MADE IN GERMANY

KERAFOL®

Preview

KERATHERM®

Thermal Management Solutions

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KERAFOL®

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KERAFOL®

Your partner for Thermal Interface Materials and Technical Ceramic special thin- and thickfilm substrates, kiln furniture, wear protection substrates and customer specific development and services!

- **Quality Assurance**
- **International Distribution Network**
- **Optimum Price-Performance-Ratio**
- **Environmental-Friendly**
- **Research & Development**
- **Future-Oriented**

Experienced, innovative and customer-oriented

Many years of experience with oxidic and non-oxidic ceramic materials, continuous development of innovative and customer-focused solutions, and a global sales and distribution network with short delivery times are just some of the reasons why we are one of the leading specialists and manufacturers for thermal management solutions.

Modern production facilities

Our ceramic tapes are manufactured on the latest production facilities, either as standard or customer-specific products in a continuous process. The films can be ordered as endless, rolled material, or already individually punched in several thicknesses. Thereby the flexible ceramic films can be processed in customer specific geometries.

Development, quality control RoHS/Reach compliant

In order to offer our customers competent, customized advice and individual problem solutions, our engineers and staff are constantly doing research, development and tests on new, innovative and high quality materials in our inhouse R&D laboratory.

All KERATHERM® products are RoHS- and REACH compliant!

Many years of experience and a wide variety of innovative solutions makes KERAFOL® your essential partner in the field of “Thermal Management”.

KERAFOL® – Customer satisfaction in all areas

KERAFOL® offers a wide range of products, suitable for diverse electronic and power electronic applications, as for example in the field of Automotive, energy, consumer electronic, power tools or industrial applications.

Thermal Management
and KERATHERM®

Why “Thermal Solutions”?

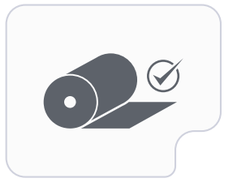
The continuously increasing technical demands, placed by the electronics industry on electronic and electrical devices, have led to a dramatic rise in the problem of heat generation. Higher frequencies, component miniaturization, enhanced functionality and increased device power ratings all lead to high temperatures that need to be controlled to ensure excellent long term stability and durability. Heat sinks, cooling plates and ventilators are often used to dissipate the heat and to reduce the temperature of the electrical circuits to a minimum.

The thermal coupling of suitable conducting materials is also gaining importance in this area. KERAFOL®, with its KERATHERM® products, offers an effective range of products for this purpose.

KERATHERM® are highly flexible products consisting of thermally conductive and electrically insulating polymers filled with either single or multi-component ceramic or thermally conductive materials. Possible mechanical reinforcements with glass fibers or other materials result in a product that is superior to conventional ceramic or mica discs.

KERATHERM® Products:
Advantages and Properties

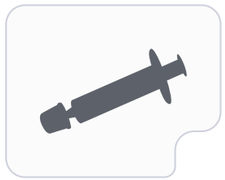
- High thermal conductivity
- High electrical isolation
- Very wide range of product categories like Tapes, Pads and liquid solutions
- Usage of different polymer base for individual needs
- Customized solutions possible
- 100 % Made in Germany



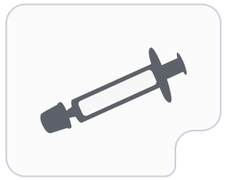
Thermal Conductive Tapes

Graphite Films

EMI-Absorber

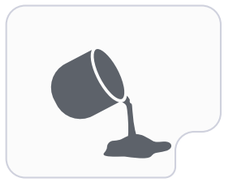


Thermal Adhesive

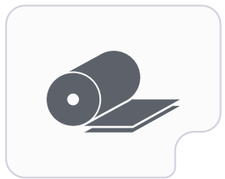


Thermal Grease

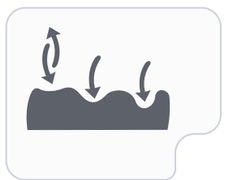
PCM



Gap Filler Liquids



Double sided Adhesive Films



Gap Pads

KERATHERM®
Products

Gap Filler Liquids

Gap Filler Liquids are ceramic filled two-component elastomers without solvents, based on silicone or PU. The new product line of KERAFOL® product is characterized by its wide range of thermal conductivity, high degree of thermal insulation and its good rheological behavior. Due to the low viscosity, such Gap Filler Liquids are ideal for dispensing and even potting. Consequently, an installation with low mechanical stress can be realized, regardless of the tolerances and irregularity of the heat source/sink.

Thermal Adhesive

Two component liquid adhesive with high bond strength and room temperature curing. This silicone based elastomer combines a high thermal conductivity with a very good electrical isolation.

Gap Pads

SOFTTHERM® is the ideal material for smoothing out even large component irregularities. Thanks to its outstanding compressibility, it produces an optimum thermal contact combined with electrical insulation. The supplied thicknesses range from 0.5 - 5.0 mm. Other thicknesses on request.

Thermal Conductive Tapes

Thermal Conductive Tapes, silicone based and silicone free, have a smooth surface, in order to ensure that there is no entrapped air that would interfere with the heat transfer between the component and the heat sink. The material smoothes out microscopic irregularities in the contact surfaces, which improves the thermal interface and therefore increases the heat dissipation.

Adhesive Films

The Adhesive Films KL 90, KL 91 and KL 95 are thermoconducting, electrically insulating, double sided adhesive films. They have an excellent, permanent adhesive strength with high thermal conductivity and outstanding insulation characteristics at the same time.

Thermal Grease

Thermal Grease is especially characterized, by its good plasticity and very low thermal resistance. This non curing single component materials can be applied by dispensing or screen printing and achieves a very low bondline-thickness.

Graphite Films

Graphite Films are based on 100% pure graphite. The films are available as uncoated types or with filled adhesive or standard adhesives for specific applications.

PCM

Phase-Change-Material (PCM) is an excellent alternative for thermal pastes. The PCM changes its aggregate state from solid to liquid at a certain melting temperature. The result is a thermal interface material with a very low bond line. Furthermore the PCM compensates irregularities between the electronic component and the heat sink, thereby optimizing the contact between the surfaces and increasing the heat transfer.

EMI-Absorber

The new series KERABSORB is a hybrid material of THERMAL & EMI ABSORBER. This means, besides the classic properties of a Gap Pad (Softtherm Film) that is used between the heat source (electronic device) & heat sink, this new material also suppresses unwanted energy coupling, resonances or surface currents which cause board level EMI issues.

Gap Filler Liquids

	thermal conductivity	viscosity	dielectric breakdown voltage	density	hardness	characteristics	page
	W/mK	Pas	kV	g/cm³	Shore 00		
GFL 3040	4.3	55 – 85	5.0	3.05	65 – 85	Gap Filler Liquids	17
GFL 3030	3.0	50 – 80	6.0	2.94	65 – 85	Gap Filler Liquids	17
GFL 3020 RF	2.0	45 – 85	10.0	2.4	45 – 60	Gap Filler Liquids	16
GFL 3020	1.8	45 – 70	10.0	2.3	45 – 60	Gap Filler Liquids	16
GFL 1800 SL	1.8	2 – 8	7.5	2.3	55 – 75	Gap Filler Liquids	18
GFL 3000 SL	2.8	25 – 55	8.0	2.54	30 – 40	Gap Filler Liquids	19

Gap Filler Liquids (silicone free)

	thermal conductivity	viscosity	dielectric breakdown voltage	density	hardness	characteristics	page
	W/mK	Pas	kV	g/cm³	Shore 00		
GFU 15	1.5	140 – 180	8.0	2.3	65 – 85	Gap Filler Liquids	21

Thermal Conductive Tapes

	thermal conductivity	thermal resistance	dielectric breakdown voltage	hardness	characteristics	page
	W/mK	K/W	kV	Shore A		
86/82 KERATHERM® red	6.5	0.09	1.0	60 – 70	very high thermal conductivity	43
86/60 KERATHERM® pink	4.5	0.14	5.0	45 – 60	high thermal conductivity, high insulation	42
86/50 KERATHERM® pink	3.5	0.16	1.5	70 – 80	high thermal conductivity	40
86/25 KERATHERM® mint	2.5	0.225	3.5	60 – 75	high thermal conductivity	37
86/30 KERATHERM® white	2.5	0.22	1.5	70 – 80	high thermal conductivity	38
86/37 KERATHERM® green	1.8	0.32	8.0	65 – 75	high insulation	39
L 86/50 KERATHERM® PEEK	1.1	0.51	8.0	70 – 80	high electrical isolation	41

Thermal Conductive Tapes (silicone free)

	thermal conductivity	thermal resistance	dielectric breakdown voltage	hardness	characteristics	page
	W/mK	K/W	kV	Shore A		
U 90 silicone free	6.0	0.082	4.0	70 – 85	silicone free, high thermal conductivity	45
U 85 silicone free	3.0	0.165	6.0	70 – 85	silicone free, high thermal conductivity and high insulation	44
U 80 silicone free	1.8	0.20	4.0	80 – 90	silicone free	45

Gap Pads (SOFTTHERM® Films)

	thermal conductivity	thermal resistance	dielectric breakdown voltage	hardness	characteristics	page
	W/mK	K/W	kV	Shore 00		
6000 SOFTTHERM® Film	6.0	0.41	4.0	55 – 75	high thermal conductivity	34
86/525 SOFTTHERM® Film	5.5	0.44	1.25	50 – 65	high thermal conductivity, very good compressibility	33
86/450 SOFTTHERM® Film	4.5	0.54	5.0	65 – 75	very good thermal and dielectric properties	32
3500 SOFTTHERM® Film	3.5	0.73	5.0	45 – 65	soft, very good thermal and dielectric properties	31
86/325 SOFTTHERM® Film	3.0	0.82	6.0	35 – 50	soft, high thermal conductivity	30
86/320 SOFTTHERM® Film	2.5	1.0	5.0	25 – 38	very soft, good dielectric properties	29
86/235 SOFTTHERM® Film	2.0	1.2	6.0	25 – 45	soft, high thermal conductivity	28
86/238 SOFTTHERM® Film	2.0	1.2	6.0	25 – 45	double layer	28
86/225 SOFTTHERM® Film	2.0	1.2	6.0	30 – 45	fibreglass-reinforced, good self-w adhesive behavior on both sides	27
86/228 SOFTTHERM® Film	2.0	1.2	6.0	30 – 45	double layer	27
86/125 SOFTTHERM® Film	1.5	1.6	6.0	10 - 25	soft, high compressibility	26
86/128 SOFTTHERM® Film	1.5	1.6	6.0	10 - 25	soft, high compressibility	26

Gap Pads (silicone free)

	thermal conductivity	thermal resistance	dielectric breakdown voltage	hardness	characteristics	page
	W/mK	K/W	kV	Shore 00		
U 110 SOFTTHERM® Film (silicone free)	2.0	1.2	8.0	60 – 75	elastic, silicone free	35

Graphite Films

	thermal conductivity	thermal resistance	dielectric breakdown voltage	measured thickness	hardness	characteristics	page
	W/mK	K/W	kV	mm	Shore D		
S 900 highly compressed Graphite film	7.5	0.08	non isolating	0.290	25 – 35	high thermal conductivity	51

Thermal Adhesive

	thermal conductivity	viscosity	dielectric breakdown voltage	density	hardness	characteristics	page
	W/mK	Pas	kV	g/cm³	Shore A		
KERATHERM® Bond 100 RT	1.5	20 – 35	6.0	2.1	20 – 35	Thermal Adhesive	22

Kerabsorb

	thermal conductivity	EMI Attenuation	dielectric breakdown voltage	measured thickness	hardness	page
	W/mK	dB	kV	mm	Shore 00	
Kerabsorb 2500 EMI Absorber	2.5	≥40	5.0	1.0	35 – 50	53
Kerabsorb 1500 EMI Absorber	1.5	≥40	5.0	1.0	35 – 45	53

Adhesive Films

	thermal conductivity	thermal resistance	dielectric breakdown voltage	hardness	characteristics	page
	W/mK	K/W	kV	Shore A		
KL 90 thermal conductive, adhesive film without fibreglass	1.40	0.52	6.0	45	thermal conductivity insulating adhesive	47
KL 91 thermal conductive, adhesive film with fibreglass	1.35	0.55	6.0	59	thermal conductivity insulating adhesive	47
KL 95 thermal conductive, adhesive film without fibreglass	1.30	0.32	2.0	60	thermal conductivity insulating adhesive	46

Thermal Grease

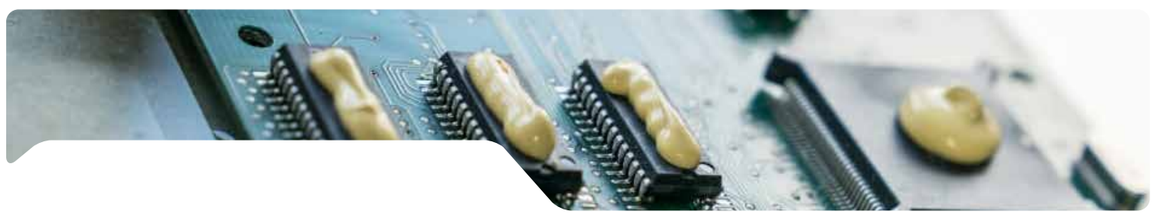
	DeltaT	measured thickness	characteristics	page
	°C	mm		
KP 12 silicone free thermal compound	≤1.2	0.025	silicone free	50
KP 14 silicone free thermal compound	≤1.2	0.025	silicone free	50
KP 99 ceramic filled silicone component	≤1.2	0.025	very low thermal resistance	50
KP 98 ceramic filled silicone component	≤1.4	0.025	silicone based, low thermal resistance	50
KP 97 ceramic filled silicone component	≤1.6	0.025	silicone based	50

PCM

	thermal conductivity	Operating temperature	Softening interval	Possible layer thickness	Post-curing time (40°C @ 250 µm)	page
	W/mK	°C	°C	µm	h	
PCM 16125c phase change material	>3.5	-40 to +120	52 – 54	50 – 250	18 – 24	52

Thermal Management
Challenges for electric vehicles

The change to electric powertrains and the increasing importance of autonomous driving imply a variety of new challenges. Thermal management or rather thermal connectivity and cooling of electrical components have an important role to play. While there is a large number of Thermal Interface Materials, the most common solution for the automotive sector are the Gap Filler Liquids (GFL) and the SOFTTHERM® Pads.

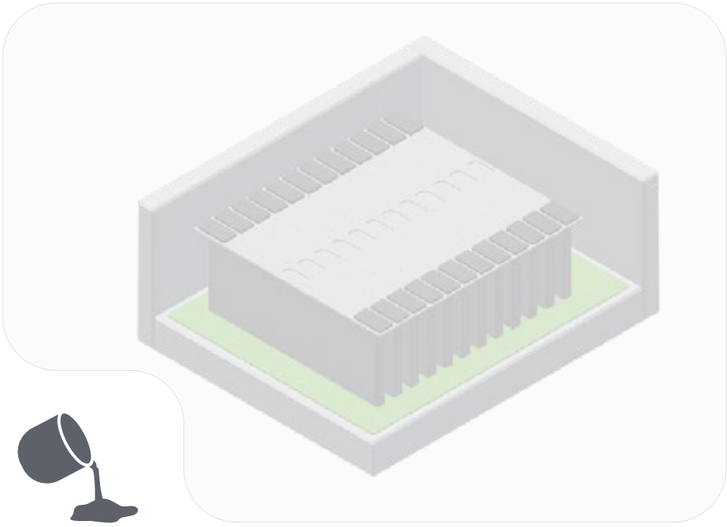


The switch to electric vehicles and the increasing importance of autonomous driving presents completely new applications and challenges in the area of “thermal management”. The functional relationship between the operating temperature of a battery stack and its maximum achievable number of cycles has been proven. According to the literature, the following rule of thumb applies:

“Lowering the operating temperature by just 10°C can double the service life of battery cells”.

The net reach of an electric car is also dependent on the operating temperature of the battery and thus also indirectly on the present thermal cooling. In addition to the concept for thermal connectivity of the energy source, the “car of tomorrow” also requires solutions for electrical components in the areas of LED, sensor technology, on-board network and inverter, one of the core elements of the electric powertrain.

Optimized thermal management for **e-mobility** and performance electronics through - Gap Filler “Liquids”.



The use of thermal pad setups in **e-mobility** is quite common.

Additionally, KERAFOL® also offers Gap Filler Liquids as an alternative to conventional heat conductive Gap Pads. The soft and elastic Gap Filler Liquids are dispensable and quite easy to process.

used in...

Airplanes

Electrical Cars

Multi-media

Cell phones

Power tools

GFL 3020 & GFL 3020 RF
Gap Filler Liquid

Benefits

- Room temperature curing
- Easy to process and dispense
- High material utilization
- Very soft and elastic
- Very good price performance ratio

Properties	Unit	GFL 3020	GFL 3020 RF
Colour		yellow	yellow
Basic material		silicone	silicone
Mixing ratio		1:1	1:1
Curing		1h; RT	1h; RT
Thermal Properties*			
Thermal resistance R_{th}	K/W	1.4	1.2
Thermal conductivity λ	W/mK	1.8	2.0
Electrical Properties**			
Dielectric breakdown voltage $U_{d;\,ac}$	kV	10.0	10.0
Mechanical Properties			
Hardness	Shore 00	45 - 60	45 - 60
Physical Properties			
Application temperature	°C	-40 to +200	-40 to +200
Density	g/cm³	2.30	2.40
Viscosity***	Pas	45 - 70	45 - 85
Total mass loss (TML)	Ma. -%	0.19	0.19
Flame rating	UL-94	V - 0	
Possible thickness	mm	0.05 - 5.0	0.1 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm
*** Shear rate 4.6s^{-1} / 25°C

GFL 3030 & GFL 3040
Gap Filler Liquid

Benefits

- Room temperature curing
- Very high thermal performance
- Highly thixotropic
- High material utilization

Properties	Unit	GFL 3030	GFL 3040
Colour		green	lilac
Basic material		silicone	silicone
Mixing ratio		1:1	1:1
Curing		1h; RT	1h; RT
Thermal Properties*			
Thermal resistance R_{th}	K/W	0.82	0.58
Thermal conductivity λ	W/mK	3.0	4.3
Electrical Properties**			
Dielectric breakdown voltage $U_{d;\,AC}$	kV	6.0	5.0
Mechanical Properties			
Hardness	Shore 00	65 - 85	65 - 85
Physical Properties			
Application temperature	°C	-40 to +200	-40 to +200
Density	g/cm³	2.94	3.05
Viscosity***	Pas	50 - 80	75 - 110
Total mass loss (TML)	Ma. -%	< 0.06	< 0.09
Flame rating	UL-94	V - 0	V - 0
Possible thickness	mm	0.2 - 5.0	0.2 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm *** Shear rate 4.6s^{-1} / 25°C

GFL 1800 SL
Gap Filler Liquid

Benefits

- Room temperature curing
- Higher thermal conductivity in comparison to potting material
- Usage for Encapsulation, electromagnetic coils and applications with small fabrication tolerances
- Low Viscosity Gap Filler Liquid

Properties	Unit	GFL 1800 SL
Colour		green, white
Basic material		silicone
Mixing ratio		1:1
Curing	°C	1h ; 25 °C
Thermal Properties*		
Thermal resistance R_{th}	K/W	1.38
Thermal conductivity λ	W/mK	1.8
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,ac}$	kV	7.5
Mechanical Properties		
Hardness	Shore 00	55 - 75
Physical Properties		
Application temperature	°C	-40 to +200
Density	g/cm³	2.3
Viscosity***	Pas	2 - 8
Total mass loss (TML)	Ma. -%	< 0.17
Flame rating	UL-94	V - 0
Possible thickness	mm	0.2 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm *** Shear rate 4.6s^{-1} / 25°C

GFL 3000 SL
Gap Filler Liquid

NEW PRELIMINARY DATA SHEET

Benefits

- Room temperature curing
- Higher thermal conductivity in comparison to potting material
- Usage for Encapsulation, electromagnetic coils and applications with small fabrication tolerances
- High thermal performance
- Low Viscosity Gap Filler Liquid

Properties	Unit	GFL 3000 SL
Colour		steelblue
Basic material		silicone
Mixing ratio		1:1
Curing	°C	1h ; 25 °C
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.90
Thermal conductivity λ	W/mK	2.8
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	6
Mechanical Properties		
Hardness	Shore 00	55 - 75
Physical Properties		
Application temperature	°C	-40 to +200
Density	g/cm³	2.77
Viscosity***	Pas	10 - 30
Total mass loss (TML)	Ma. -%	< 0.17
Possible thickness	mm	0.2 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm
*** Shear rate 4.6s^{-1} / 25°C

GFU 15 silicone free
Gap Filler Liquid

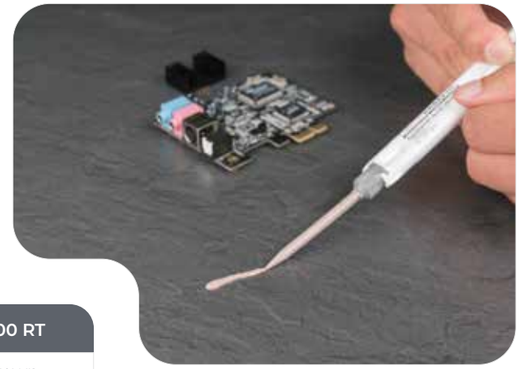
Benefits

- Room temperature curing
- Liquid assembly
- silicone free
- Contains no diisocyanate
- 1:1 Mixing ratio

Properties	Unit	GFU 15
Colour		orange
Basic material		silicone free
Mixing ratio		1:1
Curing at room temperature	h	< 24 RT
Thermal Properties*		
Thermal resistance R_{th}	K/W	1.6
Thermal conductivity λ	W/mK	1.5
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	8.0
Mechanical Properties		
Hardness	Shore 00	65 - 85
Physical Properties		
Application temperature***	°C	-40 to +110
Density	g/cm³	2.30
Viscosity A Comp.****	Pas	140 - 180
Viscosity B Comp.****	Pas	140 - 180
Possible thickness	mm	0.2 - 3.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm *** may increase in hardness
**** Shear rate 4.6s^{-1} / 25°C

KERATHERM® Bond 100 RT
KERATHERM® Thermal Adhesives



Benefits

- High bond strength
- Room temperature curing
- Thixothropic and filling surface structures
- Very soft to compensate mechanical impacts like vibrations

Properties	Unit	100 RT
Colour		brown
Mixing ratio		1:1
Curing	°C	20 min RT
Thermal conductivity λ*	W/mK	1.5
Thermal resistance R_{th}	K/W	1.66
Hardness	Shore A	20 - 35
Tensile shear strength	MPa	>15
Dielectric breakdown voltage $U_{d;\,AC}$	kV	6.0
Density	g/cm³	2.1
Viscosity***	Pas	20 - 40
Application temperature	°C	-40 to +180

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm *** Shear rate 4.6s^{-1} / 25°C

Packing units:

- Syringe: 5 ml
- Double cartridge: 50 ml & 400 ml
- Hobbock set with 34,5 kg per component

Special packing on request!

Application Notes

- All surfaces should be even and free from oil, grease or dust. Clean surface with a solvent (e.g. acetone, thinner, etc.).
- Screw emulsion tube onto the cartridge.
- Squeeze adhesive out of the emulsion tube (in a strand of ca. 3 cm), until the adhesive emitted is of consistent light brown colour. Adhesive that is not of consistent colour will not bind and is thus to be disposed of.
- Evenly spread the adhesive on one of the surfaces to be bonded.
- Bond the components.
- Briefly press the components onto each other and avoid moving them for the next 30 minutes. If bonded at an angle or overhead, please secure the components.
- The initial hardness is achieved after 15 minutes, final hardness is achieved after four hours.

Gap Filler Liquids

Kerafol offers dispensing tests in our in-house laboratory. For further information please contact our application engineering team.

Benefits

- High temperature stability
- High thermal performance
- High dielectric strength
- Compensation of tolerances
- Balancing of vibrations and thermal expansions (CTE)
- Cycle resistant

Application service

Dispensing service

KERAFOL® is using a professional cnc-controlled dispensing system in-house, which is available for trials under the guidance of an expert. Here, customized trial setups can be dispensed and assembled directly on site, perfect for trial setups in the sampling phase. This gives a first preview of the parameters for your serial process (cycle times, dispensing quantity, etc.).

The advantage of such a service is that an automated process with high repeatability and dosing accuracy can be simulated, which is not the case with a „test dosing“ by hand (human factor). The gap filler for the tests is always fresh and perfectly homogenized, which is often not the case with sample cartridges (especially if stored incorrectly).

Screen-Printing service

To apply Thermal Greases or liquid Phase Change Materials (PCM) in a precise way, KERAFOL® also provides a service for screen printing. In terms of PCMs, the materials are heated up to reach a certain flowing behaviour and afterwards they get applied by an individual screen to ensure the requested final thickness. For thermal greases, KERAFOL® is also able to apply the material by a special screen-printing process on both sides of the final product.

Possible applications are covering of electronic components like thyristors or the connection of semiconductors on ceramic or metal plates.

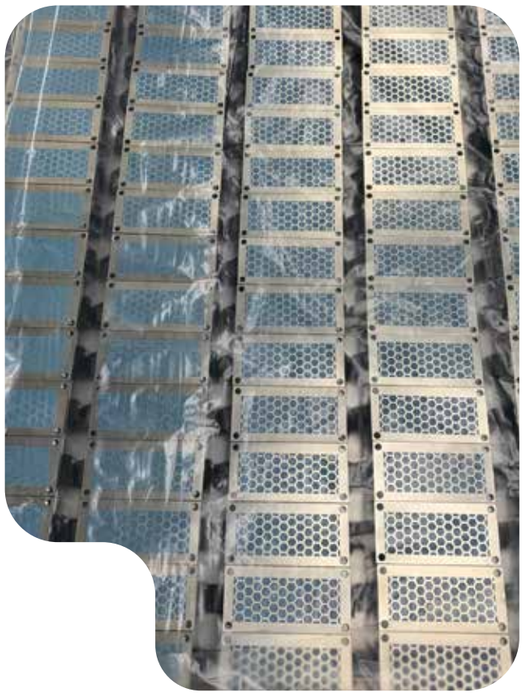
The service last from Prototypes to serial production.

Preparation for the test

- Kick-off-meeting with project presentation
- Send required parts in advance (equipment setup)
- Specification of cycle times / gap
- dimensions/dosing volumes (if required)
- Specification of special requirements (if requested)

Have we aroused your interest?

Request an appointment at:
keratherm@kerafol.com



Gap Pads (SOFTTHERM® Films)

Gap Pads (SOFTTHERM® films) are highly thermally conductive and electrically insulating elastomers based on silicone or polyurethane.

Their softness and elasticity make them ideal for compensating even large unevennesses and air gaps between electronic components and heat sinks, thus enabling efficient heat transfer. In addition to different thermal conductivity and insulation classes, the gap pads differ in their feel.

Two-layer gap pads with additional protective layer or special adhesive coatings are also possible in principle. Depending on customer requirements, gap pads in various thicknesses (0.5 mm to 5.0 mm) can also be manufactured on request.

Benefits

- Industrial applications of components
- Compensation of component unevenness
- High thermal conductivity and electrical isolation
- Good compression behaviour
- Balancing of vibrations and thermal expansions (CTE)
- Easy handling and good mechanical stability

Applications

- Power electronics
- Power Tools
- Automotive
- Energy storage and converter
- Plasma supply panels

Film Options

- Different options in terms of mechanical strength (fiber glass) and adhesion level
- Single-sided adhesive coating possible
- Can be supplied as sheets or die-cut part

Properties

- High elastic behaviour
- Graduated thermal conductivity
- Good electrical insulation
- High temperature stability

used in...

Airplanes

Electrical Cars

Multi-media

Cell phones

Power tools

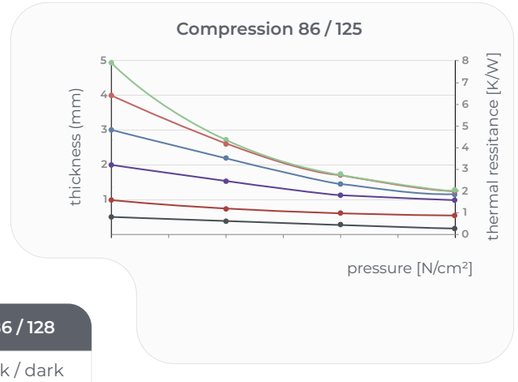
Attention

At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

86 / 125 & 86 / 128
Silicone Gap Pad

Benefits

- Low cost solution
- Very low Hardness
- Elastic behavior
- Also available as a double layer material



Properties	Unit	86 / 125	86 / 128
Colour		dark orange	pink / dark orange
Assembly		single layer, fibre glass reinforce-ment up to 4.0 mm	double layer carrier film 86/52 in 0.125 mm
Thermal Properties*			
Thermal resistance R_{th}	K/W	1.6	1.6
Thermal impedance R_{ti}	°Cmm²/W	322	322
	Kin²/W	0.5	0.5
Thermal conductivity λ	W/mK	1.5	1.5
Electrical Properties**			
Dielectric breakdown voltage $U_{d;\,AC}$	kV	6.0	6.0
Volume resistivity	Ωm	6.1 x 10^{10}	1.8 x 10^{12}
Dielectric loss factor tan δ		1.5 x 10^{-1}	1.0 x 10^{-3}
Dielectric constant ε_r		4.3	2.3
Mechanical Properties			
Hardness	Shore 00	10 - 25	10 - 25
Young´s modulus	N/cm²	24	67
Physical Properties			
Application temperature	°C	-40 to +180	-40 to +180
Density	g/cm³	2.0	1.9
Total mass loss (TML)	Ma.-%	< 0.29	< 0.29
Flame rating	UL-94	V - 0	
Possible thickness	mm	0.5 - 5.0	0.5 - 5.0

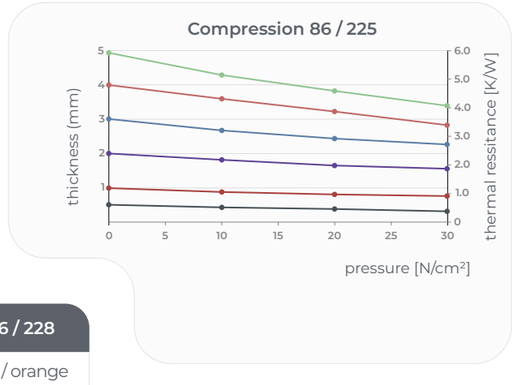
* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm

! At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

86 / 225 & 86 / 228
Silicone Gap Pad

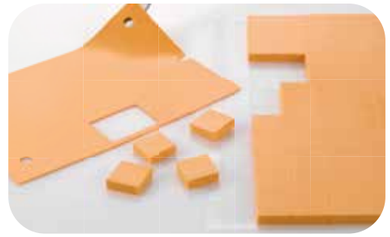
Benefits

- Good price performance ratio
- Very soft to compensate mechanical impacts like vibrations
- Elastic behavior
- Also available as a double layer material



Properties	Unit	86 / 225	86 / 228
Colour		orange	pink / orange
Assembly		single layer, fibre glass reinforce-ment up to 4.0 mm	double layer carrier film 86/52 in 0.125 mm
Thermal Properties*			
Thermal resistance R_{th}	K/W	1.2	1.2
Thermal impedance R_{ti}	°Cmm²/W	240	240
	Kin²/W	0.37	0.37
Thermal conductivity λ	W/mK	2.0	2.0
Electrical Properties**			
Dielectric breakdown voltage $U_{d;\,AC}$	kV	6.0	6.0
Volume resistivity	Ωm	2.2 x 10^{11}	2.8 x 10^{11}
Dielectric loss factor tan δ		1.0 x 10^{-3}	1.0 x 10^{-3}
Dielectric constant ε_r		3.6	2.5
Mechanical Properties			
Hardness	Shore 00	30 - 45	30 - 45
Young´s modulus	N/cm²	58	160
Physical Properties			
Application temperature	°C	-40 to +180	-40 to +180
Density	g/cm³	1.65	1.95
Total mass loss (TML)	Ma.-%	< 0.44	< 0.44
Flame rating	UL-94	V - 0	
Possible thickness	mm	0.5 - 5.0	0.5 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm



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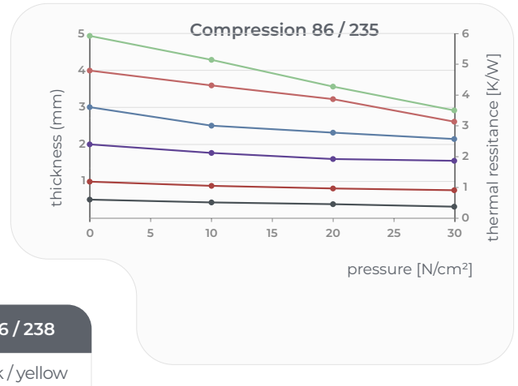
86 / 235 & 86 / 238
Silicone Gap Pad

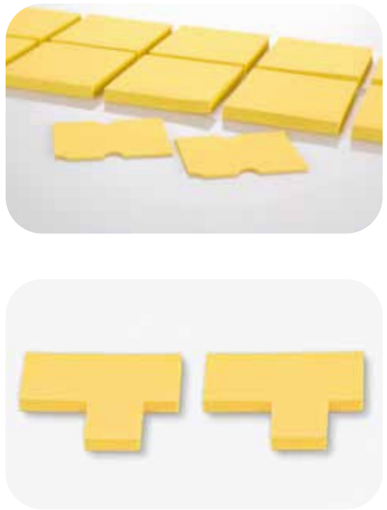
Benefits

- low TML
- Very soft to compensate mechanical impacts like vibrations
- Elastic behavior
- Also available as a double layer material



Properties	Unit	86 / 235	86 / 238
Colour		yellow	pink / yellow
Assembly		single layer, fibre glass reinforce-ment up to 2.0 mm	double layer carrier film 86/52 in 0.125 mm
Thermal Properties*			
Thermal resistance R_{th}	K/W	1.2	1.2
Thermal impedance R_{ti}	°Cmm²/W	240	240
	Kin²/W	0.37	0.37
Thermal conductivity λ	W/mK	2.0	2.0
Electrical Properties**			
Dielectric breakdown voltage $U_{d; AC}$	kV	6.0	6.0
Volume resistivity	Ωm	1.7 x 10^{11}	4.7 x 10^{11}
Dielectric loss factor tan δ		2.0 x 10^{-2}	1.0 x 10^{-3}
Dielectric constant ε_r		3.7	1.9
Mechanical Properties			
Hardness	Shore 00	25 - 45	25 - 45
Young´s modulus	N/cm²	32	122
Physical Properties			
Application temperature	°C	-40 to +200	-40 to +200
Density	g/cm³	1.65	1.65
Total mass loss (TML)	Ma.-%	< 0.10	< 0.05
Flame rating	UL-94	V-0	V - 0
Possible thickness	mm	0.5 - 5.0	0.5 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm



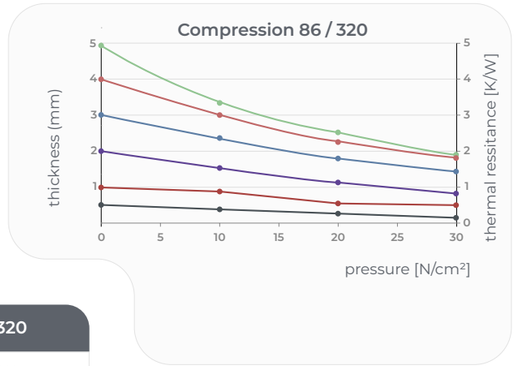
! At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

86 / 320
Silicone Gap Pad

Benefits

- Good compromise between softness and thermal conductivity
- Very soft to compensate mechanical impacts like vibrations
- Elastic behavior



Properties	Unit	86 / 320
Colour		yellow
Assembly		single layer, fibreglass re-inforcement up to 1.5 mm
Electrical Properties*		
Thermal resistance R_{th}	K/W	1.0
Thermal resistance R_{ti}	°Cmm²/W	147
	Kin²/W	0.23
Thermal conductivity λ	W/mK	2.5
Electrical Properties**		
Dielectric breakdown voltage $U_{d; AC}$	kV	5.0
Volume resistivity	Ωm	6.8 x 10^{11}
Dielectric loss factor tan δ		2.9 x 10^{-2}
Dielectric constant ε_r		3.4
Mechanical Properties*		
Hardness	Shore 00	25 - 38
Young´s modulus	N/cm²	32
Physical Properties		
Application temperature	°C	-40 to +180
Density	g/cm³	1.69
Total mass loss (TML)	Ma.-%	< 0.46
Possible thickness	mm	1.0 - 5.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm

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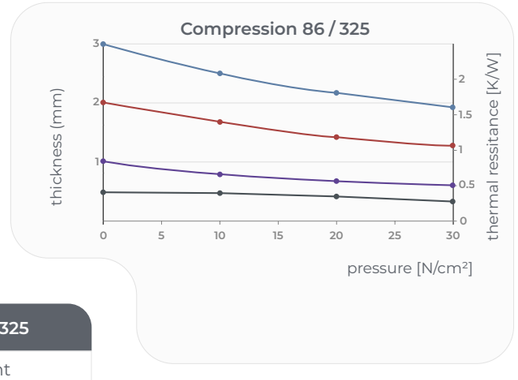
Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

86 / 325
Silicone Gap Pad

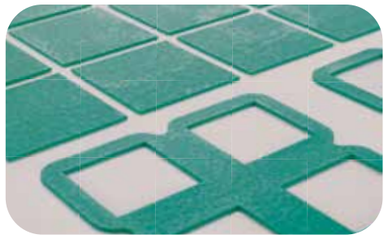
Benefits

- Good compromise between softness and thermal conductivity
- Very soft to compensate mechanical impacts like vibrations
- Elastic behavior



Properties	Unit	86 / 325
Colour		mint
Assembly		single layer, fibreglass re-inforcement up to 1.0 mm
Electrical Properties*		
Thermal resistance R_{th}	K/W	0.82
Thermal resistance R_{ti}	°Cmm²/W	164
	Kin²/W	0.25
Thermal conductivity λ	W/mK	3.0
Electrical Properties**		
Dielectric breakdown voltage $U_{d; AC}$	kV	6.0
Volume resistivity	Ωm	8.5×10^{10}
Dielectric loss factor tan δ		1.5×10^{-1}
Dielectric constant ε_r		3.8
Mechanical Properties*		
Hardness	Shore 00	35 - 50
Young´s modulus	N/cm²	64
Physical Properties		
Application temperature	°C	-40 to +180
Density	g/cm³	1.95
Total mass loss (TML)	Ma.-%	< 0.35
Flame rating	UL-94	V - 0
Possible thickness	mm	0.5 - 4.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm



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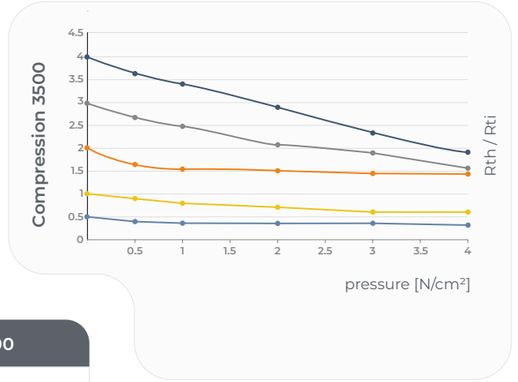
SOFTTHERM® 3500
Silicone Gap Pad

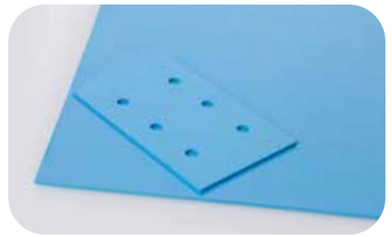
Benefits

- Low thermal resistance
- Good price performance ratio
- Elastic behavior



Properties	Unit	3500
Colour		azure
Assembly		single layer
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.73
Thermal resistance R_{ti}	°Cmm²/W	144
	Kin²/W	0.22
Thermal conductivity λ	W/mK	3.5
Electrical Properties**		
Dielectric breakdown voltage $U_{d; AC}$	kV	5.0
Volume resistivity	Ωm	8.1×10^{10}
Dielectric loss factor tan δ		0.3
Dielectric constant ε_r		3.3
Mechanical Properties*		
Hardness	Shore 00	45 - 65
Physical Properties		
Application temperature	°C	-40 to +200
Density	g/cm³	2.9
Total mass loss (TML)	Ma.-%	< 0.1
Flame rating	UL-94	V - 0
Possible thickness	mm	1.0 - 4.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm



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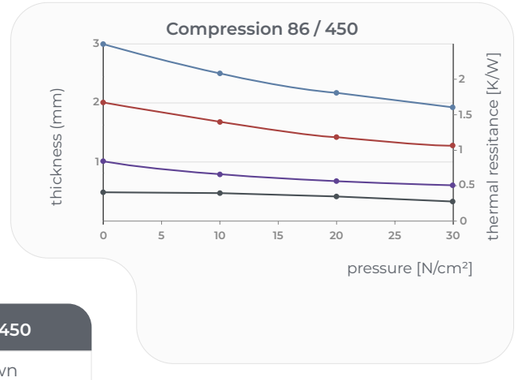
86 / 450
Silicone Gap Pad



Benefits

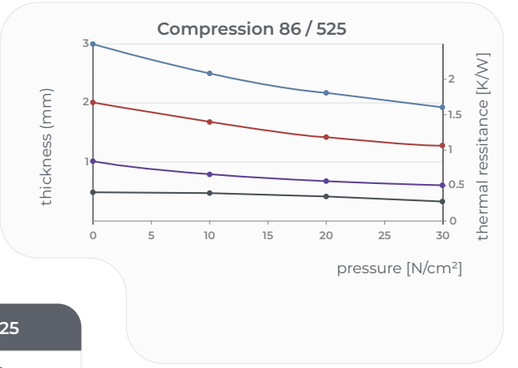
- Low thermal resistance
- High mechanical stability
- Elastic behavior

Properties	Unit	86 / 450
Colour		brown
Assembly		single layer
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.54
Thermal resistance R_{ti}	°Cmm²/W	108
	Kin²/W	0.18
Thermal conductivity λ	W/mK	4.5
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,ac}$	kV	5.0
Volume resistivity	Ωm	3.6×10^{12}
Dielectric loss factor tan δ		3.0×10^{-3}
Dielectric constant ε_r		2.5
Mechanical Properties*		
Hardness	Shore 00	65 - 75
Young´s modulus	N/cm²	95
Physical Properties		
Application temperature	°C	-40 to +180
Density	g/cm³	1.32
Total mass loss (TML)	Ma.-%	< 0.4
Flame rating	UL-94	V - 0
Possible thickness	mm	0.5 - 4.0

At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm

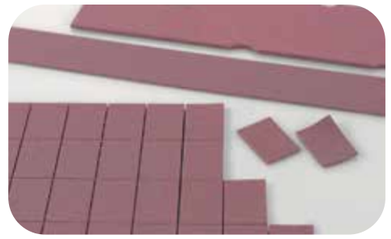
86 / 525
Silicone Gap Pad



Benefits

- Low thermal resistance
- High compensation of surface roughness
- Plastic behavior
- Non sticky, available with adhesive coating

Properties	Unit	86 / 525
Colour		violet
Assembly		single layer
Electrical Properties*		
Thermal resistance R_{th}	K/W	0.44
Thermal resistance R_{ti}	°Cmm²/W	89
	Kin²/W	0.14
Thermal conductivity λ	W/mK	5.5
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,ac}$	kV	1.25
Volume resistivity	Ωm	1.6×10^{13}
Dielectric loss factor tan δ		1.0×10^{-3}
Dielectric constant ε_r		2.7
Mechanical Properties*		
Hardness	Shore 00	50 - 65
Young´s modulus	N/cm²	99
Physical Properties		
Application temperature	°C	-40 to +180
Density	g/cm³	1.18
Total mass loss (TML)	Ma.-%	< 0.35
Flame rating	UL-94	V-0
Possible thickness	mm	0.5 - 3.0



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* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm

SOFTTHERM® 6000
Silicone Gap Pad

NEW
DATA SHEET

Benefits

- High thermal conductivity
- High electrical insulating
- Elastic

Properties	Unit	6000
Colour		pink
Assembly		silicone
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.41
Thermal conductivity λ	W/mK	6.0
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	4.0
Mechanical Properties		
Hardness	Shore 00	55 - 75
Physical Properties		
Application temperature	°C	-40 to +200
Density	g/cm³	3.18
Flame rating	UL-94	V - 0
Possible thickness	mm	0.8 - 3.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm

At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

U 110
Silicone free Gap Pad

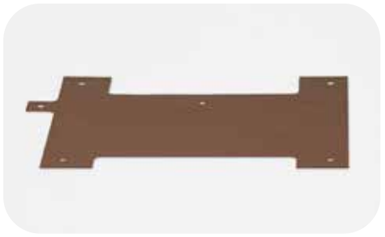
NEW
DATA SHEET

Benefits

- high electrical insulating
- elastic
- Silicone free

Properties	Unit	U 110
Colour		brown
Basic material		silicone free
Thermal Properties*		
Thermal resistance R_{th}	K/W	1.2
Thermal conductivity λ	W/mK	2.0
Electrical Properties**		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	8.0
Mechanical Properties		
Hardness	Shore 00	60 - 75
Physical Properties		
Application temperature***	°C	-40 to +110
Density	g/cm³	1.87
Flame rating	UL-94	V - 0
Possible thickness	mm	0.5 - 2.0

* Measured @ thickness 1 mm ** Measured @ thickness 0.5 mm
*** may cause increase in hardness



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Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

Cost effective standard solutions

Thermally conductive films (KERATHERM®) are highly thermally conductive and electrically insulating elastomers based on silicone or polyurethane. Due to their low layer thickness of 100 to 500 µm, these materials are particularly suitable for generating efficient heat transfer from the heat source (e.g. semiconductor) to the heat sink (e.g. heat sink), especially with low component tolerances. The simultaneously very high electrical insulation strength prevents electrical breakdowns and flashovers. To increase the mechanical stability, most of the films are also available with a glass fiber reinforcement; in addition, a one-sided adhesive coating can be applied.

Benefits

- Smooth surface
- Very good thermal properties even at low contact pressure
- Low hardness
- High self-adhesion
- High temperature stability

Applications

- Power supplies
- Automotive
- White goods
- Industrial applications
- Power converters

Film Options

- Optional single-sided adhesive coating
- Special thicknesses available
- Can be supplied on roll or already punched
- Fibreglass reinforcement available

Properties

- Thermally conductive and electrically insulating at the same time
- Usage for low component tolerances and gap dimensions in the range of 0.1 to 0.5 mm
- Different polymer base possible

used in...

Airplanes

Electrical Cars

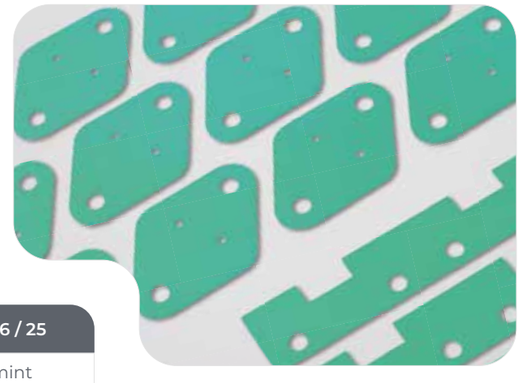
Multi-media

Cell phones

Power tools

86 / 25 KERATHERM®

PRELIMINARY DATA SHEET

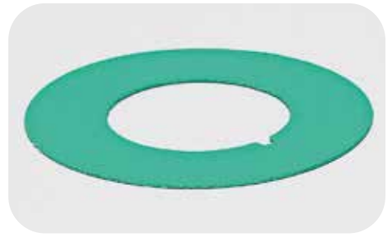


Benefits

- high thermal conductivity
- high electrical isolation
- easy handling
- optional available with adhesive coating

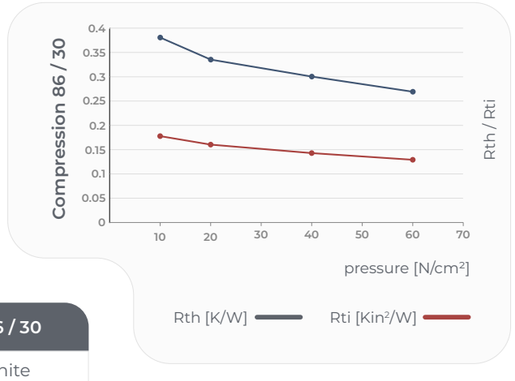
Properties	Unit	86 / 25
Colour		mint
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.225
Thermal conductivity λ	W/mK	2.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	3.5
Volume resistivity	Ωm	$1{,}5 \times 10^{11}$
Dielectric loss factor tanδ		8×10^{-3}
Dielectric constant ε_r		1,9
Mechanical Properties		
Hardness	Shore A	60 - 75
Tensile strength	N/mm²	tbd
Elongation	%	tbd
Physical Properties		
Application temperature	°C	-60 to +200
Density	g/cm³	2.37
Possible thickness	mm	0.225

* Measured @ thickness 0.225 mm



Optional available with oneside adhesive coating **86/25 K**

86 / 30
KERATHERM® white



Benefits

- Good thermal conductivity
- Available with adhesive coating
- Reinforcement with fiberglass possible

Properties	Unit	86 / 30
Colour		white
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.22
Thermal impedance R_{ti}	°Cmm²/W	90
	Kin²/W	0.13
Thermal conductivity λ	W/mK	2.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d;AC}$	kV	1.5
Volume resistivity	Ωm	2.5×10^{11}
Dielectric loss factor tanδ		2.2×10^{-2}
Dielectric constant ε_r		3.0
Mechanical Properties		
Hardness	Shore A	70 - 80
Tensile strength	N/mm²	1.5
Elongation	%	31
Physical Properties		
Application temperature	°C	-60 to +250
Density	g/cm³	2.33
Flame rating	UL - 94	V - 0
Possible thickness	mm	0.125 - 0.5

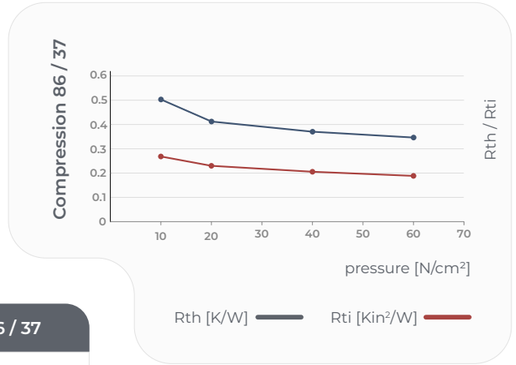
Options

Properties	Unit	86 / 10	86 / 20	86 / 40
Film structure		with fibreglass	with fibreglass and adh. coating	with adh. coating
Overall thickness	mm	0.225	0.250	0.250
Tensile strength	N/mm²	7.5	7.5	1.5
Breakdown voltage $U_{d;ac}$*	kV	1.5	1.5	1.5
Thermal resistance	K/W	0.250	0.300	0.265

* Measured @ thickness 0.225 mm

Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

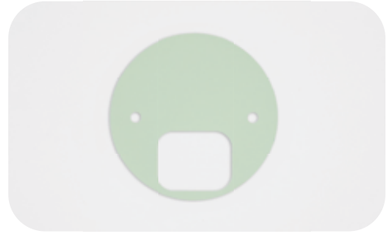
86 / 37
KERATHERM® green



Benefits

- High electrical insulation
- Cost effective solution
- Available with adhesive coating
- Reinforcement with fiberglass possible

Properties	Unit	86 / 37
Colour		green
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.32
Thermal impedance R_{ti}	°Cmm²/W	129
	Kin²/W	0.20
Thermal conductivity λ	W/mK	1.8
Electrical Properties*		
Dielectric breakdown voltage $U_{d;AC}$	kV	8.0
Volume resistivity	Ωm	2.5×10^{11}
Dielectric loss factor tanδ		6.0×10^{-3}
Dielectric constant ε_r		2.9
Mechanical Properties		
Hardness	Shore A	65 - 75
Tensile strength	N/mm²	2.0
Elongation	%	75
Physical Properties		
Application temperature	°C	-60 to +250
Density	g/cm³	2.29
Flame rating	UL - 94	V - 0
Possible thickness	mm	0.125 - 0.5



Options

Properties	Unit	86 / 17	86 / 27	86 / 47
Film structure		with fibreglass	with fibreglass and adh. coating	with adh. coating
Overall thickness	mm	0.225	0.250	0.250
Tensile strength	N/mm²	7.5	7.5	2.0
Breakdown voltage $U_{d;ac}$*	kV	6.0	6.0	8.0
Thermal resistance	K/W	0.50	0.55	0.39

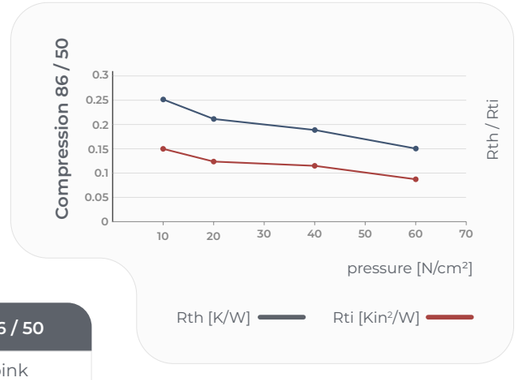
* Measured @ thickness 0.225 mm

Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

86 / 50
KERATHERM® pink

Benefits

- High thermal conductivity
- Available with adhesive coating
- Reinforcement with fiberglass possible



Properties	Unit	86 / 50
Colour		pink
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.16
Thermal impedance R_{ti}	°Cmm²/W	64
	Kin²/W	0.09
Thermal conductivity λ	W/mK	3.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d;AC}$	kV	1.5
Volume resistivity	Ωm	1.3×10^{14}
Dielectric loss factor tanδ		6.7×10^{-2}
Dielectric constant ε_r		2.3
Mechanical Properties		
Hardness	Shore A	70 - 80
Tensile strength	N/mm²	1.3
Elongation	%	25
Physical Properties		
Application temperature	°C	-60 to +250
Density	g/cm³	1.97
Flame rating		UL-94 V-0
Possible thickness	mm	0.125 - 0.5

Options

Properties	Unit	86 / 51	86 / 52	86 / 53
Film structure		with adh. coating	with fibreglass	with fibreglass and adh. coating
Overall thickness	mm	0.250	0.225	0.250
Tensile strength	N/mm²	1.3	10.0	10.0
Breakdown voltage $U_{d;ac}$*	kV	1.5	1.5	1.5
Thermal resistance	K/W	0.26	0.22	0.27

* Measured @ thickness 0.225 mm

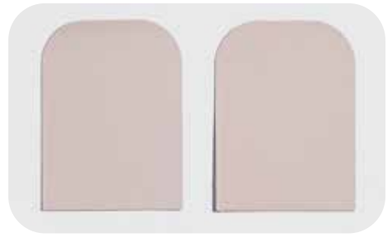
L 86 / 50 – PEEK
KERATHERM®

Benefits

- Double layer material
- High electrical insulation
- Higher thermal performance in comparison to comparable hybrid films
- No removal of a carrier film require

Properties	Unit	
Carrier material		**PEEK® – Folie**
Material thickness	µm	25
Compression material		**Keratherm 86/50**
Thickness	µm	225
Laminate construction		**86/50-PEEK®-Folie**
Thickness	µm	250
Thermal conductivity*	W/mK	1.1
Thermal resistance R_{th}	K/W	0.51
Dielectric breakdown	KV/mm	8.0
Hardness	Shore A	70 - 80
Application temperature	°C	-40° to +250°
Tensile strenght	N/mm²	8

* Measured @ thickness 0.25 mm

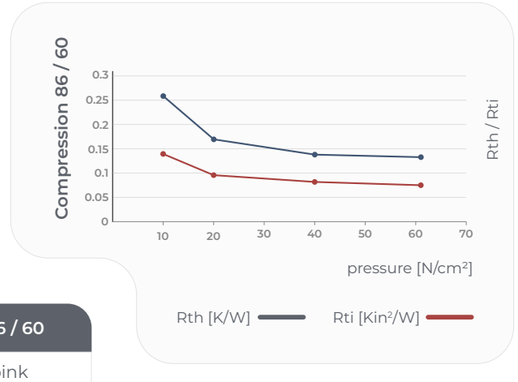


Customized, KERATHERM® Hybrid film with PEEK® carrier film

86 / 60
KERATHERM®

Benefits

- High thermal conductivity
- High electrical insulating
- Available with adhesive coating



Properties	Unit	86 / 60
Colour		pink
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.14
Thermal impedance R_{ti}	°Cmm²/W	56
	Kin²/W	0.079
Thermal conductivity λ	W/mK	4.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	5.0
Volume resistivity	Ωm	>6.0 x 10^{12}
Dielectric loss factor tan δ		0.0
Dielectric constant ε_r		1.5
Mechanical Properties		
Hardness	Shore A	45 - 60
Tensile strength	N/mm²	0.5
Elongation	%	25
Physical Properties		
Application temperature	°C	-60 to +200
Density	g/cm³	1.38
Flame rating	UL-94	V - 0
Possible thickness	mm	0.25 - 0.5

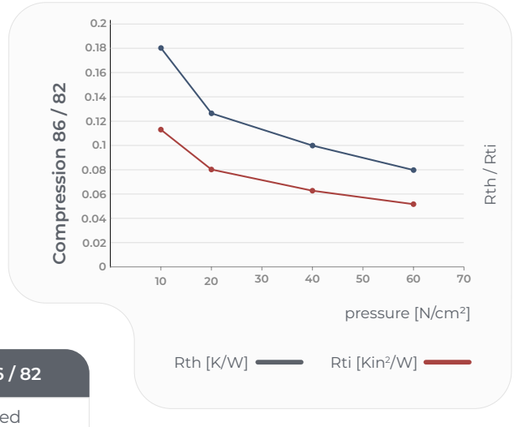
* Measured @ thickness 0.25 mm

Optional available with oneside adhesive coating **86/60 K**

86 / 82
KERATHERM® red

Benefits

- High thermal conductivity
- High electrical insulating
- Available with adhesive coating



Properties	Unit	86 / 82
Colour		red
Assembly		fibreglass reinforcement
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.09
Thermal impedance R_{ti}	°Cmm²/W	35
	Kin²/W	0.05
Thermal conductivity λ	W/mK	6.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d;\,AC}$	kV	1.0
Volume resistivity	Ωm	2.0 x 10^{14}
Dielectric loss factor tanδ		1.4 x 10^{-3}
Dielectric constant ε_r		2.4
Mechanical Properties		
Hardness	Shore A	60 - 70
Tensile strength	N/mm²	13.0
Elongation	%	2
Physical Properties		
Application temperature	°C	-40 to +200
Density	g/cm³	1.23
Flame rating	UL-94	V - 0
Possible thickness	mm	0.25 - 0.3

* Measured @ thickness 0.25 mm

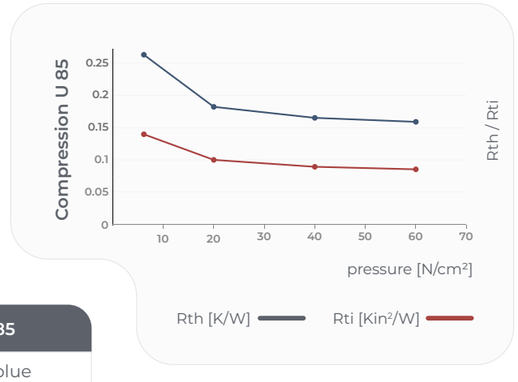
Optional available with oneside adhesive coating **86/82 K**

Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

U 85
KERATHERM® silicone free Thermal Tape

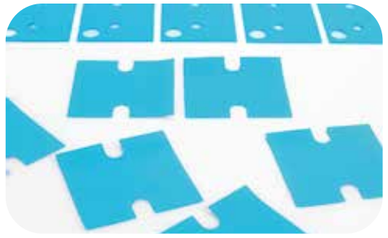
Benefits

- Silicone free (Epoxy)
- High temperature stability
- Good ratio between thermal performance and electrical isolation
- Non sticky, available with adhesive coating



Properties	Unit	U 85
Colour		light blue
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.165
Thermal resistance R_{ti}	°Cmm²/W	60
	Kin²/W	0.091
Thermal conductivity λ	W/mK	3.0
Electrical Properties*		
Dielectric breakdown voltage $U_{d; AC}$	kV	6.0
Volume resistivity	Ωm	4.1×10^{9}
Dielectric loss factor tan δ		2.6×10^{-2}
Dielectric constant ε_r		2.0
Mechanical Properties*		
Hardness	Shore A	70 - 85
Tensile strength	N/mm2	1.0
Elongation	%	>50
Physical Properties		
Application temperature	°C	-40 to +150
Density	g/cm³	1.44
Flame rating	UL-94	V - 0
Possible thickness	mm	0.2

* Measured @ thickness 0.2 mm

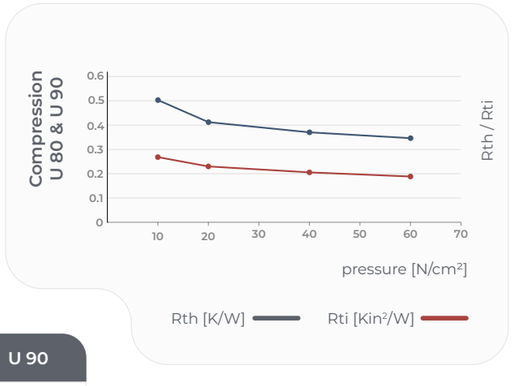


Optional available with adhesive coating **U 80K / U 90K**

U 80 & U 90
KERATHERM® silicone free Thermal Tape

Benefits

- Silicone free (polyurethane)
- Very high thermal performance
- Good ratio between thermal performance and electrical isolation
- Softening effect for an additional increase in heat output
- Non sticky, available with adhesive coating



Properties	Unit	U 80	U 90
Colour		blue	light blue
Thermal Properties*			
Thermal resistance R_{th}	K/W	0.2*	0.082**
Thermal impedance R_{ti}	°Cmm²/W	73*	33**
	Kin²/W	0.11*	0.05**
Thermal conductivity λ	W/mK	1.8*	6.0**
Electrical Properties**			
Dielectric breakdown voltage $U_{d; AC}$	kV	4.0*	4.0**
Volume resistivity	Ωm	$1.4 \times 10^{14*}$	$2.0 \times 10^{11**}$
Dielectric loss factor tan δ		$1.3 \times 10^{-2*}$	$1.4 \times 10^{-2**}$
Dielectric constant ε_r		3.2*	3.1**
Mechanical Properties			
Hardness	Shore A	80 - 90	70 - 85
Tensile strength	N/mm²	3.0	2.0
Elongation	%	130	150
Physical Properties			
Application temperature	°C	-40 to +125	-40 to +125
Density	g/cm³	2.26	1.46
Flame rating	UL-94	V - 0	V - 0
Possible thickness	mm	0.15 - 0.3	0.1 - 0.3

* Measured @ thickness 0.15 mm ** Measured @ thickness 0.2 mm

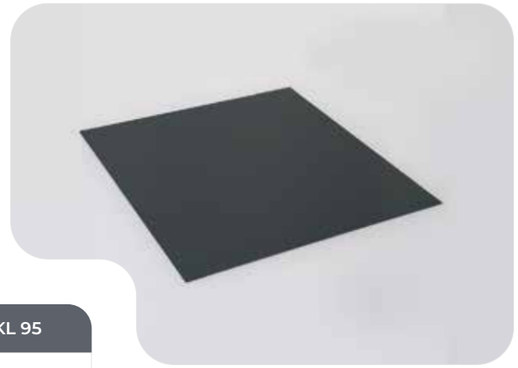
Optional available with adhesive coating **U 80K / U 90K**

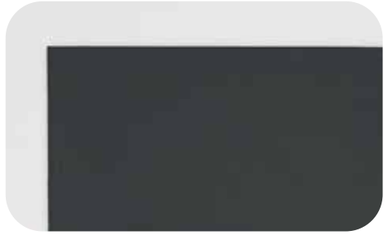
Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

KL 95
KERATHERM® thermally conductive adhesive film

Benefits

- High thermal conductivity
- High adhesive strength
- Good adhesion to various surfaces
- low thickness





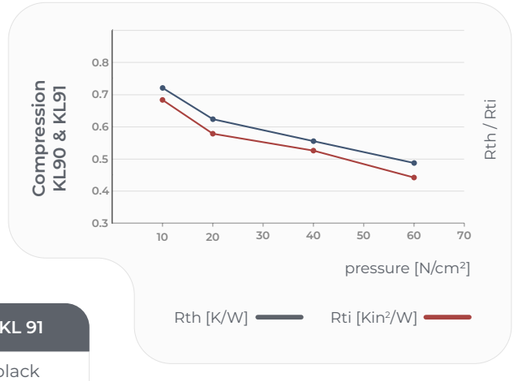
Properties		Unit	KL 95
Colour			grey
Basic material			Filled Acrylic Polymer
Thermal Properties*			
Thermal conductivity λ**		W/mK	1.3
Thermal resistance R_{th}		K/W	0.32
Electrical Properties*			
Dielectric breakdown voltage $U_{d;\,AC}$		kV/mm	2.0
Volume resistivity		Ωm	2.0×10^{11}
Dielectric loss factor tan δ			24×10^{-1}
Dielectric constant ε_r			1.7
Mechanical Properties			
Hardness		Shore A	60
Tensile shear strength*		N/cm²	> 6.5
Tensile shear strength* (Temperature aging)	1h/65°C 24h/65°C 72h/65°C	N/cm²	26.90 34.30 48.80
Physical Properties			
Adhesion*** (bonding strength)		Nmm	> 0.5
Tack*** (surface Adhesiveness)		mm	> 1.0
Density		g/cm³	2.24
Application temperature***		°C	-40 to +100
Flame rating		UL-94	V - 0
Possible thickness		mm	0.18 - 0.3

* Measured @ thickness 0.18 mm
** Tensile shear strength Alu/Foil/Alu – 25x25 mm²(outsourcing – 48h/RT);
*** used measurement – Texture Analyser (TA.XT-plus)

KL 90 & KL 91
KERATHERM® thermally conductive adhesive film

Benefits

- High thermal conductivity
- High adhesive strength
- Good adhesion to various surfaces
- Reinforcement with fiberglass possible



Properties		Unit	KL 90	KL 91
Colour			black	black
Basic material			acrylate	acrylate
Reinforcement (fibreglass)			without	with
Thermal Properties*				
Thermal resistance R_{th}		K/W	0.52	0.55
Thermal impedance R_{ti}		°Cmm²/W	208	220
		Kin²/W	0.32	0.34
Thermal conductivity λ		W/mK	1.40	1.35
Electrical Properties*				
Dielectric breakdown voltage $U_{d;\,AC}$		kV	6.0	6.0
Volume resistivity		Ωm	2.6×10^{4}	2.6×10^{4}
Dielectric loss factor tan δ			3.1×10^{-1}	3.1×10^{-1}
Dielectric constant ε_r			18.5	18.5
Mechanical Properties				
Hardness		Shore A	45	59
Tensile strength		N/mm²	0.3	11.3
Physical Properties				
Application temperature		°C	-40 to +125	-40 to +125
Density		g/cm³	1.98	1.87
Total mass loss (TML)		Ma.-%	< 0.15	< 0.15
Flame rating		UL-94	V-0	V - 0
Possible thickness		mm	0.3 - 0.5	0.3

* Measured @ thickness 0.3 mm

Ceramic filled double-sided adhesive film - with or without fibreglass! KL 90 and KL 91 are double sided adhesive films. They have an excellent, adhesive strength with high thermal conductivities and very good insulation characteristics at the same time.

Low thermal contact resistances can be achieved with adhesive strength on different surfaces.

No mechanical fixation with clips or screws needed.

Due to the soft surface finish, tolerances can be compensated very well. Light weight, easy handling and high elasticity are further advantages.

Adhesive Films
Specific film characteristics

Specific film characteristics		Unit	KL 90	KL 91
			(without fibreglass)	(with fibreglass)
Testing the reflow stability 10s/270°C			passed	passed
		µm	300	300
Shelf Life		month	12	12
Application conditions	[pressure/ time]	N/cm²/sec.	10/10	10/15
Tensile shear strength		N/cm²	> 30	> 25
[25mmx25mm-adhesive area-180°		[DIN EN 1465]		
aluminum – adhesive film – aluminum]		[ASTM D 1002]		
Tensile shear strength	-20°C	N/cm²	157.2	146.8
temperature-depending**	+20°C	[DIN EN 1465]	51.7	50.3
[25mmx25mm-adhesive area-180°	+60°C	[ASTM D 1002]	14.1	13.6
aluminum – adhesive film – aluminum]	+70°C		12.0	10.7
	+80°C		10.7	9.5
Tensile shear strength		N/cm²	31.5	32.5
after vibration test (sinusoidal with temperature overlay at 60°C)				
vibration 10–500 Hz; 50 s/m² (5g) test cycle 24h (6h per axis) [1]				
Tensile shear strength		N/cm²	32.1	35.9
after vibration test (sinusoidal at RT)				
vibration 10–500 Hz; 100 s/m² (10g) test cycle 24h (8h per axis) [2]				
Adhesion* (bonding strength)		Nmm	> 1.2	> 1.0
Tack* (surface adhesiveness)		mm	> 1.5	> 1.2
Peel strength [90° -on aluminum]		N/25mm	3 [adhesive]	9 [adhesive]

Adhesive Coatings

1. Processing and handling instructions

When the basic rules of processing and handling are followed, KL 90, KL 91 and KL 95 double-sided adhesive films display very good processing characteristics. They enable to dispense with mechanical fastening aids such as staples, screws or rivets. In addition to the good thermal and dielectric properties, the adhesion and good plasticity enhace good processability.

2. Surface conditions

The surfaces must be dry and free of any impurities, (such as oil, fat, dust, paint coatings and possible solvent contamination). Condensation (e.g. when changing from cold to warm) must be avoided.

3. Cleaning the surfaces

Depending on the component‘s condition, its surface may need to be cleaned mechanically or chemically. Mechanical cleaning roughens the surface. Make sure that the surface roughness is not as deep as the adhesive tape‘s thickness. Chemical cleaning should be done with soft, clean cloths and solvents that are compatible with the material, such as alcohols, benzines, esters or ketones. These solvents‘ residues must not be left on the surfaces because they interfere with the tape‘s adhesion.

4. Adhesion

Naturally on plastics containing plasticizers and those of a nonpolar character, the bond is impaired. Besides appropriate adhesion tests on these materials, a chemical or physical surface treatment is, if necessary a prerequisite for improved bonding of the materials.

1. Processing temperatures and necessary transmission forces

The adhesive tapes processing temperature is between +18°C and +35°C with a relative air humidity of 50% – 70%. A different temperature or air humidity will change the initial strength (adhesion). Increased contact pressure improves the tape‘s adhesion on the surface of the component. For larger, flatter bonds, adhesion can be improved by using a pressure roller or a surface press (contact pressure about 10 – 15 N/cm²). The final, highest adhesive strength is reached about 24 to 72 hours after application. A moderate temperature treatment to a maximum of 80°C supports this process and shortens the time (dynamic cycle with 30 minutes hold time).

2. Protective sheets and application to the component

The KL 90, KL 91 and KL 95 adhesive films are covered with two different siliconized sheets. To apply the adhesive film, first the PP sheet must be peeled off the tape (re-lease lightly!). Then the adhesive tape (or also stamping) is pressed onto the surface to be adhered to (as described above). This can be followed by direct further processing or interim storage. For final assembly, the PETP protective sheet must be removed.

3. Storage

KL 90, KL 91 and KL 95 double-sided adhesive films must be stored at room temperature and normal humidity (room temp. = 18°C – 22°C; rel. humidity = 50% – 70%). Direct (effects of) sunlight or storage near heat sources must be absolutely avoided. To prevent pressure points, the rolls should be stored only vertically. It is recommended to test Therefore, it is recommended to test the adhesion before each use and application.

KP 97, 98, 99, 12 & 14
KERATHERM® Thermal Grease

Benefits

- Outstanding thermal performance
- Easy to apply
- Available in different packaging forms (syringe, cartridges, cans & hobbocks)
- Available as silicone and silicone free option
- Very low bond line thickness

Properties	Unit	97	98	99	12 silicone free	14 silicone free
Colour		white	grey	anthra-cite	silver	
		◄ softy / pasty ►				
Thermal Properties*						
DeltaT	°C	≤1.6	≤1.4	≤1.2	≤1.2	≤1.2
Electrical Properties*						
Electrical conductivity (according to DIN 51412-1)	pS/m	0	0	0	53	0
Mechanical Properties						
Measured thickness (+/-10%)	mm	0.025	0.025	0.025	0.025	0.025
Physical Properties						
Application temperature	°C	-60 to +200	-60 to +200	-60 to +200	-60 to +150	-60 to +150
Density	g/cm³	2.1	2.2	1.9	1.4	2.2
Viscosity***	Pas	70 - 110	110 - 150	90 - 140	30 - 60	150 - 180
Total mass loss (TML)	Ma.-%	<1.3	<1.5	<0.80	<0.1	<0.25
Possible thickness	mm	◄ variable ►				

* Measured @ thickness 0.025 mm *** Shear rate 4.6s^{-1} / 25°C

KERATHERM® Thermal Greases are ceramic-filled single component silicones with a high thermal conductivity.

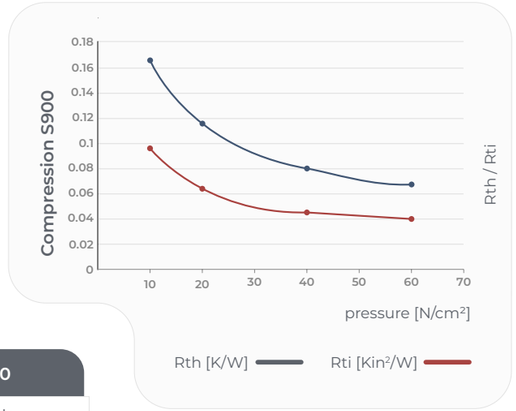
The thermal grease KP 99 is a high-quality thermal grease. The homogeneous thixotropic grease shows a very good fluidity thanks to its low viscosity characteristics, which leads to a good surface adaptation. The silicone free thermal compound KP 12 & KP14 consists of synthetic, thermal polymers and is suitable for a fast and effective heat dissipation. The paste is particularly suitable for silicone sensitive application. If any separation of the filler materials becomes evident, the KP´s must be mixed thoroughly before use according to the corresponding processing instructions.

Special packing on request!

S 900
Interface Material

Benefits

- Outstanding thermal performance
- Heat spreading effect, perfect match for “Hot Spots”
- electrically conductive
- Non sticky, available with adhesive coating
- High temperature stability



Properties	Unit	S 900
Colour		black
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.08
Thermal resistance R_{ti}	°Cmm²/W	34
	Kin²/W	0.047
Thermal conductivity λ z (x / y)	W/mK	7.5 (>300)
Electrical Properties*		
Breakdown voltage $U_{d; AC}$	kV	conductive
Electrical resistance z (x / y)	Ωµm	700 - 800 (7 - 9)
Mechanical Properties		
Hardness	Shore D	25 - 35
Tensile strength	N/mm²	10.0
Elongation	%	5
Physical Properties		
Application temperature	°C	-40 to +500
Total mass loss (TML)	Ma.-%	0.01
Flame rating	UL-94	V - 0
Possible thickness	mm	0.15 - 0.29

* Measured @ thickness 0.29 mm

Graphite S 900 is a highly densed, natural graphite without binding material, which is rolled or pressed into films or plates.

S 900 has exceptional qualities and is therefore used particularly as a cost-effective alternative to conventional interface material. Especially, the anisotropy of the thermal properties (coupled with a possible weight saving of up to 30% compared to conventional materials made of copper or aluminum), makes the S 900 interesting for headspreader applications.

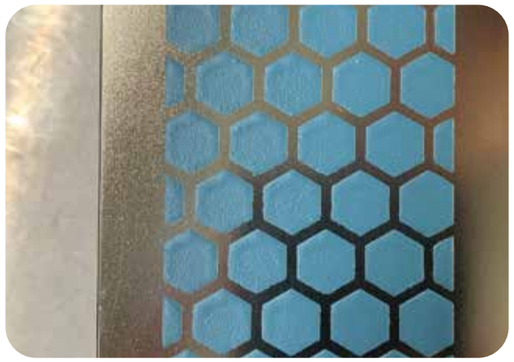
In addition, applications in vacuum or even at higher temperatures (400 °C) are possible. Graphite S 900 has no electrical insulation and can be customized and applied with an adhesive coating.

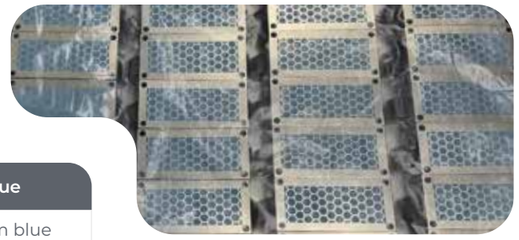
Optional available with oneside adhesive coating as **S 900K**

Data for engineer guidance only. Observed performance varies in application. Engineers are reminded to test the material in application.

PCM 16125C
KERATHERM®

NEW
DATA SHEET





Application

- Thyristors
- Desktop CPU´s
- IGBT units

Benefits

- Filling of smallest irregularities between the power module and heat sink
- Improves the contact between the surfaces and increases the heat transfer
- Good applicability in the form of screen and stencil printing
- Possibility to buy pre assembled parts
- Very low bond line thickness

Properties	Unit	Value
Colour		Titanium blue
Viscosity Brookfield K/P* (Temperature dependent; dried area)	Pas	400/creamy (@40°C) 200 (@50°C) 120 (@60°C) 80 (@80°C) 50 (@100°C)
Thermal conductivity λ	W/mK	>3.5
Dielectric breakdown E_d	KV/mm	>1
Operating temperature	°C	-40 to +120
Softening interval	°C	52 - 54
Possible layer thickness	µm	50 - 250
Post-curing time (40°C @ 250 µm)**	h	18 - 24

* Sheare rate λ 4.6s^{-1}
** This time is valid for natural convection.If there is some kind of ventilation, the time curing time is lower

KERASORB® 2500 & 1500
EMI Absorbing Gap Pad

NEW
DATA SHEET

Application

- Base Station
- 5G Data Infrastructure
- Consumer electronics
- Autonomous vehicle
- Radar sensors

Benefits

- High thermal conductivity
- High EMI suppression @ frequencies up to 77 GHz
- Electromagnetic properties independent from layer thickness
- High electrical isolation
- Elastic

Properties	Unit	2500	1500
Colour		mint	orange
Thermal Properties*			
Thermal conductivity λ	W/mK	2.5	1.5
Electrical Properties**			
Dielectric breakdown voltage $U_{d;\,AC}$***	kV	5.0	5.0
EMI Attenuation**	dB	≥40	≥40
Mechanical Properties			
Hardness	Shore 00	35 - 50	30 - 45

* Measured @ thickness 1 mm ** Measured @ 45 & 77 GHz *** Measured uncompressed

The new series KERABSORB is a HYBRID material of THERMAL & EMI ABSORBER. This means, besides the classic properties of a TIM (thermal interface material) that is used between the heat source (electronic device) & heat sink, this new material also suppresses unwanted energy coupling, resonances or surface currents which cause board level EMI issues.

The Kerabsorb 2500 is characterized by its high thermal conductivity and high level of EMI suppression at very high frequencies up to 77 GHz.

! At maximum pressure, Gap Pads (SOFTTHERM® Films) should not be compressed beyond 30% of the original thickness. In case the material should be compressed more than 30%, the SOFTTHERM® material may leak out.

Good to know...
KERATHERM® Films

KERATHERM® Films are mainly resistant to water, oils and their mixtures, organic solvents and chlorinated hydrocarbons, as well as the cleaning agents used to degrease and wash heat sinks, housings and printed circuit boards.

These materials merely cause swelling of exposed edges of the heat-conducting film, in which the degree of swelling depends on the contact period and the type of solvent applied.

After dry-out, the exposed edges return to their original state with no change in thermal or electrical properties. Due to the short contact times involved, KERATHERM® may be exposed to the conventional baths used in soldering processes.

KERATHERM® products involve none of the substances specified on the VDA list of declarable substances. KERATHERM® products contain no asbestos, lead, mercury, chromium-6, cadmium and/or halogenated hydrocarbons.

All listed products in our catalog meet the requirements of RoHS and Reach!

Delivery form

Besides a large number of standard shapes (TO, TIP, DO or other power housing shapes), we can supply punch parts in customized shapes of almost any arbitrary size based on customer drawings (max. 400x400 mm). Rolls can be supplied in film widths from 15 mm up to 500 mm. The Gap Pads (SOFTTHERM® Films) are supplied as sheets.

Tolerances

KERATHERM® Thermal Conductive Tapes: In terms of geometry, as well as position and shape of the parts or holes to be punched or relevant recesses and outlines, the tolerances are fixed at a minimum of 0.10 mm in accordance with DIN ISO 2768-m. With regard to the thickness, a tolerance of +/- 10% of the total thickness is possible.

KERATHERM® Gap Pads (SOFTTHERM® Films): the geometry, as well as position and shape of the parts are also fixed at a minimum of 0.10 mm in accordance with DIN ISO 2768-c. For holes or relevant recesses and outlines the following table applies.

KERATHERM® Graphit tolerances according DIN ISO 2768-c.

thickness	tolerance thickness	tolerance holes
up to 1.000 mm	± 0.100 mm	± 0.500 mm
up to 2.000 mm	± 0.200 mm	± 1.000 mm
up to 3.000 mm	± 0.300 mm	± 1.500 mm
up to 4.000 mm	± 0.400 mm	± 2.000 mm
up to 5.000 mm	± 0.500 mm	± 2.500 mm

Batchwise determination of thermal properties

An equi-area measurement sample (4 cm^2 base area) is placed between a heatable upper die and a cooled lower die. The lower die is pressed against the upper one by means of a pneumatic pressure cylinder. The pressure dependence of the thermal resistance of the samples is derived from the variation in contact pressure. After approx. 20 minutes, the resultant temperature gradient above the sample is determined via Pt-100 sensors. The thermal resistance (R_{th}) and the thermal conductivity (λ) are calculated on the basis of this temperature gradient, the heating power passed through the sample, and the sample geometry.

Storage conditions and preservation instructions for KERATHERM® products

For more information about the handling and storage conditions contact our team or our sales partner.

Determination of electrical properties

The electrical insulation effect of the heat-conducting films is characterized by their dielectric strength. The higher the breakdown voltage, the better the insulation behavior. Measurements are performed with an AC high-voltage detector.

Determination of mechanical properties

State-of-the-art equipment and measurement devices facilitate the batch-wise determination of tensile strength and elongation of the films. In addition to this, the peel strength of adhesive coated materials is determined on the basis of the “Finat Test Method No.1” (180°).

Determination of flame rating

Most of the available KERATHERM® products have been certified and categorized into classes with regard to their inflammability by the American institute “Underwriters Laboratories Inc.” (UL). In addition to this, the company KERAFOL® endeavours to test its products on the basis of the latest findings in research and development.

YOUNGS MODULUS studies

KERAFOL® analyses the behavior of flexible films under pressure, using the method described in ASTM D 575-91, to determine the so-called YOUNG´S MODULUS. The sample geometry of the individual film types is 30x30 mm at 2.5 mm thickness, and pressure is applied with a constant traverse path of 1 mm/min (0.04 in/min). The pressure dependence of the films is shown on the graphs.

Further information regarding the UL identifiers of KERAFOL® products is available on the UL website. Visit http//www.ul.com and select the category "Online Certifications Directory". From there you can search for the KERAFOL® file under the following file number:

QMFZ2E140693: Plastics Component. This category contains all KERAFOL® products.

KERATHERM®
Test Methods

discription	unit	test method	
Thermal resistance Rth*	K/W	KERAFOL® - test method	
Thermal conductivity*	W/mK	KERAFOL® - test method	ASTM D 5470
Breakdown voltage (Ud; ac)	kV	IEC 243 1+2	ASTM D 149
Dielectric breakdown (Ed; ac)	kV/mm	IEC 243 1+2	ASTM D 149
Volume resistivity	Ωm	DIN 53483-3	ASTM D 257
Dielectric loss factor tan δ		DIN 53483	ASTM D 150
Dielectric constant ε_r		DIN 53483	ASTM D 150
Electrical conductivity	pS/m	DIN 51412-1	
Measured thickness	mm	DIN 53370	ASTM E 252
Tensile strength	N/mm²	DIN EN ISO 527-3	ASTM D 412a
Elongation	%	DIN EN ISO 527-3	ASTM D 412a
Hardness	Shore (A,D) Shore 00	DIN 53505	ASTM D 2240
Compressibility**	mm	DIN ISO 815-1	ASTM D 395
Youngs Modulus**	N/cm²	-	ASTM D 575
Flame rating	UL	UL 94 / E140693	UL 94 / E140693
Total mass loss (TML)	Ma.-%		ASTM E 595

Modified test geometry

* Thermal conductivity λ, thermal resistance R_{th} and thermal impedance Rti (4 cm²)
** Compressibility and „Young´s Modulus“ (3.0 cm x 3.0 cm = 9.0 cm²)

Conversion

Shape: 1000 mil = 1 inch (1“) = 2.54 cm = 25.4 mm
Area: 1 inch² = 6.45 cm2 = 645 mm²
Pressure: 100 N/cm² = 1MPa = 10 bar = 145.037 psi

Have we aroused your interest?
Request a meeting at:
keratherm@kerafol.com

Customized solutions

We are looking forward to receiving your inquiry!

KERAFOL® products are applied in vehicle electronics, telecommunications, aerospace, computers and the semi-conductor industry – in fact, in all areas in which generated heat has to be dissipated from sensitive components to the heat sink.

Discover our wide range of products and take advantage of the diverse application possibilities!

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