

WACKER

CREATING TOMORROW'S SOLUTIONS

SEMICOSIL®

WACKER SilGel®

ELASTOSIL®

SOLUTIONS FOR THE
SEMICONDUCTOR AND POWER
ELECTRONICS INDUSTRIES

WACKER SILICONES –
WHERE RELIABILITY MEETS
PERFORMANCE





Whether in a wind power generator or an electric car, power semiconductors need to work under extreme conditions. WACKER silicone encapsulants and adhesives are used to protect against corrosion, thereby ensuring long-term, reliable operation.

For over forty years now, WACKER has been conducting continuous research on new silicone products. Whereas the focus used to be on formulations, today production efficiency and environmental protection are growing in prominence.

In response to rising operating temperatures in power modules, WACKER has developed high-temperature-resistant silicone gels that can guarantee safe operation even at temperatures exceeding 200° Celsius. Another recent innovation

is UV-curing silicones. Because they cure rapidly, UV-curing silicones shorten production time and reduce energy costs.

But at WACKER, the stream of innovation does not stop at process technology. Sophisticated production processes are crucial to the reliable quality of WACKER silicones. In addition to state-of-the-art technologies, our quality management sets a good example throughout the world. Every batch is subjected to rigorous tests and controls. Accustomed to delivery after delivery of consistent product quality, the leading semiconductor companies have learned to rely on WACKER.

Global Production – Local Customer Support

The silicones that WACKER makes at its various production sites worldwide meet identical quality standards.

What's more, we have set up technical centers across the globe to offer all manner of support for product selection, manufacturing, and end-product specification. For more information, visit: www.wacker.com



SEMICOSIL® high-purity silicone encapsulant

EXCEPTIONAL PURITY FOR PRODUCTS WITH LONG-TERM RELIABILITY

WACKER's SEMICOSIL® range of silicone encapsulants have extremely high chemical purity and very low ion content.

Where others give up, WACKER opens up a whole new dimension for you – in the chemical purity of semiconductor encapsulants. Whereas our WACKER SilGel® and general purpose ELASTOSIL® already have a very low level of impurities such as

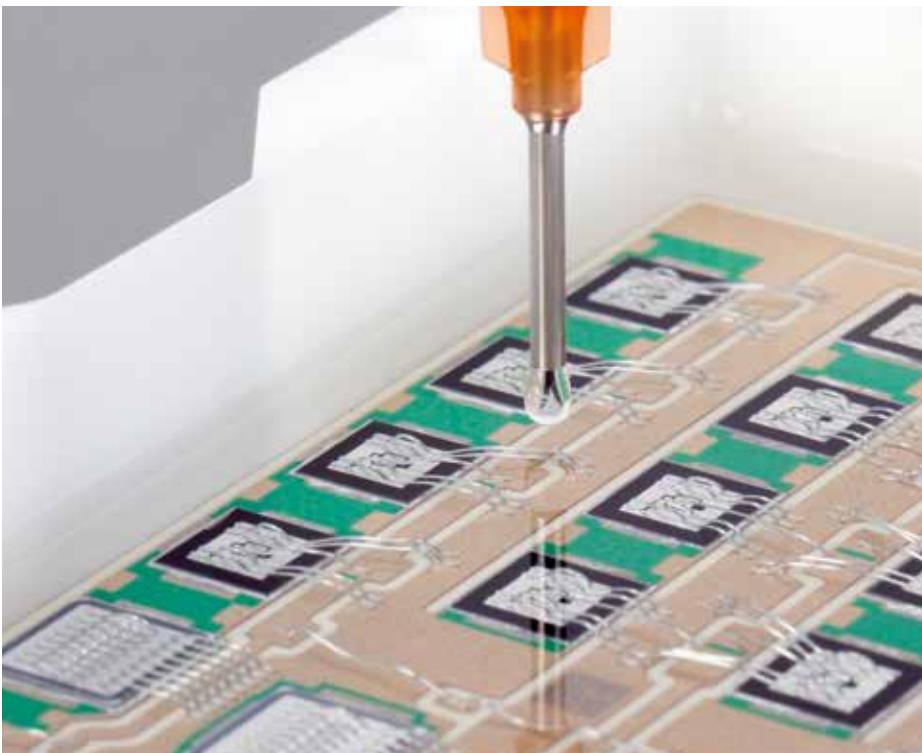
metal ions or halides, WACKER SEMICOSIL® is several times purer yet.

This can only be achieved when the starting materials have been specially purified. In addition, we perform rigorous quality controls. All our silicone gels must undergo the standardized pressure cooker test. This ensures that our silicone products are of the highest quality – and that power modules operate with maximum reliability.

The table below shows typical results achieved with SEMICOSIL® cured silicone products and WACKER SilGel® products, our standard encapsulants for the electronics industry.

Ion Content as per Pressure-Cooker-Test QSCA005						
Ion	Application	Sodium [ppm]	Potassium [ppm]	Chloride [ppm]	Bromide [ppm]	Iodide [ppm]
WACKER SilGel® 612	Encapsulation	< 10	< 10	< 10	< 10	< 10
WACKER SilGel® 613	Encapsulation	< 10	< 10	< 10	< 10	< 10
SEMICOSIL® 912	Encapsulation	< 2	< 2	< 2	< 2	< 2
SEMICOSIL® 914	Encapsulation	< 2	< 2	< 2	< 2	< 2
SEMICOSIL® 915 HT	Encapsulation	< 2	< 2	< 2	< 2	< 2
SEMICOSIL® 920 LT	Encapsulation	< 2	< 2	< 2	< 2	< 2
SEMICOSIL® 987 GR	Frame bonding	< 2	< 2	< 2	< 2	< 2
SEMICOSIL® 971 TC	Heat transfer	< 1	< 1	< 1	< 1	< 1
WACKER Silicone Paste P12	Heat transfer	< 10	< 10	< 10	< 10	< 10

HIGH DIELECTRIC STRENGTH AND UNSURPASSED INSULATING PROPERTIES



Encapsulation of a power module with WACKER SilGel® 612

Thanks to their high chemical purity and minimum water absorption, WACKER silicone gels feature high dielectric strength and insulation resistance.

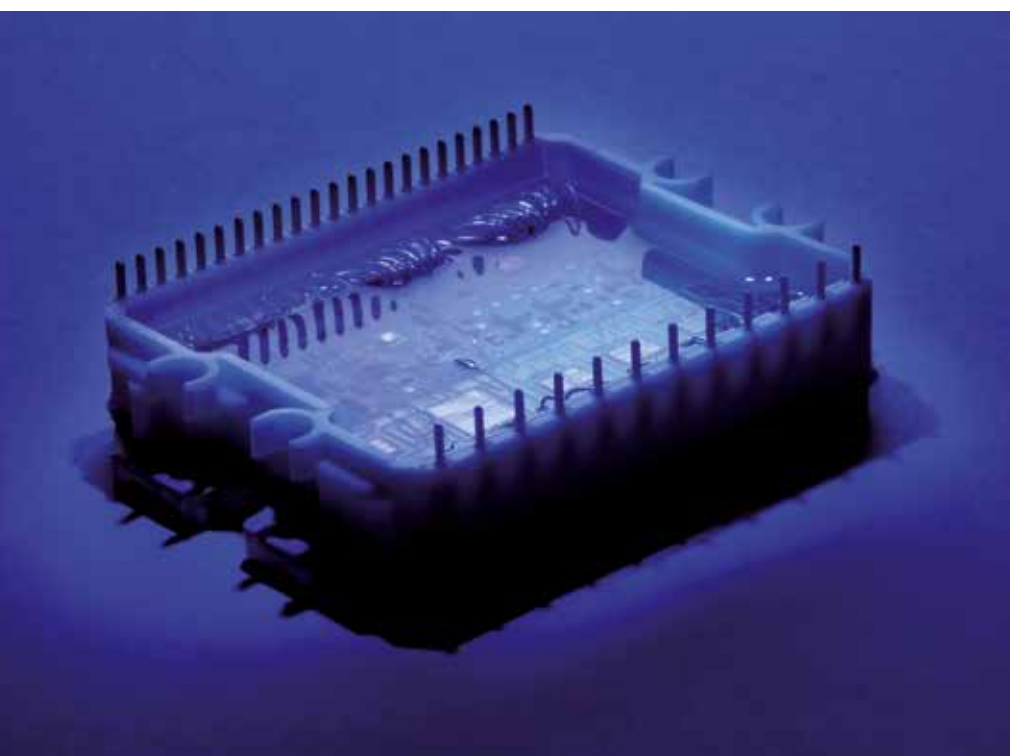
Modern power modules operate at over 6,000 volts. As a result, the quality of the encapsulant also plays a significant role in the design of new power semiconductors. Its electrical resistance determines whether or not the module operates smoothly.

SEMICOSIL® cured silicone products and WACKER SilGel® satisfy the highest chemical purity standards, and they absorb only a minimum amount of water. This ensures that your power modules have high dielectric strength and insulation resistance. Thus, not only are the insulating properties of power semiconductors secured over the long term, they can even increase.

Electrical Properties

Silicone product	Dielectric strength [kV/mm]	Volume resistivity [Ωcm] IEC 60093	Dielectric constant 50 Hz [εr] DIN VDE0303	Tracking resistance CTI IEC 60587
WACKER SilGel® 612	> 23	10 ¹⁵	2.8	> 600
WACKER SilGel® 613	> 23	10 ¹⁵	2.8	> 600
SEMICOSIL® 912	> 23	10 ¹⁵	2.8	> 600
SEMICOSIL® 914	> 23	10 ¹⁵	2.8	> 600
SEMICOSIL® 915 HT	> 30	10 ¹⁵	2.8	> 600
SEMICOSIL® 920 LT	> 23	10 ¹⁵	2.8	> 600
SEMICOSIL® 987 GR	> 45	10 ¹⁴	2.8	> 600
SEMICOSIL® 971 TC	10	10 ¹⁴	6.1	> 600
WACKER Silicone Paste P12	10	10 ¹³	–	> 600

CONSISTENTLY RELIABLE OPERATIONS FROM -120° TO +210° CELSIUS



Power module encapsulated with SEMICOSIL® 912

The trend in power semiconductors is toward higher operating temperatures – +200 °C and higher is no longer the exception. While conventional encapsulants are pressed to their limits, WACKER high-temperature silicone gels easily withstand extreme conditions such as these.

The new generation of WACKER cured silicone products have outstanding heat resistance. SEMICOSIL®, in particular, retains its thermal stability over long periods of time. As a result, the electrical and mechanical properties of the encapsulant remain as good as they were on day one – even after many years of electrical and thermal loading cycles.

SEMICOSIL® 915 HT, for example, remains heat stable at operating temperatures of 210 °C. At the opposite end of the spectrum, SEMICOSIL® 920 LT has proven its effectiveness. This encapsulant stays flexible at temperatures as low as -120 °C.

Thermal Properties						
Silicone product	Elastic modulus [kPa]			Weight loss [wt.%]		
	0 h	180 °C 1,000 h	210 °C 1,000 h	100 °C 1,000 h	180 °C 1,000 h	210 °C 1,000 h
WACKER SilGel® 612	10	10	> 2,000	0.3	2.5	6.5
SEMICOSIL® 912	15	15	> 2,000	0.3	2	5.5
SEMICOSIL® 915 HT	100	103	105	0.3	1.5	4
SEMICOSIL® 920 LT	20	22	30	0.3	1.5	3.5

A UV rheometer is used to determine the process parameters of SEMICOSIL® 912 containing ELASTOSIL® CAT UV.

THERMAL OR UV CURING – THE DECISION IS YOURS

Only WACKER offers so much flexibility: with our batch-kit system, you choose whether your silicones cure by means of heat or UV light.

The batch-kit system we developed at WACKER is unique in offering a choice of curing mechanisms. For each catalyst component, the curing parameters necessary for your process can be set as desired. The material properties remain constant after curing is complete.

ELASTOSIL® CAT PT will let you achieve longer pot lives with moderately fast curing. The more reactive ELASTOSIL® CAT PT-F will allow you to realize significantly shorter cycle times.

Another option is to activate the curing process with UV radiation. Together with UV-activated ELASTOSIL® CAT UV, the material cures very quickly. At the same time, you can have very long pot lives. In light of the ever larger quantities to be produced, UV curing is an effective way to accelerate manufacturing processes.

Process Parameters of Silicone Batch-Kit Components

Silicone product	Pot life [min]			Curing time [min]		
	10:1 with ELASTOSIL® CAT			10:1 with ELASTOSIL® CAT		
	CAT PT [min] 25 °C	CAT PT-F [min] 25 °C	CAT UV [h] 25 °C	CAT PT [min] 100 °C	CAT PT-F [min] 100 °C	CAT UV [min] 25 °C
WACKER SilGel® 613	120	5	> 72	10	2	< 2 min
SEMICOSIL® 912	120	5	> 72	15	5	< 2 min
SEMICOSIL® 914	120	5	> 72	15	5	< 2 min
SEMICOSIL® 915 HT	180	15	> 72	30	10	< 3 min



A look inside a mixer during the production of SEMICOSIL® or WACKER SilGel®

TAILOR-MADE FOR YOUR ELECTRICAL APPLICATIONS

At WACKER, customer service is one of our primary concerns. Our process engineers will be happy to advise you as to which solution best suits your needs. To do that, our top priority is to combine maximal reliability with cost efficiency.

Our specialists have many years of experience with silicone technology for the semiconductor industry. Tell us what your needs are and we will provide you with the silicone that will enable your products to operate dependably for a long time. All the while, we take into account the process engineering to be deployed as well as economic feasibility.

If you prefer a specialized solution, you can count on our full support. In our technical competence centers, we develop customized silicone products and

evaluate them to see which solution will provide the best results for your process. Furthermore, we will assist you in making your product market compatible. That may require us to tailor your product specifications to local markets and to test them under conditions typical for the area in which it is to be applied. We have twenty technical competence centers around the world – including the United States and China – ready to serve you.

PRODUCT DATA:

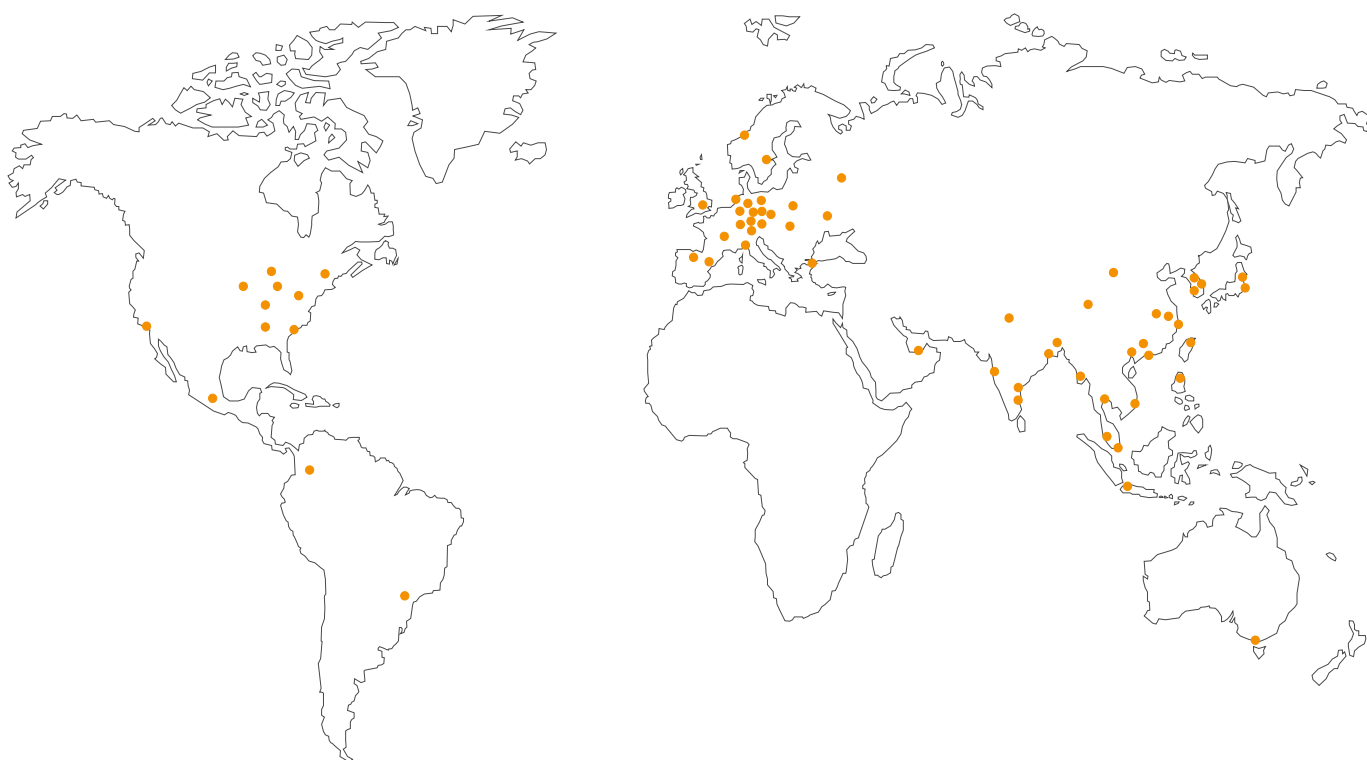
SILICONES FOR PROTECTING POWER ELECTRONICS

The following table shows you WACKER's portfolio of solutions for protecting power semiconductors. Our silicone experts would be glad to provide you with additional technical details. Just contact us.

Cured Silicone Products for Power Electronics					
Silicone product	Application	Operating temperature	Viscosity	Viscosity [mPas]	Blending ratio
WACKER SilGel® 612	Standard encapsulant	-50 °C to +180 °C	Low viscosity	1,000	1:1
WACKER SilGel® 613	Standard encapsulant	-50 °C to +180 °C	Low viscosity	200	10:1
SEMICOSIL® 912	Standard encapsulant	-50 °C to +180 °C	Low viscosity	1,000	10:1
SEMICOSIL® 914	Standard encapsulant	-50 °C to +180 °C	Thixotropic	55,000	10:1
SEMICOSIL® 915 HT	High heat resistant encapsulant	-50 °C to +210 °C	Low viscosity	1,000	10:1
SEMICOSIL® 920 LT	Low temp., flexible encapsulant	-120 °C to +190 °C	Low viscosity	450	1:1
SEMICOSIL® 987 GR	Frame bonding / adhesive	-50 °C to +180 °C	Pasty	400,000	1 part
SEMICOSIL® 971 TC	Heat transfer / adhesive	-50 °C to +180 °C	Pasty	300,000	1 part
WACKER Silicone Paste P12	Heat transfer	-50 °C to +180 °C	Pasty	1 Mio.	1 part

Silicone product	Hardness	Hardness	CTE linear	Density	Thermal conductivity
	Penetration [mm/10]	Shore A	[m/mK]	[g/cm ³]	[W/mK]
WACKER SilGel® 612	70	–	3 x 10 ⁻⁴	0.97	0.2
WACKER SilGel® 613	70	–	3 x 10 ⁻⁴	0.97	0.2
SEMICOSIL® 912	70	–	3 x 10 ⁻⁴	0.97	0.2
SEMICOSIL® 914	70	–	3 x 10 ⁻⁴	0.99	0.2
SEMICOSIL® 915 HT	20	–	3 x 10 ⁻⁴	0.97	0.2
SEMICOSIL® 920 LT	70	–	3 x 10 ⁻⁴	0.98	0.2
SEMICOSIL® 987 GR	–	55	2.5 x 10 ⁻⁴	1.10	0.2
SEMICOSIL® 971 TC	–	75	1.0 x 10 ⁻⁴	2.75	2.0
WACKER Silicone Paste P12	Pasty	–	1.5 x 10 ⁻⁴	2.25	0.8

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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