

WACKER

CREATING TOMORROW'S SOLUTIONS

SEMICOSIL®

ELASTOSIL®

SILICONE SOLUTIONS
FOR THERMAL MANAGEMENT



**Research, Improve, Research –
for over Six Decades now**

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 semiconductor manufacturers. Hence, we know the requirements of the semiconductor industry – including the worldwide cost pressure. We are continuously researching new solutions, so you can face this competition successfully. Here, we don't just concentrate on technological innovations, but always consider process engineering and cost-effectiveness, too.

COUPLED TO INNOVATION AND RELIABILITY WORLDWIDE: SILICONES FROM WACKER

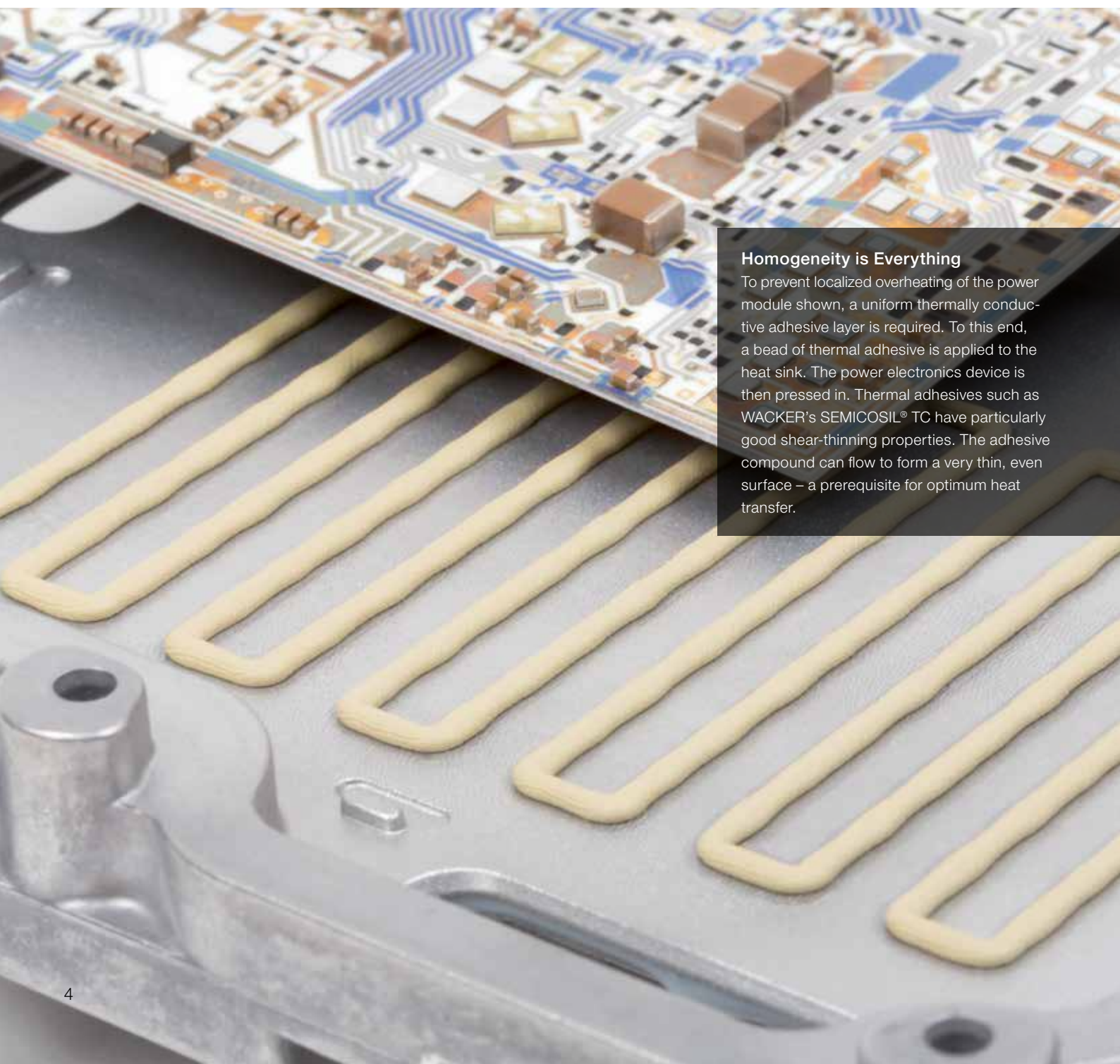
Whether for microcontrollers, power transistors, inductors or electrolytic capacitors – driven by the demand for ever smaller components with even more functions, operating temperatures are rising constantly. Thermal management is thus gaining in importance.

To ensure that the components remain functional even when they get hot, they must be thermally coupled to cooling elements. Here, the challenge is meeting the growing demands with utmost reliability. The search for new solutions is thus one of our primary concerns. In addition, we have established a quality management system that's exemplary in the sector. Every batch is subjected to the same rigorous tests and controls around the world. Accustomed to delivery after delivery of consistent product quality, leading automotive suppliers and electronics companies have learned to rely on WACKER.

Global Production – Local Customer Support

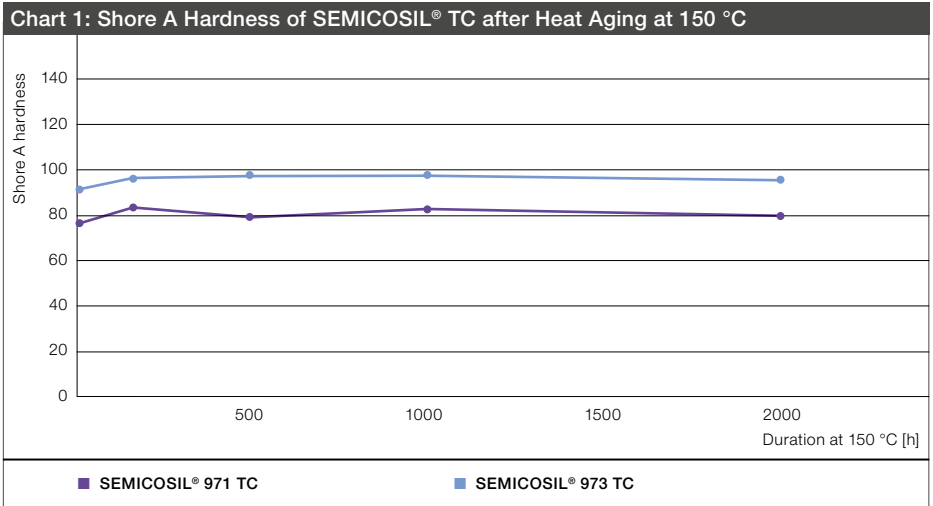
We have set up technical centers across the globe to offer all manner of support for product selection, manufacturing, and end-product specification. For more information, visit www.wacker.com

THERMALLY CONDUCTIVE ADHESIVES: MECHANICALLY AND THERMALLY WELL CONNECTED



Homogeneity is Everything

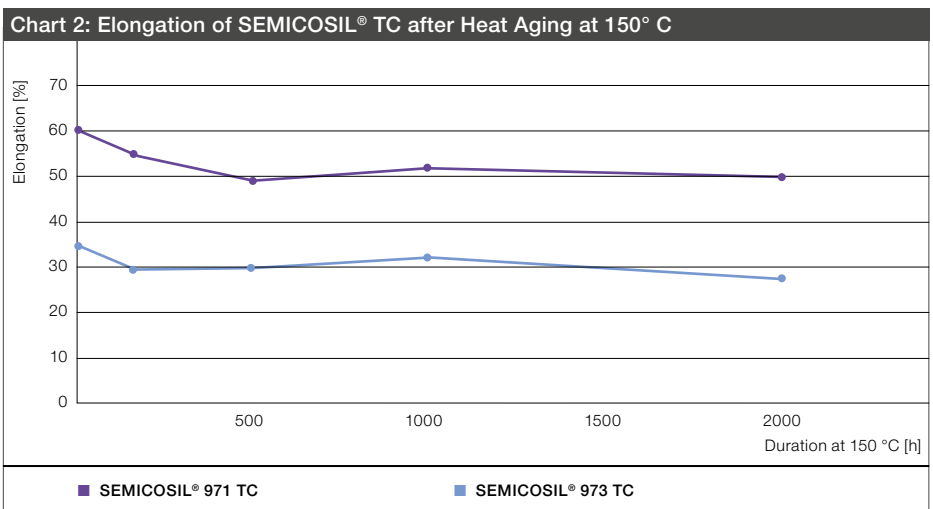
To prevent localized overheating of the power module shown, a uniform thermally conductive adhesive layer is required. To this end, a bead of thermal adhesive is applied to the heat sink. The power electronics device is then pressed in. Thermal adhesives such as WACKER's SEMICOSIL® TC have particularly good shear-thinning properties. The adhesive compound can flow to form a very thin, even surface – a prerequisite for optimum heat transfer.



We have optimized the characteristics of WACKER’s ELASTOSIL® and SEMICOSIL® TC thermal adhesives over the years. They maintain the desired properties even at permanently high temperatures. In addition, they are easy to process.

Modern power semiconductor devices and electronic control units are both subject to the same trend – miniaturization. This is leading to ever higher operating temperatures. Thermally conductive adhesives have a key dual role in this process. On the one hand, they transfer the device’s heat to the heat sink. On the other, they create a firm yet flexible mechanical bond that doesn’t require further fixing. This reduces the manufacturing costs.

Silicone-based thermal adhesives from WACKER exhibit outstanding durability. They remain virtually wear-free under permanent thermal stress. As illustrated in Chart 1, the Shore A hardness remains almost constant even after 2,000 operating hours at 150 °C.



WACKER’s thermal adhesives achieve excellent results in elongation tests, too (Chart 2). Their elongation at break only changes minimally over the long term. The material does not become brittle. What does this mean for you, the manufacturer? You have the assurance that the thermally conductive bond between the device and cooling element remains functional over the long term.

Thermally Conductive Silicone Adhesives						
Product	Thermal Conductivity [W/mK]	Type	Viscosity D = 10 1/s [Pa.s]	Hardness, Shore A	Lap Shear Strength [N/mm²]	Curing min/°C
ELASTOSIL® RT 740	0.5	2 part 10:1	1	55	> 2	30/100
SEMICOSIL® 970 TC	0.8	2 part 1:1	30	65	> 3	30/130
SEMICOSIL® 971 TC	2.0	1 part	100	75	> 2.5	30/125
SEMICOSIL® 9712 TC	2.5	2 part	150	85	> 3	15/85
SEMICOSIL® 973 TC	3.0	1 part	80	90	> 2.5	30/125
SEMICOSIL® 975 TC	4.3	1 part	140	98	> 2.5	30/130



How do you protect sensitive electronics in vehicles against overheating? With thermally conductive pads. Firstly, you apply the thermally conductive SEMICOSIL® TC to the heat sink – an aluminum die-cast housing in this case – in a meandering pattern. Thanks to the material's paste-like and shear-thinning flow properties, an exact dispense pattern can be achieved. Then press the printed circuit board into the heat-transfer material. SEMICOSIL® TC fills every last cavity – even the smallest surface roughness is smoothed out. After a few hours at room temperature, the material sets to form a soft pad.

THERMAL PADS AND PASTES: LOW-STRESS SOLUTIONS FOR THE TOUGHEST OF DEMANDS

Where no structural bond between the cooling element and device is required, thermal pads and pastes efficiently dissipate the heat. Thanks to their soft consistency, they can permanently withstand shocks, vibrations and temperature fluctuations.

Silicone-based thermal pads and pastes from WACKER are used wherever low thermal stress is a requirement, e.g. in automotive electronics. With an application range from -50 to +150 °C and a comparatively low modulus, they are ideal for applications involving extreme environmental conditions. Whether the Spanish sun shines on a hood all day long or temperatures in the Taklamakan Desert drop to minus double digits at night – the thermal and mechanical properties of the thermal pads and pastes remain unchanged.

Similar to thermal adhesives, our thermally conductive silicones for pad production are also applied to the heat sink as a paste. Thanks to their special rheology, under low pressure, they flow to form a thin homogeneous layer, which evens out component tolerances in a stress-free manner. This allows you to achieve optimum heat transfer with ultrathin layer thicknesses.

Another advantage of WACKER's thermally conductive materials for producing pads is that time-consuming heating is made redundant. The materials cure by themselves at room temperature. Four to six hours are sufficient for this. As illustrated in Chart 3, curing starts off comparatively slowly. This widens the processing window during manufacture.

Chart 3: Curing Speed of SEMICOSIL® TC at 23 °C

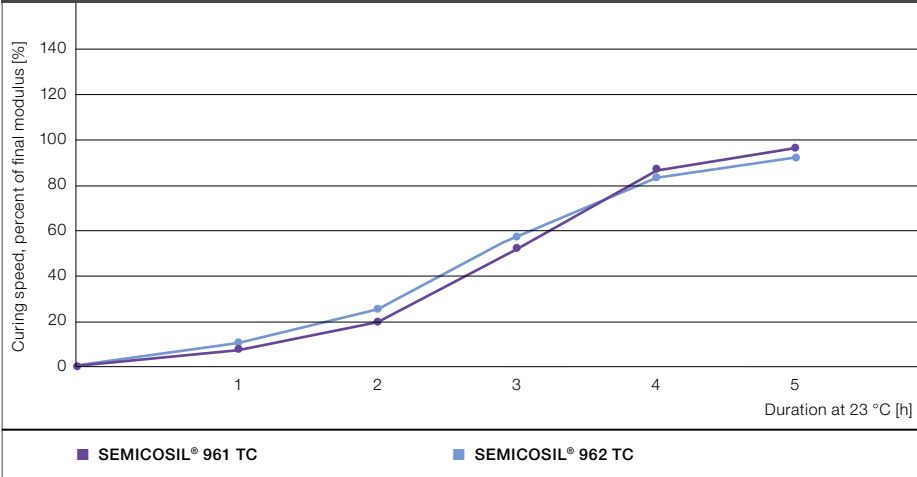
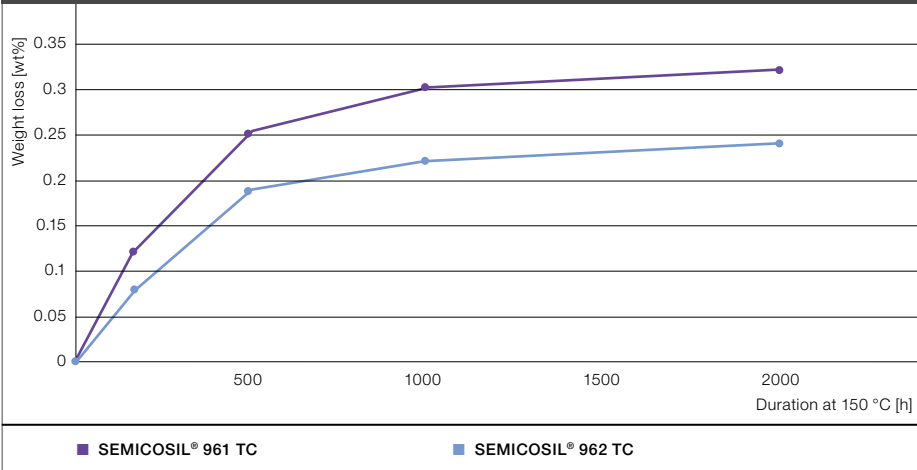


Chart 4: Weight Loss of SEMICOSIL® TC at 150 °C



Thermally Conductive Dispensable Silicone Pads and Pastes

Product	Thermal Conductivity [W/mK]	Type	Viscosity D = 10 1/s [Pa.s]	Hardness, Shore 00	Curing [h] at 23 °C
WACKER Silicone Paste P12	0.8	1 part	Pasty	Not cured	-
SEMICOSIL® Paste P40 TC	4.0	1 part	Pasty	Not cured	-
SEMICOSIL® 961 TC	2.3	2 part 1:1	130	55	4 – 6
SEMICOSIL® 962 TC	3.0	2 part 1:1	150	50	4 – 6
SEMICOSIL® 963 TC	3.0	2 part 1:1	150	Pen 20 mm/10	4 – 6

THERMALLY CONDUCTIVE ENCAPSULANTS: COMPLICATED GEOMETRIES SECURELY EMBEDDED



The image depicts the bonding of a ceramic substrate to a die-cast aluminum housing with SEMICOSIL® 971 TC. The LC module is then encapsulated with ELASTOSIL® RT 743 LV-K.

There is a good reason for the worldwide use of thermally conductive ELASTOSIL® and SEMICOSIL® silicone encapsulants: they efficiently dissipate heat even for complicated shapes. At the same time, they protect key components such as transformers and power semiconductor devices against environmental influences.

WACKER's thermally conductive encapsulants are optimized for bubble-free encapsulation. Despite their high filler content, they exhibit good flow properties with low viscosity. This property mix is achieved thanks to minimal thixotropic or pseudoplastic behavior. This reduces the risk of air bubbles. For optimum results, always fill the components to be encapsulated from the bottom upwards. To eliminate air bubbles entirely, carry out the encapsulation under vacuum.

WACKER's thermally conductive silicone encapsulants are perfect for companies that do not want to expand their process technology – they can be applied via conventional dispensers. However, if you want to process the encapsulants by screen, stencil or pad printing, preliminary tests are necessary. Our applications experts will tell you what you should watch out for here. Just contact us.

Thermally Conductive Silicone Encapsulants

Product	Thermal Conductivity [W/mK]	Type	Viscosity D = 10 1/s [Pa.s]	Hardness, Shore A	Lap Shear Strength [N/mm²]	Curing min/°C
ELASTOSIL® RT 607	0.5	2 part 9:1	8	55	-	20/70
ELASTOSIL® RT 740	0.5	2 part 10:1	1	55	> 2	30/100
ELASTOSIL® RT 743 LV-K	0.5	2 part 1:1	1	20	-	60/120
ELASTOSIL® RT 747 TC	1.4	1 part	8	70	0.8	30/130
ELASTOSIL® RT 675	1.2	2 part 1:1	30	80	-	30/100
SEMICOSIL® 970 TC	0.8	2 part 1:1	30	65	> 3	30/130

SILICONES FOR THERMAL MANAGEMENT: PROPERTY COMPARISON

The following tables illustrate the properties of our thermally conductive silicone products for the electronics and semiconductor industries.

Our silicone experts in Burghausen would be happy to provide you with additional technical details. Just contact us.

Electrical and Thermal Properties				
Silicones	Dielectric Strength [kV/mm]	Volume Resistivity IEC 60093 [Ωcm]	Thermal Expansion Coefficient [$\mu\text{m/m}$] or [ppm]	Volatile Content Weight Loss 150 °C/1,000 h [%]
ELASTOSIL® RT 607	> 23	> 10 ¹⁴	180	< 1
ELASTOSIL® RT 675	15	> 10 ¹⁴	160	< 1
ELASTOSIL® RT 740	> 23	> 10 ¹⁴	160	< 2
ELASTOSIL® RT 743 LV-K	> 23	> 10 ¹⁴	180	< 1
SEMICOSIL® 970 TC	15	> 10 ¹⁴	180	< 1
SEMICOSIL® 971 TC	12	> 10 ¹⁴	95	< 0.5
SEMICOSIL® 9712 TC	7	> 10 ¹³	90	< 0.5
SEMICOSIL® 961 TC	8	> 10 ¹³	90	< 0.5
SEMICOSIL® 962 TC	7	> 10 ¹³	90	< 0.5
WACKER Silicone Paste P12	10	> 10 ¹³	150	< 1

Mechanical Properties					
Silicones	Hardness, Shore A	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Maximum Particle Size [μm]
ELASTOSIL® RT 607	55	3.5	100	1.4	30
ELASTOSIL® RT 675	80	2	50	2.3	100
ELASTOSIL® RT 740	55	4	130	1.5	30
ELASTOSIL® RT 743 LV-K	20	3	150	1.5	30
SEMICOSIL® 970 TC	65	4	90	2.3	100
SEMICOSIL® 971 TC	75	5	70	2.7	100
SEMICOSIL® 9712 TC	85	5	60	2.9	90
SEMICOSIL® 961 TC	25	n.d.	n.d.	2.9	90
SEMICOSIL® 962 TC	25	n.d.	n.d.	3.1	90
WACKER Silicone Paste P12	Pasty	n.d.	n.d.	2.3	30

Overview of Electrical, Thermal and Mechanical Properties				
Product	Thermal Conductivity [W/mK]	Type	Viscosity D = 10 1/s [Pa.s]	Application
ELASTOSIL® RT 607	0.5	2 part 9:1	8	Thermally conductive silicone encapsulants
ELASTOSIL® RT 675	1.2	2 part 1:1	30	Thermally conductive silicone encapsulants
ELASTOSIL® RT 740	0.5	2 part 10:1	1	Thermally conductive silicone encapsulants, Thermally conductive silicone adhesives
ELASTOSIL® RT 743 LV-K	0.5	2 part 1:1	1	Thermally conductive silicone encapsulants
SEMICOSIL® 970 TC	0.8	2 part 1:1	30	Thermally conductive silicone encapsulants, Thermally conductive silicone adhesives
SEMICOSIL® 971 TC	2.0	1 part	100	Thermally conductive silicone adhesives
SEMICOSIL® 9712 TC	2.5	2 part 1:1	150	Thermally conductive silicone adhesives
SEMICOSIL® 961 TC	2.3	2 part 1:1	130	Thermally conductive dispensable silicone pads/pastes
SEMICOSIL® 962 TC	3.0	2 part 1:1	150	Thermally conductive dispensable silicone pads/pastes
WACKER Silicone Paste P12	0.8	1 part	Pasty	Thermally conductive dispensable silicone pads/pastes

EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS



• Sales offices and production sites, plus 18 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 €4.6 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, 18 technical competence centers, 13 WACKER ACADEMY training centers and 48 sales offices in Europe, North and South America, and Asia – including a presence in China. With a workforce of some 13,450, 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.

Visit us anywhere, anytime around the world at: www.wacker.com



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6953e/05.17 replaces 6953e/05.15

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