

WACKER


CREATING TOMORROW'S SOLUTIONS

SEMICOSIL®

WACKER SiIGel®

ELASTOSIL®

SILICONE GEL SOLUTIONS



Research, Improve, Research.

We have been researching silicones since 1947. The development of novel silicones is linked to the WACKER name around the world. As an internationally active company, we produce silicones for almost every application and sector. This includes many well-known car, semiconductor and PV manufactures. Hence, we know the requirements of these industries – including the worldwide cost pressure. We are continuously researching new solutions, so you can face this competition successfully.

SILICONE GEL

A SOFT MATERIAL FOR HARD DEMANDS

With WACKER silicone gels, you can protect sensitive components against external influences. Silicone gels are water-repellent, have high electric strength and dampen mechanical vibrations excellently.

Silicone gels' special feature is their extraordinary flexibility. In a silicone gel, the individual polymer molecules are interconnected to form a loosely crosslinked network. In this way, the silicone chains are able to yield whenever they encounter a hard surface.

Since silicone gels are so resilient, they can absorb thermomechanical stress better than any other materials. That's why they are ideal for the encapsulation of material systems such as electronic assemblies and solar cells. Thanks to their outstanding electrical properties, they prevent leakage currents and flashovers. Another interesting characteristic of silicone gels is their excellent temperature tolerance. Whether -50 °C or +200 °C – their physical and technical properties remain unchanged, even after several thousand hours in service. In short, most WACKER silicone gels are probably more durable than the devices or assemblies that they encapsulate.

Global Production – Local Customer Support

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



Soft and deformable: silicone gels feature the lowest modulus of elasticity of all available materials. This allows them to withstand mechanical pressure and thermal stress particularly well. The images illustrates the measurement of penetration depth. For very soft silicone gels, this is typically between 50 and 70 mm/10.

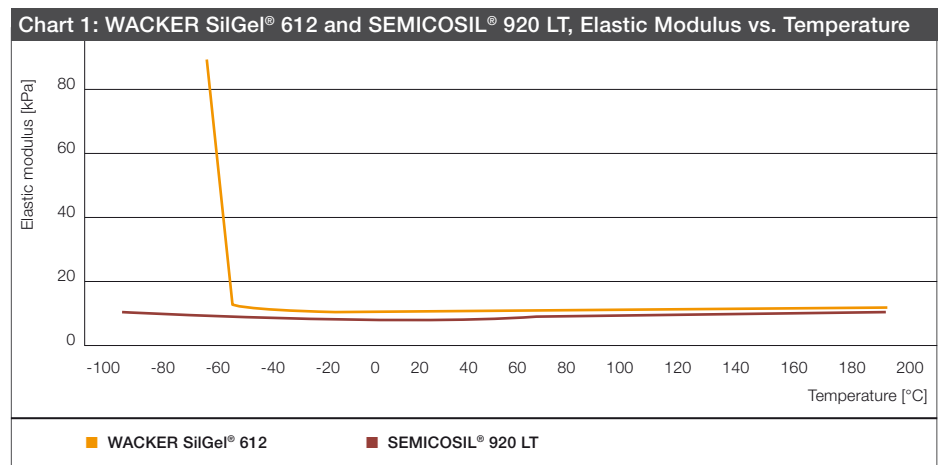
UNIQUE IN FLEXIBILITY AND PURITY

WACKER silicone gels permanently cushion thermomechanical stress. Their purity ensures durable electrical functionality and provides protection against corrosion.

Exceptional in their Resilience

Whether computer or solar module, modern industrial commodities consist of numerous materials with different coefficients of thermal expansion (CTEs). For the materials to bond together permanently, they require a substance with high elasticity, because thermomechanical stress should not be transferred to adjoining components. Silicone gels are ideal for this.

Another advantage of silicone gels is that, due to their chemical structure, they are extremely temperature-stable. Standard silicone gels remain flexible at temperatures ranging from -50 °C to +200 °C. Low-temperature silicone gels even retain their elasticity down to -100 °C (see Chart 1).

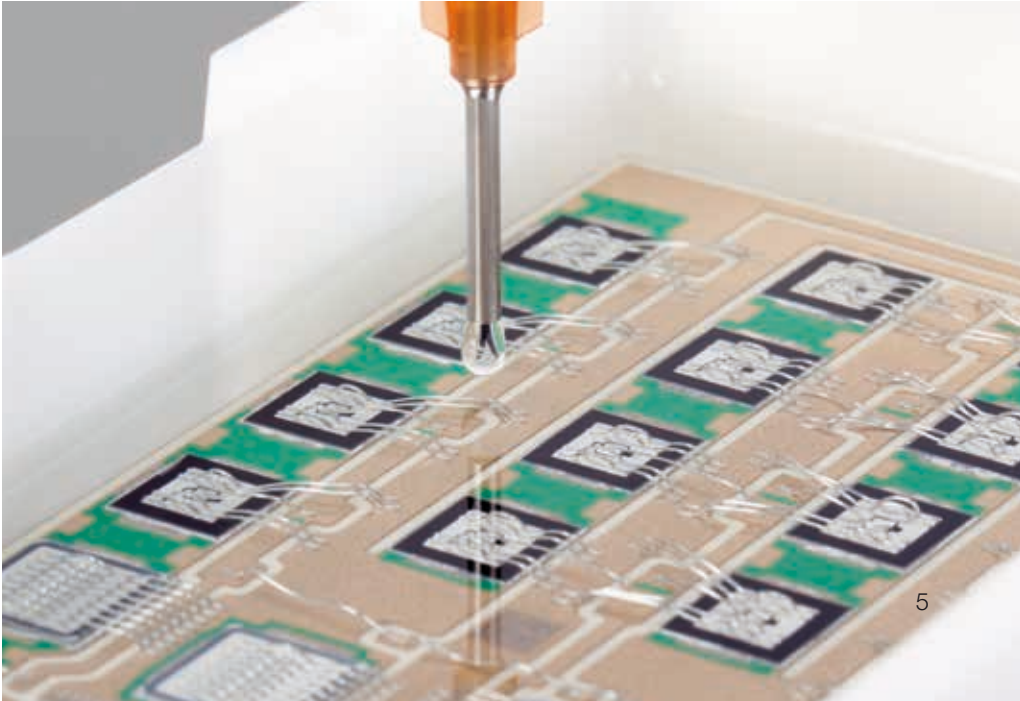
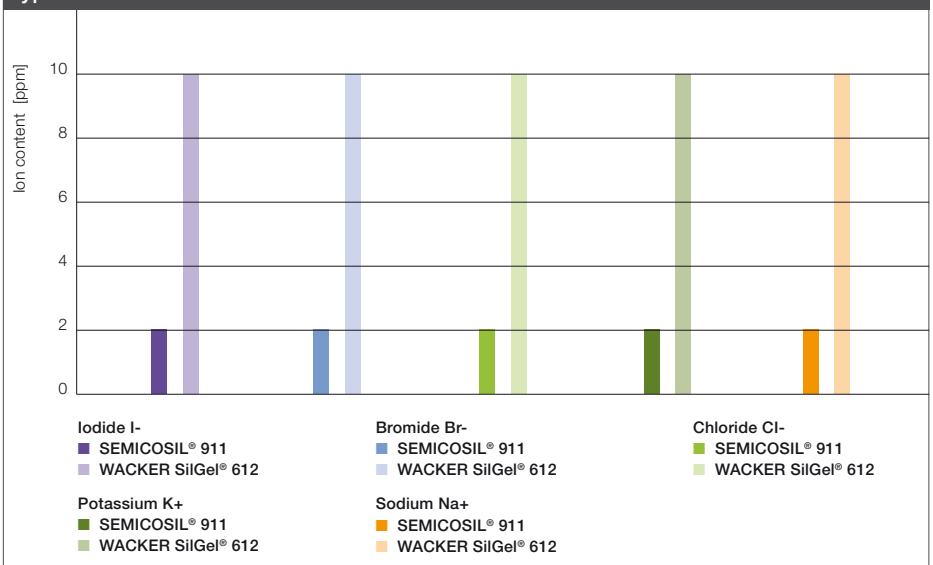


High Chemical Purity Guaranteed

Based on how they are produced, silicone gels from WACKER are highly pure. The low amount of ionic impurities also increases the operational reliability of your products. For example, WACKER SilGel® silicone gels, which are often used in the electrical industry. At a maximum of 10 ppm, they only contain traces of impurities such as metal ions or halides (see Chart 2).

SEMICOSIL® silicone gels are a lot purer still. They are already produced from purified raw materials. In addition, they undergo a regular, standardized quality test: the pressure cooker test. As depicted in Chart 2, we thus achieve typical ion contents of less than 2 ppm.

Chart 2: Ion Content of SEMICOSIL® 911, Specified Data vs. WACKER SilGel® 612, Typical Data



WACKER silicone gels open up a new dimension of chemical purity for the encapsulation of semi-conductors. This makes for high operational safety.



High electrical strength: in the transmission and distribution industry, silicone gels can be used to encapsulate cable accessories, for example.

OUTSTANDING ELECTRICAL PROPERTIES AND HEAT STABILITY

Ever more powerful devices are raising the demands on dielectric strength, insulation resistance and tracking resistance. With silicone gels from WACKER, you can stay on the growth path.

Outstanding Electrical Parameters

With a silicone gel from WACKER, you have a material with outstanding electrical parameters. The reason for this is silicone gels' high chemical purity and very low water uptake. In addition, silicones are exceptionally aging resistant due to their chemical structure. As a result, they maintain their specific electrical properties for a long time.

Resistant to Heat and Cold

Faster, higher, hotter – miniaturization and growing functionality increase the heat that electric and electronic assemblies give off. At the same time, the products must function flawlessly under extremely cold conditions, too.

WACKER's standard silicone gels retain their favorable electrical and mechanical properties over a temperature range of -50 °C to +180 °C – even after several thousand operating hours. Strong radiation, ozone gas and high atmospheric humidity also only alter the silicone gels' properties very slightly. Furthermore, there are specialty silicone gels with low-temperature flexibility and high-temperature stability for extreme environments.

Chart 3: WACKER SilGel® 612, Dielectric Constant

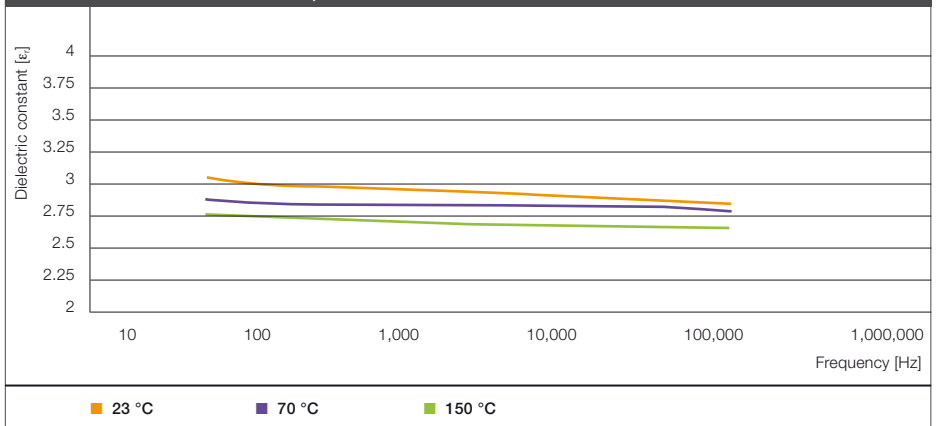
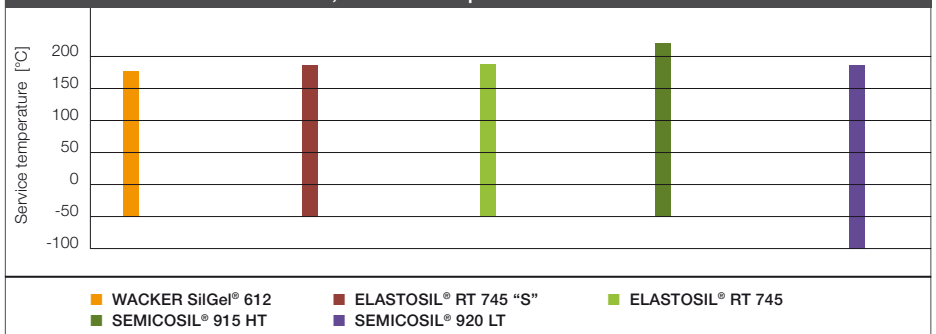
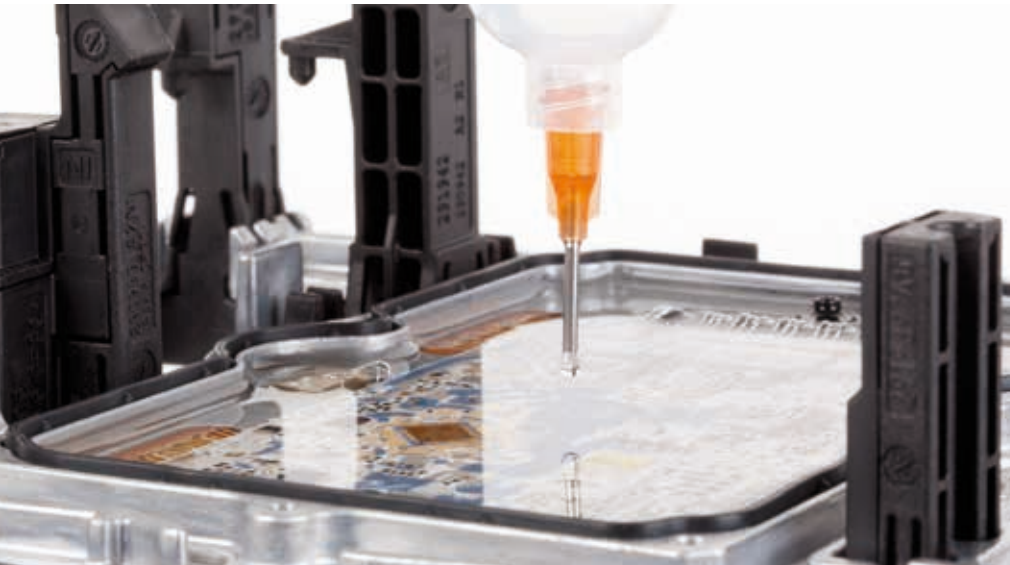


Chart 4: WACKER Silicone Gels, Service Temperature



STANDARD SILICONE GELS – EVEN THE STANDARD GRADES ARE OF THE HIGHEST QUALITY



Protection against vibrations and corrosion: the amount of electronic components in cars is constantly increasing. Encapsulation makes control systems resistant to everything that impacts on vehicles: vibrations, temperature fluctuations and moisture. Image: encapsulation of an automotive electronic controller with WACKER SilGel® 612.

WACKER's Standard Silicone Gels – Product Details

Silicone Product	Type	Characteristics	Viscosity of Mix [mPa.s]	
WACKER SilGel® 612	2-part, 1:1 mix, long pot life	Very soft, clear, low bleed, general purpose	Low viscosity	1,000
WACKER SilGel® 612 EH	2-part, 1:1 mix, short pot life	Soft, fast cure, low bleed, inhibition robust	Low viscosity	1,000
WACKER SilGel® 613	2-part, 10:1 mix, heat or UV curing	Very soft, clear, general purpose	Very low viscosity	180
WACKER SilGel® 616	2-part, 1:1 mix, long pot life	Very soft, clear blue, best self-healing	Very low viscosity	250
SEMICOSIL® 911	2-part, 1:1 mix, long pot life	Very soft, low bleed, ion cont. spec	Thixotropic	8,000
SEMICOSIL® 912	2-part, 10:1 mix, heat or UV curing	Very soft, clear, low bleed	Low viscosity	1,000
SEMICOSIL® 914	2-part, 10:1 mix, heat or UV curing	Very soft, clear, low bleed	Thixotropic	42,000
SEMICOSIL® 917	2-part, 10:1 mix, heat or UV curing	Soft, UV tracer, low bleed	Thixotropic	11,000

WACKER's standard silicone gels have high inherent tack and self-healing properties. They dampen mechanical and thermal stress in an exemplary manner.

Excellent Inherent Tack

WACKER silicone gels really display their strength when it comes to difficult-to-bond surfaces. Thanks to their good inherent tack, they form firm and durable bonds to virtually all standard materials.

Self-Healing Effect

Thanks to their good self-healing properties, you can touch up and repair WACKER silicone gels without pretreatment by applying more of the liquid silicone gel to the already cured gel surface.

Silicone Gels for Diverse Applications

WACKER's standard silicone gels differ in viscosity, processing and curing speeds, transparency and color. As shown in the table, the products are available as two-part systems in a mixing ratio of either 1:1 or 10:1. The 10:1 mixtures are so-called modular systems. Find out how you can use these to enhance your process control on page 14.

Key Features of WACKER's Standard Silicone Gels

- Addition-curing systems
- Elastic modulus approx. 5 – 50 kPa
- Penetration approx. 50 – 70 mm/10
- Specific density: 0.97 – 0.99 g/cm³
- Dielectric constant: approx. 2.8 at 1 kHz
- Typical service temperature range: -50 °C to +180 °C
- Thermal conductivity: 0.2 W/mK
- Linear thermal expansion coefficient: approx. 3 x 10⁻⁴ m/mK

Hardness Penetration [mm/10]	Pot Life [min]	Curing Time	Volume Resistivity [Ohm.cm]	Dielectric Strength [kV/mm]
70	150	8 h / 25 °C 15 min / 100 °C	10 ¹⁵	> 23
35	30	90 min / 25 °C 10 min / 70 °C	> 10 ¹⁴	> 23
70	Please refer to page 14, modular system		10 ¹⁵	> 23
70	120	8 h / 25 °C 15 min / 100 °C	–	–
60	70	6 h / 25 °C 5 min / 100 °C	10 ¹⁵	> 30
70	Please refer to page 14, modular system		10 ¹⁵	> 30
70	Please refer to page 14, modular system		10 ¹⁵	–
55	Please refer to page 14, modular system		10 ¹⁵	–

SPECIALTY SILICONE GELS – OPTIMIZED FOR EXTREME DEMANDS

Our standard silicone gels already combine a large number of excellent properties. For our specialty silicone gels, we have additionally enhanced individual parameters, such as temperature resistance.

Designed for Fast Processing

Low-viscosity WACKER SilGel® 619 is easy to apply and flows quickly. Due to its very high reactivity, it cures rapidly. This makes for extremely quick in-line application with large quantities per unit time.

Optimized for Energy Transmission

POWERSIL® silicone gels feature optimized and separately monitored electrical parameters such as dielectric strength and tracking resistance. Their application field is insulators for the transmission and distribution industry that are exposed to weathering for decades.

Ready for Extreme Temperatures

Whether desert or polar circle: at WACKER, you can find silicone gels that retain their properties even at extreme temperatures. For example, low-temperature-flexible SEMICOSIL® 900 LT and SEMICOSIL®

920 LT and high-temperature-resistant SEMICOSIL® 915 HT. After all, vehicles must still function in Alaska at -60 °C, just like power modules must still function at +200 °C service temperature.

Resistant to Aggressive Media

For automotive and aircraft engineering, we have developed silicones that retain their favorable properties even when in contact with fuels or acidic exhaust gases. In the product table, you can find this special fluoro-silicone gel under the tradename SEMICOSIL® 928 F.

WACKER's Specialty Silicone Gels – Product Details

Silicone Product	Type	Characteristics	Viscosity of Mix [mPa.s]	
WACKER SilGel® 619	2-part, 1:1 mix, very short pot life	Very soft, clear yellowish, good flow properties, fast curing at 25 °C	Very low viscosity	200
POWERSIL® Gel	2-part, 1:1 mix, long pot life	Very soft, clear blue, gel dedicated to power transmission	Low viscosity	1,000
POWERSIL® Gel C670	2-part, 10:1 mix, heat or UV curing	Very soft, whitish, density 0.7 g/cm³, compressible	Medium viscosity	4,000
SEMICOSIL® 900 LT	2-part, 1:1 mix, long pot life	Very soft, translucent, low-temp.-flexible, thixotropic, ion cont. spec	Thixotropic	13,000
SEMICOSIL® 920 LT	2-part, 1:1 mix, long pot life	Very soft, clear yellowish, low-temp.-flexible, ion cont. spec	Very low viscosity	420
SEMICOSIL® 915 HT	2-part, 10:1 mix, heat or UV curing	Shore 00 hardness, clear yellowish high-temp.-resistant up to 210 °C	Low viscosity	1,000
SEMICOSIL® 928F	1-part, heat curing	Very soft, beige, fluoro silicone, media resistant	Thixotropic	6,000
SEMICOSIL® 9242	1-part*, heat curing	Soft, low bleed, low volatility UV tracer, ion cont. spec	Thixotropic	20,000

* For SEMICOSIL® 9242, metering and mixing are obsolete due to the one-part formulation. The material can be used directly from the container it is supplied in. Curing is typically either thermally induced in a circulating air oven or in-line in a heating tunnel. Visual and optoelectronic monitoring of the correct application of the silicone can be carried out very neatly in-line via the existing UV tracer.



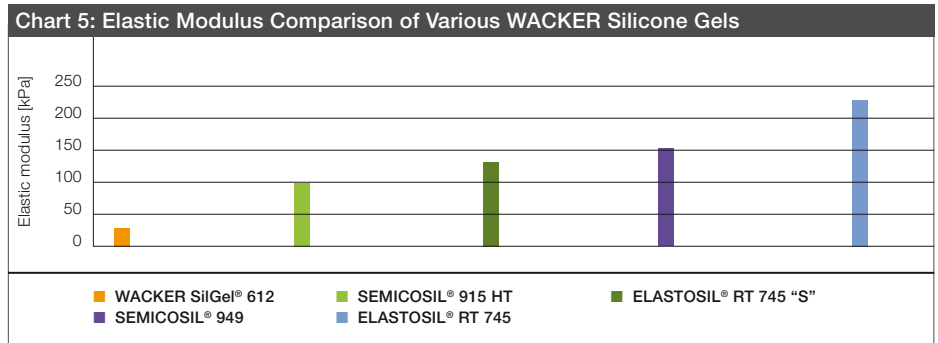
Flexibility at work: WACKER's low-temperature-flexible silicone gels remain soft even at -60 °C.

Hardness Penetration [mm/10]	Pot Life [min]	Curing Time	Volume Resistivity [Ohm.cm]	Dielectric Strength [kV/mm]
60	5	3 h/25 °C 15 min/100 °C	10 ¹⁵	> 23
70	120	24 h/25 °C 15 min/100 °C	> 10 ¹⁴	> 23
50	140	8 h/25 °C 15 min/100 °C	10 ¹⁵	18
70	120	12 h/25 °C 10 min/120 °C	10 ¹⁵	> 23
70	600	30 min/110 °C 10 min/150 °C	10 ¹⁵	> 23
15 Shore 00	Please refer to page 14, modular system		> 10 ¹⁴	> 23
60	–	4 h/100 °C 30 min/150 °C	–	–
50	–	40 min/130 °C 10 min/150 °C	10 ¹⁵	> 23

TOUGH SILICONE GELS – WHEN ADDITIONAL MECHANICAL STABILITY IS REQUIRED

Typical silicone gels cure to form soft products. However, some applications require enhanced mechanical protection. For this, we offer you so-called tough silicone gels with increased hardness.

Soft silicone gels typically have a modulus of elasticity of 5 to 10 kPa. This is too low for applications such as the potting of solar junction boxes. For this purpose, we have developed silicone gels with increased hardness (see table). The measurement parameter is no longer material penetration, but Shore 00 hardness.



WACKER's Tough Silicone Gels – Product Details

Silicone Product	Type	Characteristics	Viscosity of Mix [mPa.s]	
ELASTOSIL® RT 604	2-part, 9:1 mix, long pot life	High hardness, clear	Low viscosity	1,000
ELASTOSIL® RT 745“S”	2-part, 1:1 mix, long pot life	Low hardness, translucent yellowish, primerless bonding, inhibition robust	Low viscosity	1,000
ELASTOSIL® RT 745	2-part, 1:1 mix, long pot life	Medium hardness, translucent yellowish, primerless bonding, inhibition robust	Low viscosity	1,000
SEMICOSIL® 915 HT	2-part, 10:1 mix, heat or UV curing	Shore 00 hardness, clear yellowish, longterm heat resistance up to 210 °C	Low viscosity	1,000
SEMICOSIL® 949	2-part, 10:1 mix, heat or UV curing	Low hardness, transparent, primerless bonding, UV tracer	Very low viscosity	180

Most WACKER silicone gels build up chemical bonds to the materials they are in contact with. Thermal curing is favorable for particularly fast and sufficient bond development.



Potting of photovoltaic junction box with one of WACKER's tough silicone gels.

Hardness	Pot Life [min]	Curing Time	Volume Resistivity [Ohm.cm]	Dielectric Strength [kV/mm]
25 Shore A	90	24 h/25 °C 8 min/100 °C	$> 10^{14}$	> 30
35 Shore 00	240	60 min/80 °C 10 min/120 °C	$> 10^{14}$	> 30
10 Shore A	240	60 min/80 °C 10 min/120 °C	$> 10^{14}$	> 30
15 Shore 00	Please refer to page 14, modular system		$> 10^{14}$	> 23
35 Shore 00	Please refer to page 14, modular system		$> 10^{14}$	> 23

Quality control of UV-curing silicone gels by means of UV rheometry.



MORE FLEXIBILITY THANKS TO WACKER'S MODULAR SYSTEM

You will only experience this much flexibility at WACKER. Thanks to our modular system, you can decide how you want to cure your silicone gels, whether thermally or by UV light.

Power semiconductors are being manufactured in ever higher quantities. To reduce cycle times, encapsulants that cure rapidly are in demand. Our modular system offers you unique flexibility. Depending on the catalyst of choice, you can specify the curing time yourself. For example, a gel time of about 3 hours is achieved with a platinum catalyst at 20 °C

and of approx. 20 minutes in an oven at 120 °C; the gel time is less than 3 minutes at room temperature in the presence of UV radiation and a UV catalyst. The product's end properties remain constant, independent of the curing process.

Process Parameters of Silicone Module Components

Silicone Product	Pot Life [min] 10:1 with ELASTOSIL® CAT			Curing Time [min] 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
SEMICOSIL® 917	120	5	> 72	10	2	< 2 min
SEMICOSIL® 949	120	–	> 72	15	–	< 2 min

ELASTOSIL® CAT PT will let you achieve longer pot lives with moderately fast curing. The significantly more reactive ELASTOSIL® CAT PT-F will allow you to realize shorter cycle times. You can achieve very fast curing with the UV-activated ELASTOSIL® CAT UV, while very long pot lives are possible at the same time.

EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS



WACKER is one of the world's leading and most research-intensive chemical companies, with total sales of €4.91 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered 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 five business divisions, operating 25 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 17,200, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps 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. Visit us anywhere, anytime around the world at:

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