

ELASTOSIL®

POWERSIL®

SEMICOSIL®

WACKER SilGel®



MOBILITY

e-NOVATION FOR BATTERIES POWERED BY SILICONES



AT THE HEART OF e-MOBILITY



Batteries, and their power storage ability, can be seen as at the heart of e-vehicles. As their capacities and voltage levels have steadily increased, thermal management has become a pressing matter. With our long experience in the automotive, semiconductor and power electronics industry, we have developed a range of solutions to tackle this problem.

e-Innovation is Our Business

WACKER is one of the most research-intensive chemical corporations worldwide, with strong R&D that goes far beyond just product development. At our technical centers across the globe, we test formulations on state-of-the-art manufacturing machinery in order to match our products to processing requirements. We invite you to benefit from this process infrastructure and to innovate the future of e-Mobility with us.

**Let's power up the future.
Let's put the wheels on e-Mobility.**

ELASTOSIL®, POWERSIL®, SEMICOSIL®
and WACKER SilGel® are registered
trademarks of Wacker Chemie AG.

LONGER LIFE THANKS TO IMPROVED PERFORMANCE

Silicones are perfect for thermal management. They can efficiently dissipate heat – even from complicated shapes and they maintain their properties for a long period of time over a broad range of temperatures (-50 °C to +180 °C, special grades up to +230 °C).

They can also withstand mechanical stress, vibrations and temperature fluctuations. Silicone gap fillers, gels, adhesives and pastes help to

- Keep operating temperatures within an optimum range, connect elements to active cooling systems
- Protect against moisture, oxidation, chemicals and vibration
- Extend life and performance

Silicones for Battery Modules

- Dissipate heat (thermal management)
- Couple cells with heat-sink elements (bonding)
- Couple cells for vibration control (bonding)
- Seal modules (CIPG – cured-in-place-gasket)

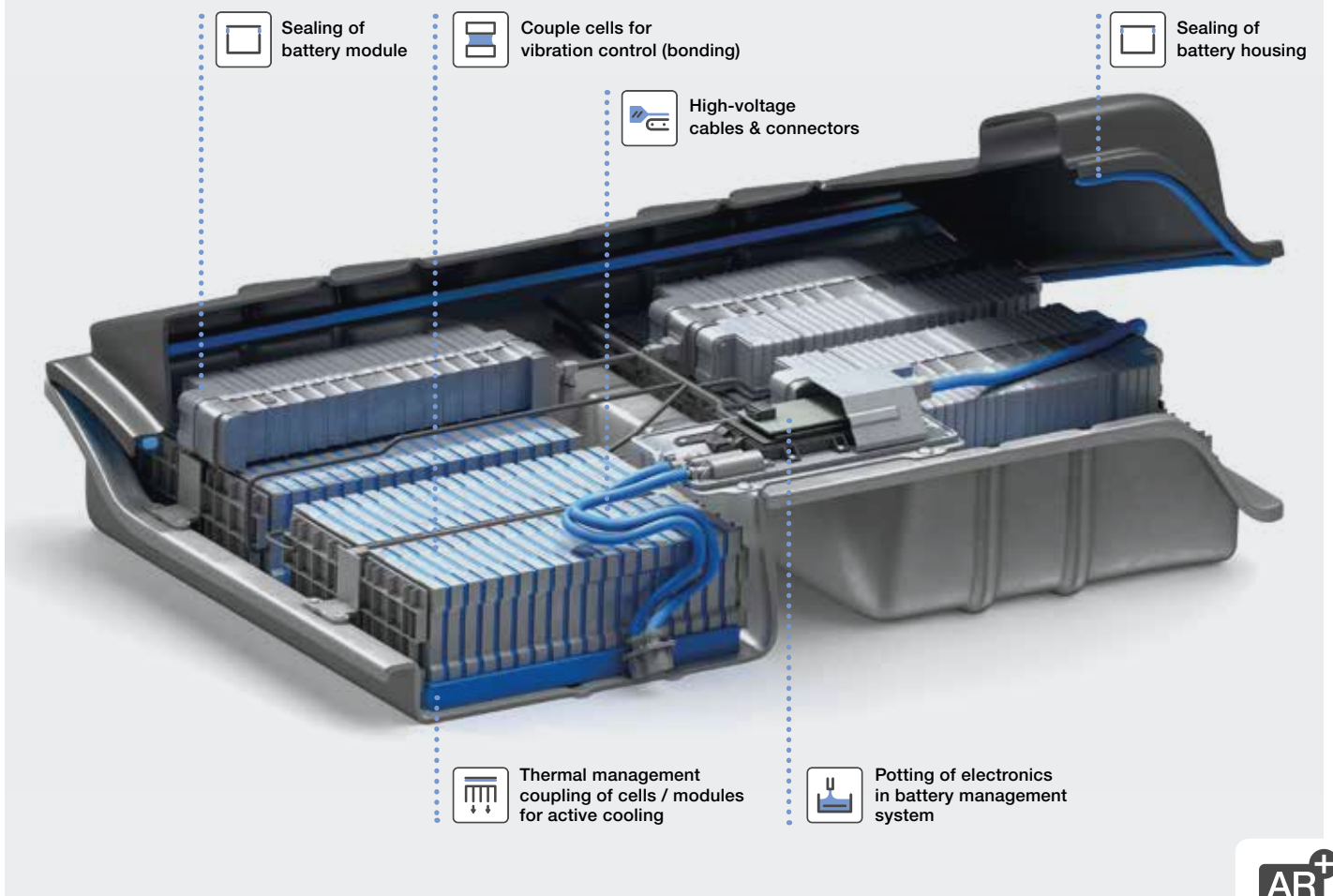
Silicones for Battery Pack System

- Dissipate heat (thermal management)/couple modules to active cooling
- Seal modules (CIPG – cured-in-place-gasket)
- Insulate high-voltage cables and seal connectors

Silicones for Battery Management System

- Protect electronic components (encapsulation)

Silicone Application Fields



SILICONES – PROVEN SOLUTIONS TO A HOT ISSUE

As yet, there is no industry standard for e-vehicle batteries. Their designs vary but the basic components are the same: cells of different shapes, sizes and chemistry are stacked together to form modules, which are then assembled into a pack: the “battery.” During storage, operation and charging of the battery, thermal management is needed.

Temperature impacts the lifetime, performance, reliability, safety and cost of a battery. Heat dissipation to establish a uniform temperature has to occur at a rate that enables the battery to operate optimally within a desired temperature range and this requires a cooling mechanism.

While air cooling is relatively effective, it requires large gaps between the cells for air circulation. This has led to alternatives being developed. Liquid coolants can absorb more heat, are good conductors and require less space. As an active coolant and insulating fluid, WACKER’s POWERSIL® Fluid TR 50 dissipates the thermal energy to a heat exchanger and is a well proven and reliable solution that has been used in high-voltage transformers for decades.

However, when it comes to cooling in the battery stack, thermally conductive silicone can be applied to the cells to dissipate internal heat, to bond them to each other or to the module casing, and to form a larger pack. The silicone also provides additional damping and vibration control and can be used as a soft, flexible gap filler between uneven surfaces across broad temperature ranges.

Silicone Based Cooling Liquids Have Been Successfully Used in HV Applications (Transformers) for Decades

Products	POWERSIL® Fluid TR 50	WACKER® AK 20
Viscosity 23 °C	50 mm ² /s	20 mm ² /s
Viscosity 50 °C	35 mm ² /s	10 mm ² /s
Viscosity -40 °C	150 mm ² /s	70 mm ² /s
Flash point	> 240 °C	> 240 °C
Ignition temperature	> 340 °C	> 340 °C
Breakdown voltage	> 40 kV	> 40 kV
Relative permittivity, 90 °C/50 Hz	2.55 (± 0.05)	2.55 (±0.05)
Specific volume resistance, 90 °C	> 10 ¹³ Ω·cm (> 100 GΩ·m)	> 10 ¹³ Ω·cm (> 100 GΩ·m)
Thermal conductivity	0.15 W/m·K	0.15 W/m·K
Specific heat capacity	1.7J/(g·K)	1.7J/(g·K)

Advantages

- Excellent insulation properties
- Superior heat stability
- High chemical inertness
- High flash point, no toxic combustion products, self-extinguishing
- Environmental friendly, biocompatible and physiologically inert:
 - Riskless handling in production and servicing
 - Riskless disposal at end of lifetime
- High viscosity temperature index; liquid down to -50 °C without additives: optimal cooling (even at cold start and under maximum load)

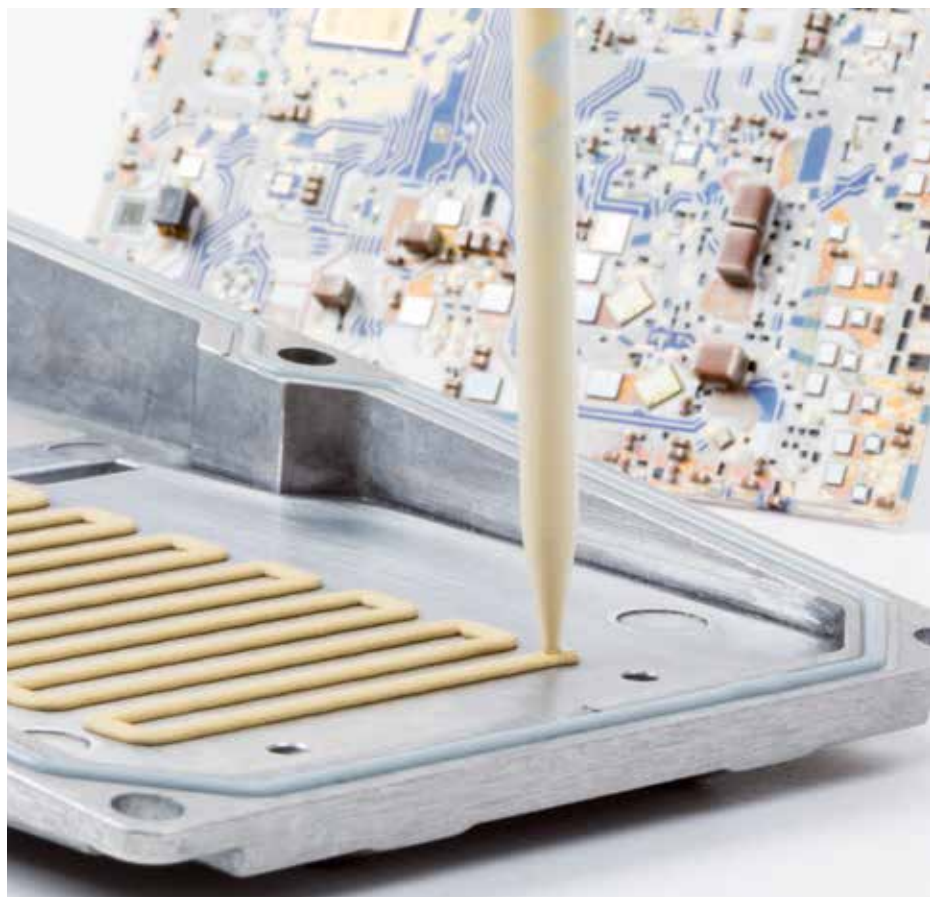
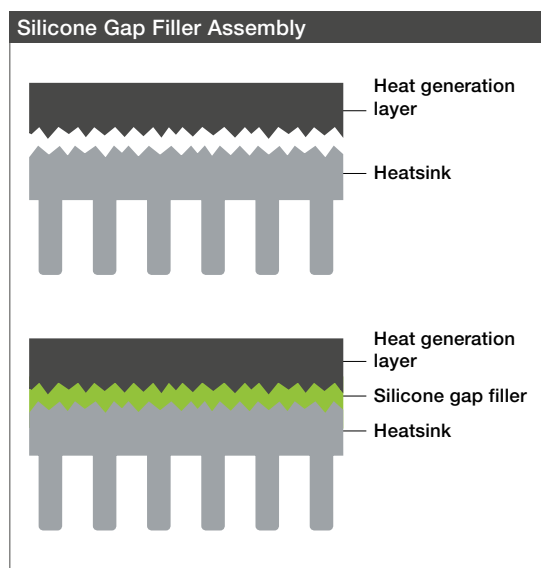
SEMICOSIL® GAP FILLER – THE ANSWER TO A BURNING QUESTION

Whether during charging or use, batteries generate and release levels of heat that need to be kept within an optimal range to ensure safety and help extend their lifetime. Soft, flexible, thermally conductive silicones dissipate this heat. With SEMICOSIL® 961 TC, SEMICOSIL® 962 TC and SEMICOSIL® 963 TC, WACKER has developed a range of thermally conductive gap fillers that are not only cost-effective and easy to process, but also offer safe functionality and high durability.

For use in batteries in both EVs and HEVs, SEMICOSIL® 96x TC series are two-component silicone fillers with thermal conductivities in the range from 2.3 W/mK to 3 W/mK, which are applied directly to the heat sink. Once pressed into place, the gap filler cures to form a soft, cushioning silicone layer that dissipates the heat. While curing to a reliable bond can occur at room temperature, higher temperatures achieve this more quickly. Some formulations incorporate glass beads to give uniform bond line thickness (BLT).

Benefits of the SEMICOSIL® 96x TC Series

- High dispensing speed and fast cure for reduced cycle times
- Low modulus allows assembly of very fragile devices
- Excellent conformability to complex surfaces and geometries
- One solution for different applications (no coordination and storage of different pad or die-cut shape sizes)
- Low volatile content
- UL 94 V-0 rating (WACKER in-house testing)
- Dielectric insulation
- Available in 200 l drums



PRODUCT OVERVIEW

SILICONES FOR xEV BATTERIES

Battery: Thermal Management Thermally Conductive Silicone Encapsulants

Tough encapsulation materials with good resistance to mechanical and environmental stress

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Lap Shear Strength [N/mm ²]	Curing
ELASTOSIL® RT 607	General-purpose potting	0.5	Addition	Heat	2-part, 9:1	10,000	55 Shore A	3.5	100	1.4	-	20 min/70 °C
ELASTOSIL® RT 743 LV-K	General-purpose potting, low viscosity	0.5	Addition	Heat	2-part, 1:1	1,100	20 Shore A	3	150	1.5	-	60 min/120 °C
ELASTOSIL® RT 736 TC*	Self-leveling, good adhesion properties, UL 94 V-0	0.6	Addition	Heat	2-part, 1:1	3,000	63 Shore A	4.6	150	1.5	1.2	60 min/120 °C
ELASTOSIL® RT 744 TC	General-purpose potting, low viscosity, medium TC	1.0	Addition	50 °C or higher	2-part, 10:1**	9,500 (D=1 1/s)	70 Shore A	3.1	70	2.2	-	15 min/80 °C
ELASTOSIL® RT 738 TC*	Self-leveling, good flow and adhesion properties	1.1	Addition	Heat	2-part, 1:1	5,500 (D=1 1/s)	20 Shore A	0.5	90	1.9	0.4	60 min/120 °C
ELASTOSIL® RT 747 TC	Self-leveling, good flow and adhesion properties	1.4	Addition	Heat	1-part	45,000	70 Shore A	4	90	2.3	0.8	30 min/130 °C
ELASTOSIL® RT 739 TC*	Self-leveling, good flow and adhesion properties	2.2	Addition	Heat	2-part, 1:1	17,000 (D=1 1/s)	50 Shore A	1.3	60	2.8	0.6	60 min/120 °C

Battery: Thermal Management Thermally Conductive Dispensable Silicone Gap Fillers & Pastes

Soft, flexible gap filling between uneven surfaces across broad temperature range; non-curing, low-stress paste solutions

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Lap Shear Strength [N/mm ²]	Curing
WACKER Silicone Paste P12	Standard thermal heat sink paste	0.8	-	-	1-part, ready-to-use	Non-slump	Paste-like	n.a.	n.a.	2.3	-	-
ELASTOSIL® Paste 30 TC*	Thermal heat sink paste	3.0	-	-	1-part, ready-to-use	Non-slump	Paste-like	n.a.	n.a.	3.2	-	-
SEMICOSIL® Paste 40 TC	High performance paste	4.0	-	-	1-part, ready-to-use	Non-slump	Paste-like	n.a.	n.a.	3.3	-	-
SEMICOSIL® 961 TC	High dosing rate, UL 94 V-0, low volatile	2.3	Addition	RT or fast cure at elevated temp	2-part, t 1:1	Non-slump	25 Shore A	n.d.	n.d.	2.9	-	4-6 h/23 °C
SEMICOSIL® 962 TC	High dosing rate, soft tacky gel, UL 94 V-0, low volatile	3.0	Addition	RT or fast cure at elevated temp	2-part, 1:1	Non-slump	25 Shore A	n.d.	n.d.	3.1	-	4-6 h/23 °C
SEMICOSIL® 963 TC	High dosing rate, UL 94 V-0, low volatile	3.0	Addition	RT or fast cure at elevated temp	2-part, 1:1	Non-slump	Pen 20 mm/10	n.d.	n.d.	3.1	-	4-6 h/23 °C

Battery: Thermal Management Thermally Conductive Silicone Adhesives

Silicone adhesives to couple cells with heat sink element/coupling of modules to active cooling; also for application in PTC heaters

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Lap Shear Strength [N/mm ²]	Curing
ELASTOSIL® RT 709 CN	Flowable, excellent thermal stability	0.4	Addition	Heat	1-part	180,000	49 Shore A	4	200	1.2	> 2.2	10 min/140 °C, 2 min/200 °C
SEMICOSIL® 970 TC	Universal self-adhesive thermally conductive silicone	0.8	Addition	Heat	2-part, 1:1	95,000	65 Shore A	4	90	2.3	> 3	30 min/130 °C
ELASTOSIL® TC 9800 CN	General-purpose potting, self-bonding	0.85	Condensation	RT	1-par, RTV-1	120,000	73 Shore A	3	85	1.6	> 1	Skin forming: 5 min/23 °C
SEMICOSIL® 971 TC	Stir cartridges	2.0	Addition	Heat	1-part	Non-slump	75 Shore A	5	70	2.7	> 2.5	30 min/125 °C
SEMICOSIL® 9712 TC	General-purpose adhesive, high heat resistance	2.5	Addition	Heat	2-part	Non-slump	85 Shore A	5	60	2.9	> 3	15 min/85 °C
SEMICOSIL® 973 TC	Primerless adhesion to many substrates, stir cartridges	3.0	Addition	Heat	1-part	Non-slump	90 Shore A	3	45	3.0	> 2.5	30 min/125 °C
SEMICOSIL® 975 TC	High thermally conductive 1-part adhesive	4.3	Addition	Heat	1-part	Non-slump	98 Shore A	3	45	3.3	> 2.5	30 min/120 °C

* Under development

** Base component to be combined with ELASTOSIL® CAT PT or ELASTOSIL® CAT PT-F to allow curing at room temperature or under heat (for details, please refer to the respective technical datasheet)

PRODUCT OVERVIEW

SILICONES FOR xEV BATTERIES

Battery Assembly Adhesives / Foam

Couple cells for vibration control, module sealing, battery housing sealing (compressible / non-compressible), electric insulation of cells

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Curing*
ELASTOSIL® E4	CIPG, FIPG	0.2	Acetoxo	RT	1-part, RTV-1	Non-slump	15 Shore A	1.7	900	1.02	120 h/23 °C
SEMICOSIL® 811	Low-energy cure adhesive, low-temperature cure, oven-free, fast adhesion build-up at moderate temperature, FlxPG	0.2	Addition	Room temperature, heat or UV	2-part 10:1	Non-slump	30 Shore A	3.3	330	1.08	BKS**, see extra table
SEMICOSIL® 986/1k	Sealing adhesive, FIPG, thixotropic, specified ion content, UV tracer	0.2	Addition	Heat	1-part	Non-slump	50 Shore A	5	200	1.1	30 min/130 °C; 10 min/150 °C
SEMICOSIL® 987 GR	Sealing adhesive, CIPG, FIPG	0.2	Addition	Heat	1-part	Non-slump	55 Shore A	5	200	1.1	60 min/130 °C; 10 min/150 °C
SEMICOSIL® 988/1k gray/tran	Sealing adhesive, CIPG, FIPG	0.2	Addition	Heat	1-part	Non-slump	35 Shore A	4.5	350	1.1	60 min/130 °C; 10 min/150 °C
SEMICOSIL® 9882	Fast curing, designed for large part CIPG and for ovenless IR curing	0.2	Addition	Heat or IR light	2-part, 1:1	Non-slump	30 Shore A	7	500	1.1	CIPG IR/heat cure 60–130 °C: > 30 min/60 °C; > 10 min/100 °C
ELASTOSIL® RT 720	Low-energy cure adhesive, CIPG, FIPG, excellent mech. properties, flowable adhesive	0.2	Addition	Heat	2-part, 1:1	Flowable	40 Shore A	6	300	1.1	45 min/90 °C; 15 min/125 °C
ELASTOSIL® RT 722	Low-energy cure adhesive, low volatile, excellent mech. properties	0.2	Addition	Heat	2-part, 1:1	Non-slump	45 Shore A	6	300	1.1	45 min/90 °C; 15 min/125 °C
ELASTOSIL® RT 725 LV	Low-energy cure adhesive, low volatile, UV tracer	0.2	Addition	Heat	2-part, 1:1	Non-slump	50 Shore A	7	250	1.1	10 min/100 °C; 30 min/60 °C
ELASTOSIL® SC 870	Silicone foam, CIPG, high LOI	0.2	Addition		2-part	Non-slump	10 Shore A			0.35	

Battery Assembly Cell Pack/Battery Management System Potting

WACKER SiiGel® 612	Very soft, clear, low bleed, general purpose, UL 94 HB	0.2	Addition	RT or Heat	2-part, 1:1, long potlife	1,000	Pen 70 mm/10	-	-	0.97	8 h/25 °C, 15 min/100 °C
--------------------	--------------------------------------------------------	-----	----------	------------	---------------------------	-------	--------------	---	---	------	--------------------------

* Speed of adhesion built-up depend on substrate

Battery Connectors Encapsulants

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Tensile Strength [MPa]	Elongation at Break [%]	Density [g/cm ³]	Curing
SEMICOSIL® 949 UV A SEMICOSIL® 949 UV B	Very low viscosity, UV tracer, primerless bonding	0.2	Addition	Room temperature, heat or UV	2-part, 10:1, BKS** with 949 UV B	200	35 Shore 00	-	-	0.97	See extra table
SEMICOSIL® 949 UV A SEMICOSIL® 950 UV B	Low hardness, transparent, UV tracer, shadow curing, primerless bonding	0.2	Addition	UV	2-part, 10:1, BKS** with 950 UV B	200	35 Shore 00	-	-	0.97	See extra table
ELASTOSIL® RT 743 LV-K	General-purpose potting, low viscosity	0.5	Addition	Heat	2-part, 1:1	1,100	20 Shore A	3	150	1.5	60 min/120 °C

Battery Connectors Adhesives / Foam

Sealing of battery connectors

SEMICOSIL® 988/1k gray/tran	Non-slump thixotropic	0.2	Addition	Heat	1-part	Non-slump thixotropic	35 Shore A	4.5	350	1.1	60 min/130 °C; 10 min/150 °C
ELASTOSIL® SC 835	Low hardness, transparent, UV tracer, shadow curing, primerless bonding	< 0.1	Addition		Silicone foam		20 Shore A			0.45	

** BKS = Batch-Kit System: base component to be combined with ELASTOSIL® CAT PT, ELASTOSIL® CAT PT-F or ELASTOSIL® CAT UV to allow curing at room temperature, under heat or by UV light (for details, please refer to the respective technical datasheet)

PRODUCT OVERVIEW

SILICONES FOR xEV BATTERIES

Battery Management System/PCB Protection Conformal Coatings

Solvent-free, 100% silicone, UV initiated products available, fast reaction, shadow cure, no volatile by-products (addition-cure)

Product	Features	Thermal Conductivity [W/mK]	Curing Type	Curing Initiated by	Product Type
SEMICOSIL® 942 UV A/B	Soft gel, sprayable, UV tracer	0.2	Addition	UV	2-part, 10:1

Product	Viscosity D = 0.5 1/s [mPa·s]	Hardness	Density [g/cm ³]	Curing
SEMICOSIL® 942 UV A/B	2,500	Pen 60 mm/10	0.98	15 min/70 °C no UV act., 20 s/UV act. for 20 sec.

Potlife and Cure Times for BKS* Grades (10:1 Mix)

Product	Potlife [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] 100 °C
SEMICOSIL® 811	45	30	> 48	–	–	< 10***
SEMICOSIL® 949	20	< 15	> 24	15	10	< 2****

* BKS = Batch-Kit System: base component to be combined with ELASTOSIL® CAT PT, ELASTOSIL® CAT PT-F or ELASTOSIL® CAT UV to allow curing at room temperature, under heat or by UV light (for details, please refer to the respective technical datasheet)

** Curing time under UV irradiation depending on substrate, layer thickness, UV intensity and dose. Ozone-free Fe-discharge lamp (emission > 250 nm) is recommended

*** Typically 40-60 sec open time (time to bond), cure at 25 °C after 30 min. Adhesion: 25 °C (PBT/AI): > 45 min; Adhesion: 80 °C (PBT /AI): < 5 min

**** As encapsulant an intensity between 100 and 400 mW/cm² can be chosen. At high intensity, material is cured almost immediately after irradiation (10 sec)





WACKER

Wacker Chemie AG
Hanns-Seidel-Platz 4
81737 Munich, Germany
Tel. +49 89 6279-1741
info@wacker.com

www.wacker.com

www.wacker.com/socialmedia



The data presented in this medium are in accordance with the present state of our knowledge but do not absolve the user from carefully checking all supplies immediately on receipt. We reserve the right to alter product constants within the scope of technical progress or new developments. The recommendations made in this medium should be checked by preliminary trials because of conditions during processing over which we have no control, especially where other companies' raw materials are also being used. The information provided by us does not absolve the user from the obligation of investigating the possibility of infringement of third parties' rights and, if necessary, clarifying the position. Recommendations for use do not constitute a warranty, either express or implied, of the fitness or suitability of the product for a particular purpose.