Elkem
A Bluestar Company

Silicones

Delivering your potential

Bluesil

CAF

Accelerate the transportation revolution

with Electronic Silicone Solutions

www.silicones.elkem.com

Protect your electronic components in electric vehicles

Why choose Elkem Silicones?

Elkem Silicones is a complete integrated global silicones manufacturer with more than 60 years of silicone expertise. Thanks to its worldwide upstream and downstream operations, Elkem Silicones offers a comprehensive range of silicone technologies in support of diverse specialty markets including paper release, healthcare, moldmaking, automotive, aerospace, personal care and electronics.

Our worldwide quality focus

At Elkem Silicones we apply our Quality Policy in line with the ISO 9001 standard, linked to a management system based on strong continuous improvement programs.

Lean manufacturing tools and methodologies are deployed through our Elkem Business System (EBS) initiative to enhance our product lines. Our worldwide operating centers - headquarters, laboratories, sales & development processes and manufacturing sites - are all ISO 9001 certified with specialty product ranges complying to specific industry standards such as ASTM and ES/AS 9100 for Aerospace applications.

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We create agile innovation

Since 1944, we have continuously developed new technologies, processes and solutions to address our customers' needs. In a changing environment, we question the status quo, we generate new ideas and constantly progress, in close cooperation with our customers.

A worldwide network to deliver our customers' potential because we care

Our upstream and downstream production units, working closely with the worldwide sales network of our subsidiaries, agents and distributors, enhance our understanding of markets and enable us to satisfy the current and future needs of Elkem Silicones customers.

We offer technical support to serve demanding markets

Our dedicated teams support you from product approval to after-sales technical services, including prototype production.

With high-performance facilities and unique know-how, our teams can validate technical solutions in the laboratory to cover all industrial applications that require bonding, sealing or potting. We test on-site performance in conjunction with your teams to define and determine the optimal solution for your processes, and to obtain your final approval.

Before ramping up to industrial-scale production, limited prototype series can be produced in-house by our technical laboratories, with access to automated manufacturing. Our technicians provide services on-demand to customers to assist and advice them throughout the production phase.

From technical support to customized formulations with quality, regulatory and supply chain services, Elkem Silicones has the people in place when and where you need them.

Why silicones for Electric Vehicle applications?

The main challenge for H&EV automakers is to ensure that the electrical and electronic parts in these new-generation vehicles are efficient, reliable and safe.

Silicones play an essential role in producing high-performance H&EV since they are used in a wide range of solutions for the assembly, integrity and protection of critical parts in these new vehicles. Our product line including Electronic Silicone Adhesives (ESA range) for potting and encapsulating, CAF™ range for sealing and bonding and syntactic and blown foam products for lightweight applications are increasingly used in the protection of battery modules and in automotive electronics (sensors, PCT heater, IGBT, etc...) as a result of their high performance physical properties and their stability across a wide range of extreme conditions.

Battery modules

The first challenge is to manage the heat of the battery modules which is the heart of the electric vehicle. The temperature affects the performance, reliability, safety, life and the cost of batteries in HEVs, PHEVs and EVs. Elkem Silicones develops customized solutions according to the design of the battey pack and the cells used in these modules. We provide two options to address this challenge, depending on the design of the battery pack and the cells used (cylindrical, pouch or prismatic):

• One approach is to create a thermal insulation of:
- the cell to avoid the overheat propagation to the other cells,
- the battery pack to limit the impact of cold environment on the temperature of the battery.

A range of foams offering a low thermal conductivity coefficient is ideal for these purposes. In addition, these foams have low densities that do not negatively impact total weight and, consequently, the energy consumption.

• A second approach is to use thermally conductive materials that can evacuate the heat from the cell. Our range includes thermally conductive adhesives, gap fillers, encapsulants and gels to meet the variety of design differences of the battery pack.

Thermal Management issues are not limited to battery applications but can be applied to other parts of the vehicle including electronic control units, electric converters and electric motors.

Electronic components

Other challenges for OEM (original equipment manufacturer) and OES (original equipment supplier) are the protection and the assembly (sealing and bonding) of electric vehicle components. Elkem Silicones provides many technologies for these functions as adhesives (ESA range) for bonding applications, gels (ESA range) for electronics potting, foams (RTFoam range) & CAF (RTV-1) for sealing and gasketing and conformal coating products.

All these products can be dispensed manually or in-line automation production.

Most common applications in EV

Key benefits for Electronic Silicone Solutions:

Excellent ageing stability
long term thermal & chemical stability

Thermal management
from thermal insulation to conduction performance

Excellent electrical insulation

Low density
for weight reduction when using silicone foams

Flexible rheological properties for easy processing

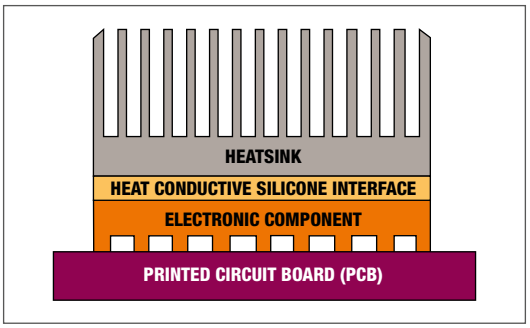
01

Thermally conductive
materials for
heat management

Thermally conductive silicones

Thermal management is a major challenge in electric vehicle components, such as in batteries or electronic control units. One option is to dissipate the heat from electronic components.
To dissipate heat in high power applications, Elkem Silicones provides a wide range of thermal interface materials with several technologies:

- thermally conductive silicone adhesives
- thermally conductive silicone gap filler
- thermally conductive silicone potting materials
- thermally conductive silicones pastes



Bluesil™ ESA Properties

Products	Application	Description	Color	Ratio	Viscosity (mPa.s)	Shore A Hardness	Thermal conductivity (W/m.K)	availability AM/AP/EMEA*
ESA 6733 A&B	Gap filler	Gap filler	Blue	1:1	A: 80 000 B: 90 000	47	2,8	on request** for AM & AP
ESA 6742 A&B	Gap Filler	Gap filler	White	1:1	A: 107 000 B: 97 000	60	2,2	on request** for AM & AP
ESA 7712 A&B	Potting	Adapted viscosity material	Grey	1:1	A: 15 000 B: 15 000	30	1,50	on request** for EMEA & AP
ESA 7721 A&B	Adhesive	Self -Adhesive on several substrates	Blue	1:1	A: 580 000 B: 310 000	69	1,00	on request** for AM & AP

* AM = Americas; AP= Asia Pacific; EMEA = Europe middle-East Africa

** need to be validated by the region

When higher values of thermal conductivity are targeted by our customers, we develop customized products. This allows us to optimize the material in front of the technical requirements for our customer.
Products with very low content of volatiles siloxanes (D3-D10) are available on request.
Gap filler grades are also available with glass beads for thickness control, on request.

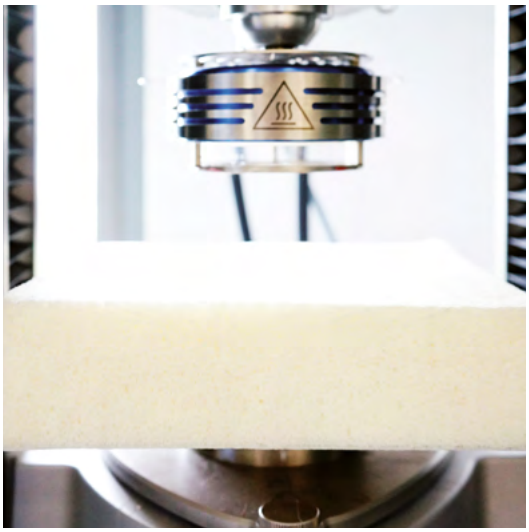
Bluesil™ ETG Pastes Properties

Properties	Test Method	ETG 100	ETG 150	ETG 200	ETG 250	ETG 300
Density	GB/T 531 (g/cm3)	2.5-3.0	2.5-3.0	2.8-3.2	3.0-3.5	3-3.5
Thermal conductivity	Hot Disc ISO22007 W/(m.K)	0.8-1.2	1.3-1.7	1.8-2.2	2.-2.5	2.7-3.2
Oil bleeding	200°C, 24h	≤ 0.2%	≤ 0.2%	≤ 0.2%	≤ 0.2%	< = 0.2%
Evaporation	200°C, 24h	≤ 0.5%	≤ 0.5%	≤ 0.5%	≤ 0.5%	≤ 0.5%
Thermal resistance	°Ccm2/W	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2
Volatile content	200°C, 24h	≤ 1%	≤ 1%	≤ 1%	≤ 1%	≤ 1%
Dynamical viscosity	Haake Pa.s	35-45	50-60	55-65	80-105	90-130

These products are available in Asia Pacific region, on request for other regions.

This family of thermally conductive products can be used in the battery pack (heat dissipation between cells and cooling plate with or without adhesion, heat dissipation between the cells) as well as in power modules, inverters, electric motors, electronic control unit and power control unit.

Lightweight Silicone
Solutions for EV



Bluesil™ RT Foam Technology for flexible solutions

Choose a room temperature (RT) curing foam when:

- A compression gasket is required
- An “environmental seal” is required (sealing against ambient air, splashed water, dust, moisture)
- A cost effective sealing solution is required (compared to preformed gaskets / foam tapes)
- Fast-cure is demanded (room-temp / low/short heat)
- Low sealing force / low modulus is needed
- High tolerance gaps exist
- Component sound and vibration requires dampening
- Gasket installation demands automation (robotic dispensing)
- An excellent temperature insulation with a very low thermal conductivity coefficient

Silicone foam is a spongy material that provides the performance benefits of standard silicone but with added flexibility, suppleness and lightweight.

Processing

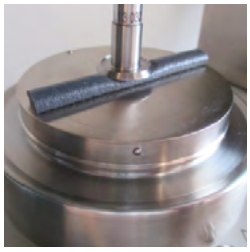
- Once the RT Foam components are mixed, a foaming agent is formed.
- The mixed RT Foam is directly dispensed onto the surface or groove to be sealed.
- The dispensed foam gasket expands in its liquid stage and cures to a foamed solid within 5 min to 4 hours at room temperature.
- The result is a low modulus integrated compression seal with the fine cell-structure.

Benefits

Elkem Silicones’ foam range is specially designed for sealing, gasketing and thermal insulation application.

More information on the foam video

Compression properties



Fire resistance

02

For thermal management, silicone foams provide light weight solutions with a very low thermal conductivity coefficient. The RT Foam product line offers insulation support and the open cell structure helps avoid overheating propagation to other cells. Furthermore, foam options can provide gasketing alternatives for sealing battery packs and devices. In addition, the low density of these materials does not impact the weight and consequently the energy consumption.

Bluesil™ RT Foam properties

Products	Application	Description	Color	Ratio	Viscosity (mPa.s)	Density	Pot life	Curing conditions	Thermal conductivity (W/m.K)	Max service Temp. (°C)
RTF 3210	Potting	Thermal insulation	Beige	1:1	A: 6000 B: 2500	0,13	1 min	2 hours @ RT	0,1	275°C
RTF 3230	interstitial fill	Thermal insulation	White	1:1	A: 17 000 B: 15 000	0,30	3 min	10 min @ RT	0,1	TBD
RTF 3242	Potting	Flowable foam, V0 on 10 mm thick	Dark grey	1:1	A: 15 000 B: 15 000	0,25	2-8 min	15 to 30 min @ RT	0,1	250°C
RTF 3244	FIPFG - gasketing	Thixotropic, RT curing, V0 on 10 mm thick	Black	1:1	A: 20 000 B: 10 000	0,25	1-3 min	10 to 30 min @ RT	0,1	275°C

The foaming is based on H_2 generation with an addition curing type, but syntactic foams are also available on request.

Bluesil™ RT Foam application

	Applications					
Products	**Frame sealing of battery pack**	**Assembly PCU, ECU**	**Cell insulation**	**Potting**	**Gap filling**	**availibility AM / AP/EMEA***
RTF 3210			•			on request** for AM/EMEA
RTF 3230						on request** for AP/EMEA
RTF 3242				•	•	on request** for AM/AP
RTF 3244	•	•				Yes

* AM = Americas; AP= Asia Pacific; EMEA = Europe middle-East Africa

** need to be validated by the region

03

Potting and encapsulating materials for your sensitive electronics

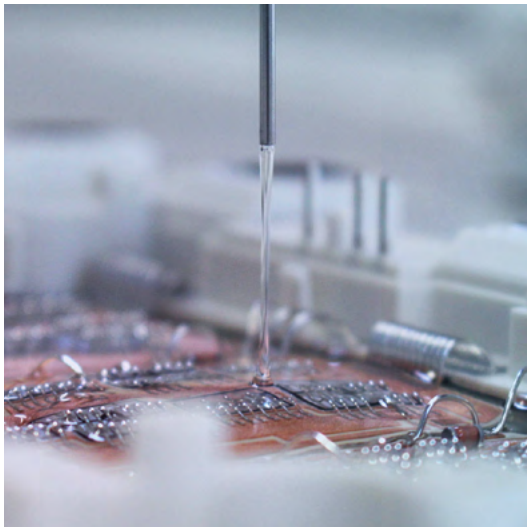
Protection of Sensitive Components

The protection of critical parts is a key challenge in electric vehicle applications.

There is a growing need to protect sensitive components against environmental factors, such as dust and moisture, as well as fluids, heat, and fire exposure. Silicones are the materials of choice for potting and encapsulating sensitive electronics like sensors, actuators, central processing units (CPUs), printed circuit board, as they are the first line of defense against outside aggression. Elkem Silicones offers a wide range of technologies for potting and encapsulating including:

- Gels: due to the low modulus, these materials can protect against external influences and transmission of mechanical stress, with easy reworkability
- Elastomers: with high mechanical performances, high thermal resistance and fire resistance (UL certification).

For power electronics devices, like IGBTs (insulated gate bipolar transistor), we developed a special grade of silicone gels to address the increased temperature performance expected for higher power density due to miniaturization of the devices. This product line was developed specifically to sustain high service temperature conditions ranging >200°C over 9,000 hours.



Bluesil™ ESA Gel Properties

Products	Application	Description	Color	Ratio	Viscosity (mPa.s)	Penetration (1/10mm)	Pot life	Curing conditions	Thermal conductivity (W/m.K)
ESA 6000 HT A&B	Potting	Thermal resistance, less tacky	Clear	1:1	1 300	50 Sh00	50 min	90 min @ 80°C	0,15
ESA 6009 A&B	Potting	High tack, quick curing, high dampening	Light purple	1:1	2 000	70	15 min	1h @ 23°C	0,15
ESA 6010 A&B	Potting	Inherent tack, high viscosity	Clear	1:1	60 000	170	120 min	60 min @ 120°C	0,18
ESA 6016 A&B	Potting	Inherent tack, high damping, low extractible	Clear	1:1	460	130	>6h	24h @ 23°C or 60min @ 70°C	0,19
ESA 6018 A&B	Potting	Inherent tack, high damping, low extractible	Clear	1:1	530	150	>3h	24h @ 23°C or 60min @ 70°C	0,15
ESA 6025 A&B	Potting	High tack, high damping, low extractibles	Blue	1:1	1 250	260	20 min	4h @ 23°C or 90min @ 80°C	0,15
ESA 6100 A&B	Potting	Low viscosity, tacky	Clear	1:1	450	255	24h	30 min @ 80°C	0,15
ESA 6110 A&B	Potting	Optically clear, shock absorption, tacky	Optically clear	1:1	1 200	250	50 min	3h @ 23°C	0,15
ESA 6110 QC A&B	Potting	Optically clear, shock absorption, tacky	Optically clear	1:1	1 200	250	5 min	30 min @ 23°C	0,15
ESA 6111 A&B	Potting	Low viscosity, high damp, tacky	Clear	1:1	600	240	16h	30 min @ 80°C	0,15
ESA 6111 QC A&B	Potting	Low viscosity, high damp, tacky	Clear	1:1	600	240	6h	35 min @ 70°C	0,15
ESA 6120 QC A&B	Potting	Low viscosity, thermal resistance	Clear	1:1	200	270	20 min	30 min @ 120°C	0,15

Bluesil™ ESA RTV-2 Properties

Products	Application	Description	Color	Ratio	Viscosity (mPa.s)	Shore A Hardness	Tensile strength (Mpa)	Elongation at break (%)	Pot life
ESA 7221	Potting	High stretchable	Transparent	1:1	4 000	20	5,0	650	50 min
ESA 7222	Potting	NVH potting	Dark Grey	1:1	5 000	22	3,5	400	3 min
ESA 7242	Potting	UL94 V0	Dark grey	1:1	3 000	50	2,9	140	60 min
ESA 7242 QC	Potting	UL94 V0, quick curing	Black	1:1	3 000	53	2,5	135	3,5 min
ESA 7250	Potting	Optically clear UL94 HB	Optically clear	10:1	4 000	52	6,2	115	4 h
ESA 7255 50	Potting	Optically clear, adhesion on plastic, metal	Transparent	10:1	2 000	30	2,5	200	8 h
ESA 7256	Potting	Clear, low temperature curing	Clear to Light Straw	10:1	4 150	40	6,9	119	3 h
ESA 7258	Potting	High durometer	Dark grey	1:1	1 250	65	2,7	44	5 h

Max service Temperature (°C)	Shelf life	Dielectric Strength (IEC 60243), kV/mm	Dielectric constant at 1 kHz (IEC 60250)	Dielectric dissipation factor at 1 kHz (IEC 60250)	Volume resistivity (IEC 60093), .cm
225	12 months		8,8	$3,0^{-04}$	$7,6x10^{14}$
TBD	6 months	18	2,8	$1,1^{-03}$	$1x10^{15}$
	12 months				
150	12 months	9,9	2,23	$2,4^{-04}$	$5,24x10^{14}$
180	12 months	23	2,8	$1,0^{-03}$	$1x10^{15}$
150	12 months	23	2,8	$5,0^{-04}$	$1x10^{16}$
150	12 months	/	/	/	/
150	12 months	23	2,8	$1,0^{-03}$	$1x10^{15}$
	12 months	23	2,8	$1,0^{-03}$	$1x10^{15}$
150	12 months	23	2,6	$1,8^{-03}$	$1.0x10^{15}$
150	12 months	23	2,6	$1,8^{-03}$	$1,0x10^{15}$
175	12 months	23	2,8	$1,0^{-03}$	$1x10^{16}$

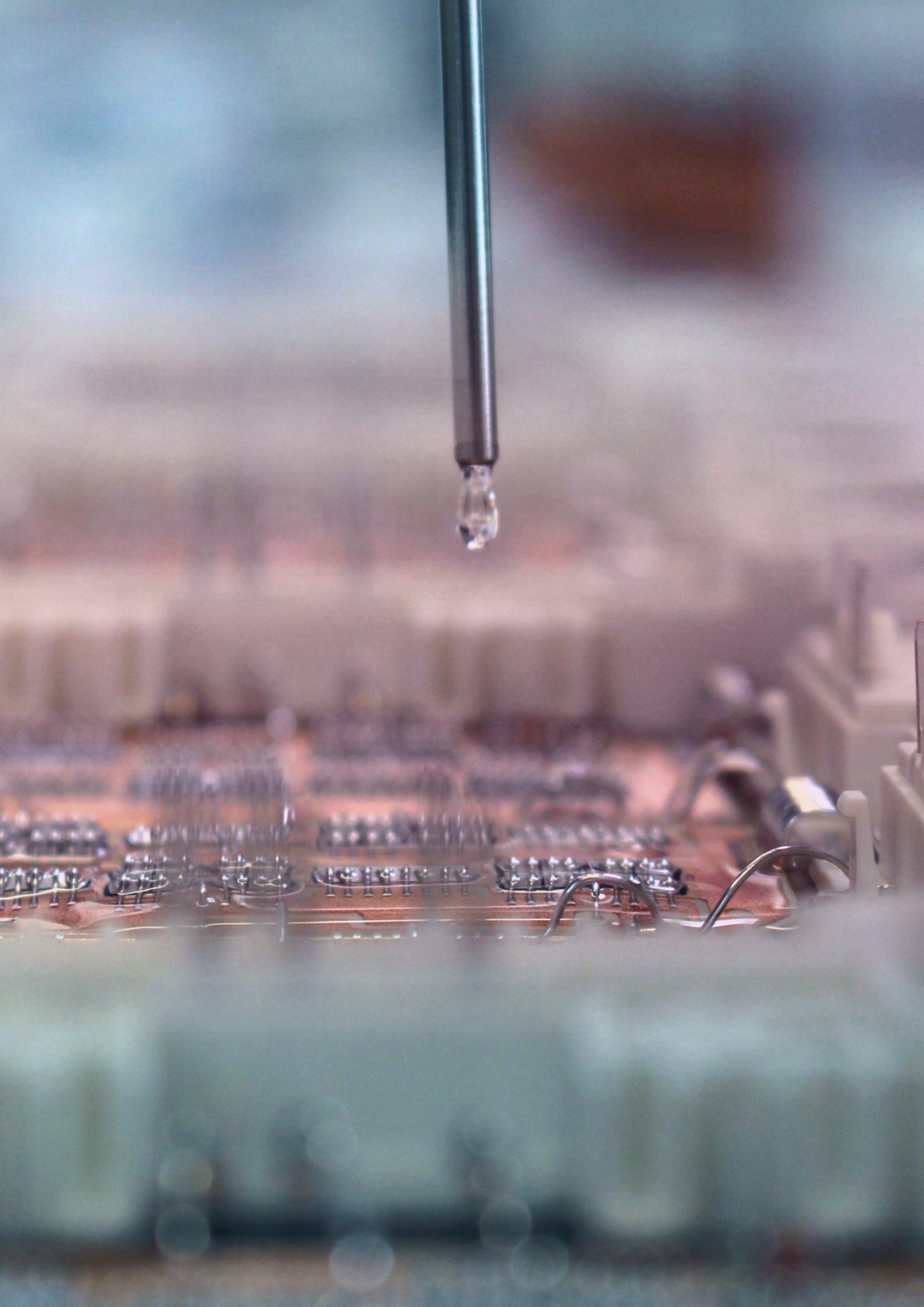
Curing conditions	Thermal conductivity (W/m.K)	Max service Temperature (°C)	Shelf life	Dielectric Strength (IEC 60243), kV/mm,	Dielectric constant at 1 kHz (IEC 60250)	Dielectric constant at 1 kHz (IEC 60250)	Volume resistivity (IEC 60093), .cm
1h @ 80°C	0,20		12 months				
10min @ 80°C	0,23	200	12 months	18	3	0,009	$1,1x10^{15}$
30 min @ 150°C	0,42	250	12 months	18,6	3,05 @ 100kHz	0,004 @ 100kHz	$8,24x10^{14}$
15 min @ 150°C	0,42	250	12 months	16,5	2,95 @ 100kHz	0,001 @ 100kHz	$7,1x10^{14}$
1h @ 150°C	0,16	200	24 months	20	2,7	0,003	$1x10^{15}$
1h @ 150°C	0,16	200	12 months	20			
35 min @ 100°C	0,16	200	12 months	20,3	2,72 @ 100KHz	0,0009 @ 100KHz	$1,03x10^{16}$
35 min @ 100°C	0,42	200	12 months	18,4	3,17 @ 100KHz	0,002 @ 100KHz	$7,42x10^{14}$

Bluesil™ ESA Applications

	Applications						
Products	**Junction box**	**IGBT**	**Sensors**	**CPU**	**PCB**	**Connectors**	**availibility AM /AP/ EMEA***
ESA 6000 HT A&B		•					Yes
ESA 6009 A&B							on request** for EMEA
ESA 6010 A&B	•		•	•			on request** for AP
ESA 6016 A&B	•		•	•		•	on request** for AP/EMEA
ESA 6018 A&B	•		•	•		•	on request** for AM/AP
ESA 6025 A&B	•		•	•		•	on request** for AM/AP
ESA 6100 A&B							on request** for AM/EMEA
ESA 6110 A&B	•		•				on request** for AM/AP
ESA 6110 QC A&B			•				on request** for AM/AP
ESA 6111 A&B	•					•	on request** for AM/EMEA
ESA 6111 QC A&B	•					•	on request** for AM/EMEA
ESA 6120 QC A&B	•		•				on request** for AM
ESA 7221 A&B	•			•		•	on request** for AM/AP
ESA 7222 A&B	•		•	•	•	•	on request** for AM/EMEA
ESA 7242	•		•	•		•	on request** for AP
ESA 7242 QC	•		•	•		•	on request** for AP
ESA 7250	•				•		Yes
ESA 7255 50	•				•		on request** for AM
ESA 7256	•				•	•	on request** for AP/EMEA
ESA 7258	•		•	•		•	on request** for AP/EMEA

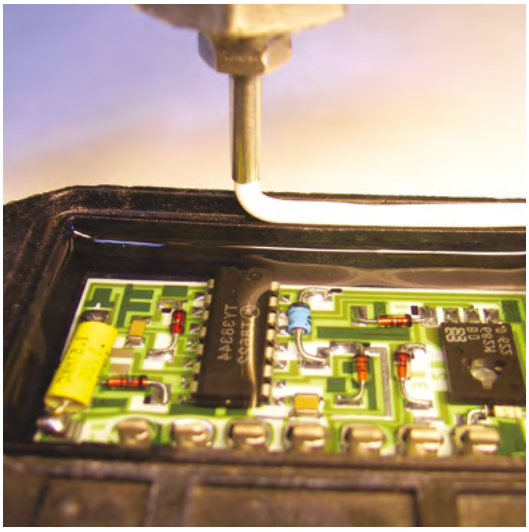
* AM = Americas; AP= Asia Pacific; EMEA = Europe middle-East Africa

** need to be validated by the region



04

Discover our
adhesive solutions



Adhesive Silicones solutions Bluesil™ ESA & CAF for Sealing & Bonding

Silicone materials are widely used in electronic applications for bonding components and sealing against environmental contaminants as they can maintain their physical and electrical properties over a wide range of temperature, moisture and other harsh environments.

Elkem Silicones offers a range of silicone adhesives with CAF™ RTV-1 and Bluesil™ ESA RTV-2 which provide self-adhesion to many metals, ceramic, glass and plastics. These solutions are excellent candidates for assembly applications on or near to sensitive electrical and electronic components as they do not release any corrosive by- products.

Bluesil™ ESA & CAF™ Properties

Type	Products	Application	Description	Color	Ratio	Viscosity (mPa.s)	Shore A Hardness	Tensile strength (Mpa)	Elongation at break (%)
CAF	CAF 2 Fluid	Adhesive potting	Neutral flowable, self-adhesive	Translucent	1 component	30 000	18	0,7	250
CAF	CAF 520	Adhesive potting	Neutral alcoxy curing, thixotropic, primerless	Trans, White	1 component	Thixotropic	15	1,1	500
CAF	CAF 530	Adhesive potting	Neutral alcoxy curing, thixotropic, primerless	Black, White	1 component	Thixotropic	34	3,5	450
CAF	CAF 7	Adhesive potting	Acetoxy flowable, adhesive	Translucent	1 components	7 000	19	0,8	220
CAF AXAD	CAF 33 Axad	Adhesive sealing	Activated acetoxy curing	Black	9:1	Thixotropic	25	2,4	500
RTV2	ESA 7230	Adhesive	Transparent, adhesion	Translucent	10:1	40 000	31	3,2	260
RTV2	ESA 7231	Adhesive	Adhesion metal, plastic, silk screening	Trans	10:1	36 000	38	6,0	400
RTV2	ESA 7241	Adhesive	Adhesion metal, plastic, silk screening	Ivory	1:1	60 000	52	5,5	200
RTV2	ESA 7244	Adhesive	Adhesion metal, plastic, silk screening	Blue	1:1	60 000	50	5,5	200
RTV2	ESA 8352	Adhesive sealing	PC, RT, Adhesive	Black	10:1	90 000	50	2,5	200

Bluesil™ ESA & CAF™ Applications

	Applications					
Products	**ECU housing**	**Connector sealing**	**PTC or Sheath heater**	**Vibration damping**	**Adhesive potting**	**availibility AM /AP/ EMEA***
CAF 2 Fluid					•	on request** for AM/AP
CAF 520	•			•		Yes
CAF 530	•			•		Yes
CAF 7					•	on request** for AM/AP
ESA 7230		•			•	on request** for AP
ESA 7231		•	•		•	on request** for AM/AP
ESA 7241		•	•		•	on request** for AP
ESA 7244		•	•		•	Yes
ESA 8352	•	•				Yes

* AM = Americas; AP= Asia Pacific; EMEA = Europe middle-East Africa

** need to be validated by the region

Pot life	Curing conditions	Thermal conductivity (W/m.K)	Max service Temperature (°C)	Shelf life	Dielectric Strength (IEC 60243), kV/mm	Dielectric constant at 1 kHz (IEC 60250)	Dielectric dissipation factor at 1 kHz (IEC 60250)	Volume resistivity (IEC 60093), .cm
12 min	16h for 2mm RT	0,20	250	10 months				
7 min	7h for 2mm RT	0,30	150	12 months				
15 min	8h for 2mm RT	0,30	185	12 months				
5 min	4h for 2mm RT	0,20	225	18 months	19	5,9	$1,3x10^{-3}$	$6,6x10^{15}$
3-5 min	90 min RT	0,20	250	18 months	20	3,2	$3x10^{-3}$	$3x10^{15}$
>16h	10 min @ 150°C	0,17	200	12 months	19	2,7	0,001	$1x10^{15}$
>16h	10 min @ 90°C	0,25	200	11 months				
>16h	10 min @ 150°C	0,34	200	12 months	19	2,9 @ 100KHz	0,003	$1,5x10^{15}$
>16h	10 min @ 150°C	0,34	200	12 months	19	2,9 @ 100KHz	0,003	$1,5x10^{15}$
12 min	RT	0,34	220	12/6 months				

Our dedicated team of experts for sealing, bonding and protective sensitive electronics applications, are focused on customer needs, providing unique silicone solutions including products and services. Ease your business hassles with Elkem Silicones, using some of our services:

Elkem
A Bluestar Company

Silicones

Delivering your potential

Elkem Silicones

Elkem Silicones is one of the world's leading fully integrated silicone manufacturers with applications and research laboratories, production sites and sales offices located around the globe.

At Elkem Silicones, we're more than just high quality silicone products and associated services. We are a team of professionals located around the globe ready to provide you with the service and performance you deserve with a personal touch.

From technical support to customized formulations and regulatory support, Elkem Silicones has the people in place when and where you need them. We are committed to help you deliver your potential because we care!

For detailed commercial contacts please visit our website: www.silicones.elkem.com

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