing temperature, we recommend leaving traction motors in the curing oven for 16 hours at 200 °C.

Gel Time for Impregnating Resin SILRES® H62 C at Different Temperatures

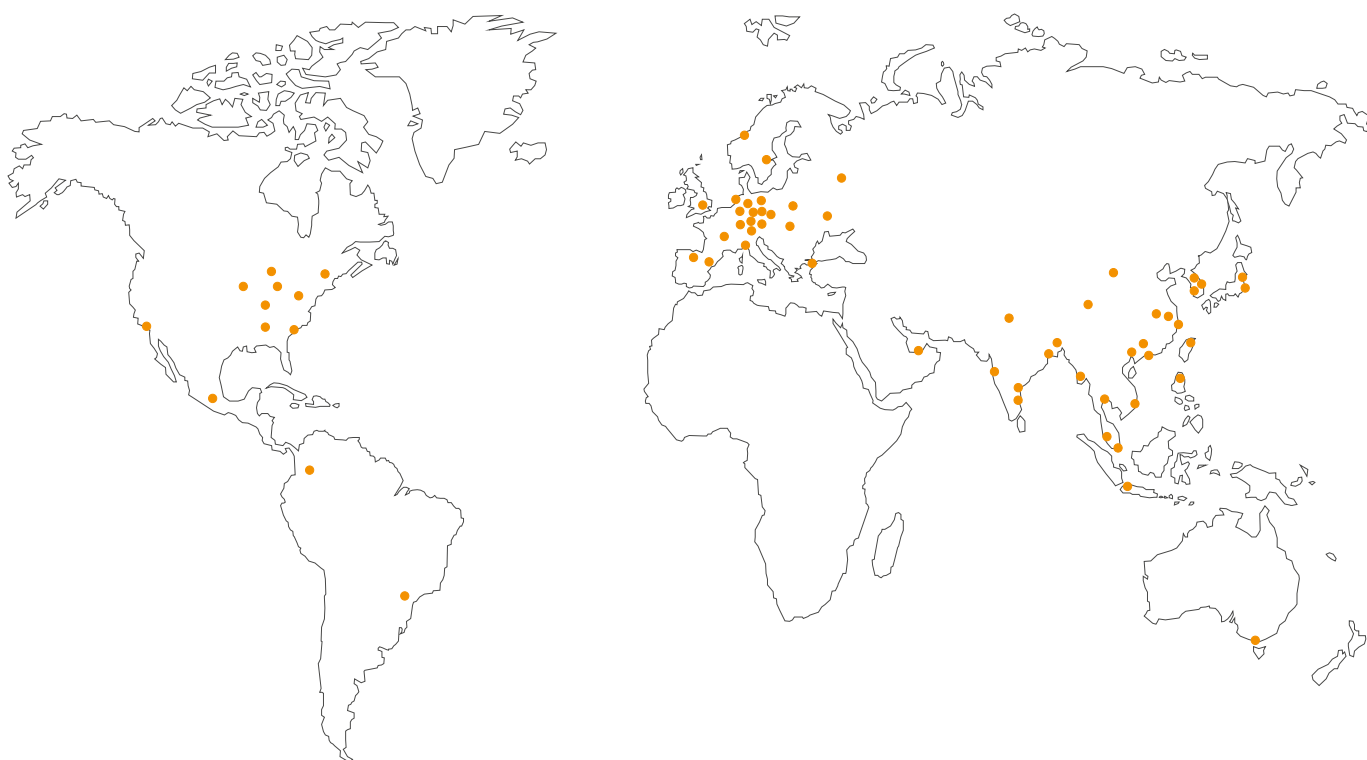
Temperature	[°C]	220	200	180	160	140
Gel time	[min]	15	26	45	100	300



Electric motors are an ingenious, modern-day, energy-saving technology. For reliable drive power, the sensitive system components require effective protection against moisture, dirt and temperature fluctuations.



EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS



• Sales offices and production sites, plus 21 technical centers, ensure you a local presence worldwide.

WACKER is one of the world's leading and most research-intensive chemical companies, with total sales of €4.92 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bioengineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on

energy efficiency and protection of the climate and environment. Spanning the globe with 4 business divisions, we offer our customers highly-specialized products and comprehensive service via 23 production sites, 21 technical competence centers, 13 WACKER ACADEMY training centers and 50 sales offices in Europe, North and South America, and Asia – including a presence in China. With a workforce of some 13,800, we see ourselves as a reliable innovation partner that develops trailblazing solutions for,



and in collaboration with, our customers. We also help them boost their own success. Our technical centers employ local specialists who assist customers worldwide in the development of products tailored to regional demands, supporting them during every stage of their complex production processes, if required. WACKER e-solutions are online services provided via our customer portal and as integrated process solutions. Our customers and business partners thus benefit from comprehensive information and

reliable service to enable projects and orders to be handled fast, reliably and highly efficiently.

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7028e/04_18 replaces 7028e/01_14

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