



KERATHERM[®]

Thermal Management Solutions

Standard Films

Phase-Change-Material

Thermal Grease

Sofftherm[®] - Films

Spaceform[®]

Thermal Compounds

Graphite Films

Copper Films

Ferrite Films

Adhesive Coatings

KERAFOL[®]

Innovation in Technology and Environmental Protection

KERAFOL®



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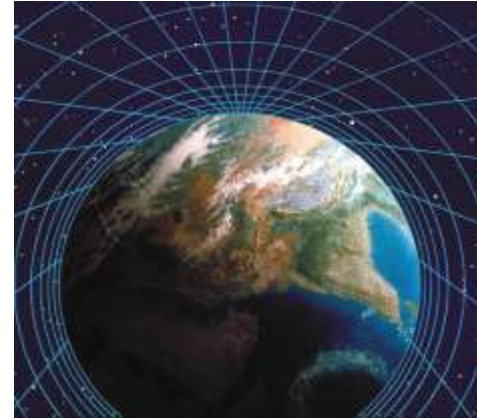
KERAFOL[®] - Your partner for Thermal Solutions and Services



Quality Assurance



Research & Development



**International
Distribution Network**

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.



**Optimum
Price-Performance-Ratio**



Environmental-Friendly Products



Future-Oriented

Development, quality control and environmental compatibility

In order to offer our customers competent, customized advice and individual problem solutions, our engineers and staff are continually carrying out research, development and tests on new, innovative and high quality materials in our in-house R&D laboratory. Through tests during product development we guarantee the environmental compatibility of all raw materials, the manufacturing process and the recyclability of our products.

Kerafol® - Customer satisfaction in all areas

Kerafol® offers a wide range of products, suitable for diverse applications, as for example in microelectronics, Powersupply, White Goods, tele-communication or AC-DC converters.

Our foremost goal is to provide our customers with competent, customer-oriented problem solutions, which we guarantee through continuous quality control, optimization of processes and manufacturing steps.

Why “Thermal Solutions”

The continuously increasing technical demands placed by the electronics industry on electronic and electrical devices has 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 very good performance, stability and durability over the long term. Heat sinks, cooling plates and ventilators are often used to dissipate the heat and reduce the temperature of the electrical circuits to a minimum.

The thermal coupling of suitable heat conducting materials is also gaining importance in this area. Kerafol, with “KERATHERM®” products, offers an effective, uncomplicated and cost-effective range of products for this purpose.

What is KERATHERM®

KERATHERM® are highly flexible products comprising thermally conductive and electrically insulating single or multicomponent polymers filled with ceramic or heat conducting materials.

KERATHERM®, when mechanically reinforced by the incorporation of fiberglass or other materials, offers the user a versatile product that is superior in many aspects to conventional ceramic or mica discs.

KERATHERM® Standard film: advantages and properties

KERATHERM®- heat conducting films are characterized by their high thermal conductivity and their electrical insulation.

In contrast to discs made of mica, aluminum or polyamide, KERATHERM® can be used without a heat conducting compound.

Compared to the thermal compounds still frequently used, KERATHERM® does not dry out during continuous use hence retaining its good thermal conductivity properties over the years.

By using KERATHERM® products, mounting problems such as smearing and assembly errors can be avoided.

Silicone-based KERATHERM® facilitates component mounting thanks to their self-adhesive properties.

An optionally available single-sided adhesive coating also allows long term attachment, even up-side down.

KERATHERM® **standard films white, green, pink, red, brown and the MT-films** 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 smooths out microscopic irregularities in the contact surfaces which improves the thermal interface and therefore increases the heat dissipation. The MT-films are new developed thermoplastic elastomere films with very good insulating behaviour and excellent mechanical and thermal characteristics.

KERATHERM® **silicone-free standard films** are used wherever the use of silicone can lead to problems. Besides good thermal and outstanding electrical properties, these films are characterized by their good cut-through resistance.

KERATHERM® **Phase Change Elastomer** films do not consist of wax material. Because of their outstanding phase changing characteristics these special elastomers are also suitable for the automatic production - easy automatic assembly.

KERATHERM® **Phase Change Material** comprises a combination of hot-melt waxes with or without support. These films smooth out even the smallest irregularities between the power module and heat sink and thereby improving the contact between the surfaces and increase heat transfer.

KERATHERM® **Thermal Grease** is characterized, in particular, by its good plasticity and very low thermal resistance. There is no drying out or leaking out of the silicone components.

KERATHERM® **Softtherm**® is the ideal material for smoothing out even large component irregularities. Thanks to their outstanding compressibility, they produce an optimum thermal contact at the same time being electrically insulating. The supplied thicknesses range from 0.5-5.0 mm. Other thicknesses or shapes are available on request.

KERATHERM® **Copper** is a heat conducting material with copper film on one side produced by a special process. Possible applications are for example, active EMC protection or as a system carrier for electronic switches. A tailored polymer paste system guarantees a wide range of applications.

KERATHERM® **Spaceform**® is a non curing, highly filled silicone compound with outstanding mechanical, electrical and thermal properties. Because of its excellent conformability, Spaceform® allows a customized solution without any restrictions to dimensions or shape.

KERATHERM® **Ferrite products** can be purchased as “KERAMOLD®” sealing compound or as the flexible “F 96” film. The solvent-free, two-component polyurethane “Keramold®” is used to encapsulate and embed electronic components. The F96 ferrite film comprises soft ferrite and, on account of its good magnetic properties, is especially suitable for electromagnetic shielding, flexible coils or other magnetic applications.

KERATHERM® **sealing compounds** can be used for encapsulating whole applications and dispensing housing lids or heat sinks. Thanks to its ease-of-use, it allows even the most complicated geometries to be encapsulated.

KERATHERM® **adhesive coating**: every film type requires its own special adhesive system. Besides flexible adhesives with low adhesive strength, Kerafol® offers adhesives with high adhesive strength or with various fillings for improved heat transfer.

Characteristics of thermal films

• very good mechanical strength	from 2.0 to 20.0 N/mm ²
• very good electrical insulation	up to 26 KV/mm
• very good thermal conductivity	up to 8.0 W/mK
• very good flexibility and temperature resistance	from -60 to +250 °C
• low hardness thereby low contact pressure	starting at 60 Shore A

Characteristics of Softtherm[®]

• low hardness	starting at 10 Shore 00
• very good compressibility (youngs modulus)	starting at 138 N/cm ²
• very good dielectric properties	starting at 10 KV/mm
• high thermal conductivity	up to 6.0 W/mK
• very good resilience	

Characteristics of thermal compounds (silicone basis)

• elastic to very inelastic behaviour	strating at 10 Shore 00
• high temperature resistance	up to 200 °C
• very good thermal conductivity	up to 5.0 W/mK
• low shrinkage	
• very good resistance to wetness, buck, acid and chemicals	
• sealing of complicated geometries and components	
• ferrite sealing compounds for EMC-applications	

Characteristics of Phase Change Materials

• very low thermal resistance	R _{th} at 0.05 KW
• electrical insulating	E _d 5.0 KV/mm
• very good compressibility	up to 80%
• single sided adhesive	

KERATHERM® - Specific Values and Characteristics

KERATHERM® Standard Films

film		thermal conductivity W/mK	thermal resistance K/W	breakdown voltage kV	thickness mm	hardness Shore A	characteristics	page
86/83	Kertherm® red with fibre glass	8.0	0.07	1.0	0.250	55	highest thermal conductivity	15
86/82	Kertherm® red with fibre glass	6.5	0.09	1.0	0.250	65	very high thermal conductivity	15
U 90	Keratherm® silicone free	6.0	0.09	4.0	0.200	70	silicone free, high thermal conductivity	17
86/81	Kertherm® red basic film	5.5	0.10	1.0	0.200	30	high thermal conductivity	15
86/50	Keratherm® pink basic film	3.5	0.16	1.5	0.225	72	high thermal conductivity	14
86/30	Keratherm® white basic film	2.5	0.22	1.5	0.225	75	good thermal conductivity / isolation	12
U 80	Keratherm® silicone free	1.8	0.20	4.0	0.150	85	silicone free	17
86/37	Keratherm® green basic film	1.8	0.35	8.0	0.225	69	high isolation	13
MT 103	Elastomer-film	1.8	0.31	10	0.225	60	silicone free, high isolation	18
70/50	Kertherm® brown with fibre glass	1.4	0.44	4.0	0.250	85	good price-performance-ratio	16
U 23	Keratherm® silicone free	1.2	0.52	9.0	0.250	85	silicone free	17
MT 102	Elastomer-film	1.1	0.50	10	0.225	70	silicone free, high isolation	18

KERATHERM® Softtherm®

film		thermal conductivity W/mK	thermal resistance K/W	breakdown voltage kV	thickness mm	hardness Shore 00	characteristics	page
86/600	Softtherm® highest thermal conductivity	6.0	0.20	1.5	0.5	60-70	highest thermal conductivity	28
86/500	Softtherm® highest thermal conductivity	5.0	0.25	1.0	0.5	75	high thermal conductivity	28
86/300	Softtherm® highest thermal conductivity	3.0	0.41	8.0	0.5	65	flexible, high thermal conductivity	28
86/255	Softtherm® high thermal conductivity	2.0	0.85	10.0	0.5	30	soft, high thermal conductivity	27
86/202	Softtherm® low cost	1.4	0.90	2.5	0.5	25	good price-performance-ratio	29
86/212lb	Softtherm® low cost	1.4	0.90	2.0	0.5	30	low bleeding behaviour	29
86/200	Softtherm® standard	1.0	1.5	8.0	0.5	10	soft, highly compressible	26
86/210lb	Softtherm® standard	1.0	1.5	8.0	0.5	15	low bleeding behaviour	26

KERATHERM® Thermal Compounds

film		thermal conductivity W/mK	viscosity Pas	dielectric breakdown KV/mm	density g/cm³	hardness Shore 00	characteristics	page
GF 5000	1-component silicone elastomer	5.0	approx. 250	> 1.0	2.50	65	single component, highly conducting	32
GF 300	2-component silicone elastomer	3.0	80	1.0	2.40	50	good compressibility	32
GF 255	2-component silicone elastomer	1.5	47.5	1.5	2.62	10	very good compressibility	32
GF 1000	1-component silicone elastomer	1.1	330	5.0	2.45	55	single component	32
Keramold® (PU-basis)	2-component ferrite-sealing compound	1.0	80	4.0	2.35		electrically isolating, high mechanical strength	38
Keramold® (silicone basis)	2-component ferrite-sealing compound	0.6	25	0.4	2.40		electrically isolating, high mechanical strength	38

KERATHERM® - Specific Values and Characteristics

KERATHERM Graphite Films

film		thermal conductivity W/mK	thermal resistance K/W	breakdown voltage kV	thickness mm	hardness Shore D	characteristics	page
S 900	highly compressed Graphite film	7.5	0.08	not insulating	0.300	30	highest thermal conductivity	35
90/25	Keratherm® Graphite film	7.0	0.05	not insulating	0.125	30	very good thermal conductivity	34
90/10	Keratherm® Graphite basic film	5.5	0.09	not insulating	0.200	30	good thermal conductivity	34

KERATHERM® Ferrite Film

film		thermal conductivity W/mK	thermal resistance K/W	dielectric breakdown KV/mm	thickness mm	hardness Shore A	application	page
F 96	thermal conductive film from soft-magnetic ferrite	1.0	-	1.0	0.225	82	for electromagnetic absorption, flexible PCBs	37

KERATHERM® Cooper Film

film		thermal conductivity W/mK	thermal resistance K/W	dielectric breakdown KV/mm	thickness mm	hardness Shore A	application	page
86/77	thermal conductive film with single sided copper lamination	1.1	0.90	10.0	0.300	85	as active EMV protection or as system carrier	36

KERATHERM® PCM, Thermal Grease

film		thermal conductivity W/mK	thermal resistance K/W	dielectric breakdown KV/mm	thickness mm	characteristics	page
KP 92	ceramic filled silicone compound	10.0	0.007	-	0.03 – 0.06	conducting	23
KP 12	silicone free thermal compound	10.0	0.006	-	0.03 – 0.06	silicone free	23
PCM 471	filled hot setting wax	4.0	0.01	5.0	0.200	easy handling	22
KP 97	ceramic filled silicone compound	5.0	0.012	2.0		insulating	23
86/114	thermoplastic silicone elastomer	4.0	0.15	5.0	0.250	equated softening interval, good compressibility, low thermal resistance	20
86/117	thermoplastic silicone elastomer	3.0	0.06	4.0	0.250	equated softening interval, good compressibility, low thermal resistance	20

KERATHERM® Spaceform®

film		thermal conductivity W/mK	thermal resistance K/W	dielectric breakdown KV/mm	thickness mm	characteristics	page
Spaceform® Q	highly filled, moulding silicone compound	1.4	1.8	-	2.0 – 30.0	non-curing thermal compound, mouldable	31

KERATHERM® - Standard Films

Flexible films consist of a silicone elastomer filled with various thermally conductive ceramic materials. All film types are electrically insulating. For increased mechanical strength, the films are also available with fibre glass reinforcement.

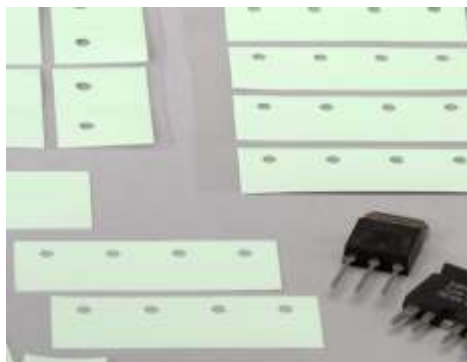
The standard films adapt to the component surface. Small irregularities can be evened out by using only minimal contact pressures.

The good thermal properties of these films guarantee optimum heat transfer to the heat sink and at the same time achieving good electrical insulation properties. All KERATHERM® standard films are UL tested.



KERATHERM® - white

The highly thermal conductive white group, with its well-balanced thermal, electrical and dielectric behaviour, is created by filling a silicone elastomer base with aluminum oxide. An increase in mechanical strength can be achieved by fibre glass reinforcement. Both unreinforced and reinforced film types can optionally be supplied with an adhesive coating. In general however, the very good self-adhesion of the film will be sufficient for most mounting required.



KERATHERM® - green

This silicone elastomer film filled with aluminium oxide is characterized by its excellent electrical characteristics. It exhibits good thermal behaviour. Optional fibre glass reinforcement leads to very good mechanical properties. These film types possess excellent mechanical stability along with good perforation strength. Because of its structure Keratherm® green has extremely good self-adhesive properties. Optional adhesive coatings are available.



KERATHERM® - pink

Keratherm®- pink has outstanding thermal conductivity which is achieved by a specially filled silicone elastomer. The good electrical insulation properties are thereby retained. On request, these films can also be supplied with fibre glass reinforcement and with or without adhesive coating. The excellent thermal resistance of this film enables the optimum heat transfer to the heat sink.

PROPERTIES

- good insulation properties
- heat-conducting
- good compressibility
- fully crosslinked
- flexible
- environmental friendly
- RoHS conform

BENEFITS

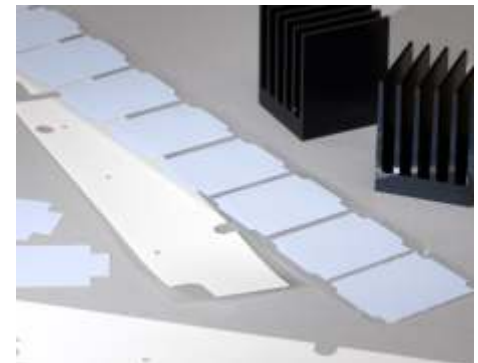
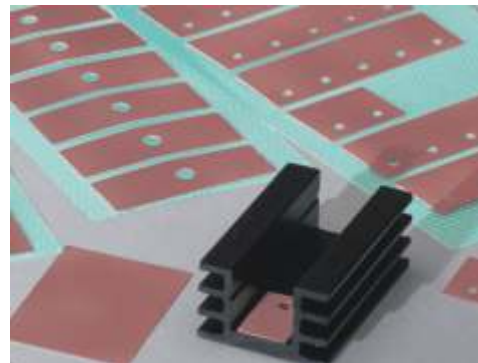
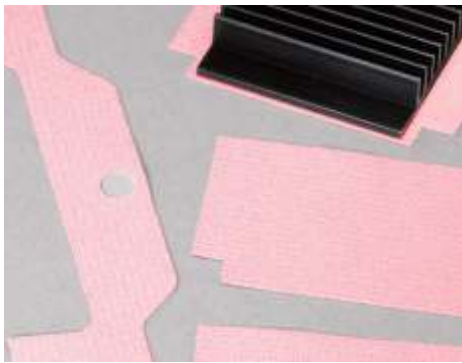
- smooth surface
- very good properties even at very low contact pressure
- low hardness
- high self-adhesion
- UL listed

FILM OPTIONS

- optional single-sided adhesive coating
- special thicknesses available
- can be supplied on roll or already punched
- fibre glass reinforcement available

APPLICATIONS

- power supplies
- automotive, engine controllers
- LCD displays
- white goods
- audio- and video components
- power converters



KERATHERM® - red

This film is especially suitable for high-power applications. It has excellent thermal and electrical properties. Thanks to its good performance, the Keratherm red can be used reliably in densely packed electronic applications.

KERATHERM® - brown

Keratherm®-brown with its very good thermal properties is an excellent choice for cost-effective solutions. These fibreglass reinforced films along with their very smooth surface has very good thermal resistance with a high insulation capacity at low mounting pressures.

KERATHERM® - silicone free

In case of concerns about using silicones, we offer you a ceramic-filled polyurethane film as an alternative material. Besides good thermal and outstanding electrical properties, these films are characterized by very good perforation strength. These good physical properties are matched with an excellent price-performance ratio.

KERAFOL®

Keratherm® - white Standard films

Applications:

- Power supplies
- Audio- and video components
- White Goods
- Power Converters (AC-DC, DC-DC)
- Engine controllers



Properties	Unit	86/30 basic film
Colour		white
Thermal properties		
Thermal resistance R_{th}	K/W	0.22
Thermal impedance R_{ti}	°Cmm ² /W Kin ² /W	90 0.13
Thermal conductivity	W/mK	2.5
Electrical properties		
Breakdown voltage $U_{d; ac}$	kV	1.5
Dielectric breakdown $E_{d; ac}$	KV/mm	7.0
Volume resistivity	cm	2.5×10^{11}
Dielectric loss factor tan	1	2.2×10^{-2}
Dielectric constant ϵ_r	1	3.0
Mechanical properties		
Measured thickness (+/-10%)	mm	0.225
Hardness	Shore A	75
Tensile strength	N/mm ²	2.0
Elongation	%	31
Physical properties		
Application temperature	°C	-60 to +250
Density	g/cm ³	2.4
Flameclass	UL	94V-0

The highly thermal conductive white group, with its well-balanced thermal, electrical and dielectric behaviour, is created by filling a silicone elastomer base with aluminum oxide. An increase in mechanical strength can be achieved by fibre glass reinforcement. Both unreinforced and reinforced film types can optionally be supplied with an adhesive coating. In general however, the very good self-adhesion of the film will be sufficient for most mounting required.

Options for Keratherm® -white

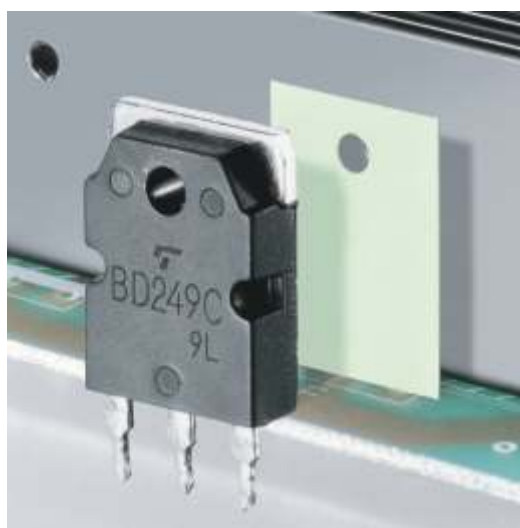
Type	Film structure	Overall thickness mm	Tensile strength N/mm ²	Thermal resistance	
				K/W	Kin ² /W
86/10	86/30 with fibre glass	0.225	15	0.30	0.15
86/20	86/30 with fibre glass and adhesive coating	0.250	15	0.49	0.19
86/40	86/30 with adhesive coating	0.250	2.0	0.37	0.17

The following thicknesses are available: 0,125 mm; 0,225 mm; 0,3 mm; 0,4 mm; 0,5 mm

Keratherm® - green Standard films

Applications:

- Automotives
- Telecommunication units
- High voltage units
- DC-DC converters



Properties	Unit	86/37 basic film
Colour		green
Thermal properties		
Thermal resistance R_{th}	K/W	0.35
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	125 0.19
Thermal conductivity	W/mK	1.8
Electrical Properties		
Breakdown voltage $U_{d; ac}$	kV	8.0
Dielectric breakdown $E_{d; ac}$	KV/mm	26
Volume resistivity	cm	2.5×10^{11}
Dielectric loss factor \tan	1	6.0×10^{-3}
Dielectric constant ϵ_r	1	2.9
Mechanical properties		
Thickness (+/-10%)	mm	0.225
Hardness	Shore A	69
Tensile strength	N/mm ²	3.0
Elongation	%	75
Physical properties		
Application temperature	$^{\circ}\text{C}$	-60 to +250
Density	g/cm ³	2.4
Flameclass	UL	94V-0

This silicone elastomer film filled with aluminium oxide is characterized by its excellent electrical characteristics. It exhibits good thermal behaviour. Optional fibre glass reinforcement leads to very good mechanical properties. These film types possess excellent mechanical stability along with good perforation strength. Because of its structure Keratherm® green has extremely good self-adhesive properties. Adhesive coatings are available.

Options for Keratherm® -green

Type	Film structure	Overall thickness mm	Tensile strength N/mm ²	Thermal resistance	
				K/W	Kin^2/W
86/17	86/37 with fibre glass	0.225	15	0.59	0.23
86/27	86/37 with fibre glass and adhesive coating	0.250	15	0.61	0.26
86/47	86/37 with adhesive coating	0.250	3.0	0.56	0.20

The following thicknesses are available: 0,125 mm; 0,225 mm; 0,3 mm; 0,4 mm; 0,5 mm

Keratherm® - pink Standard films

Applications:

- Automotives
- Audio and video components
- White Goods
- Power converters (AC-DC, DC-DC)
- Engine controllers
- LCD displays



Properties	Unit	86/50 basic film
Colour		pink
Thermal properties		
Thermal resistance R_{th}	K/W	0.16
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	64 0.09
Thermal conductivity	W/mK	3.5
Electrical properties		
Breakdown voltage $U_{d; ac}$	kV	1.5
Dielectric breakdown $E_{d; ac}$	KV/mm	7.0
Volume resistivity	cm	1.3×10^{14}
Dielectric loss factor \tan	1	6.7×10^{-2}
Dielectric constant ϵ_r	1	2.3
Mechanical properties		
Overall thickness (+/-10%)	mm	0.225
Hardness	Shore A	72
Tensile strength	N/mm ²	2.0
Elongation	%	2.5
Physical properties		
Application temperature	$^{\circ}\text{C}$	-60 to +250
Density	g/cm ³	2.4
Flameclass	UL	94V-0

Keratherm® - pink has outstanding thermal conductivity which is achieved by a specially filled silicone elastomer. The good electrical insulation properties are thereby retained. On request, these films can also be supplied with fibre glass reinforcement and with or without adhesive coating. The excellent thermal resistance of this film enables the optimum heat transfer to the heat sink.

Options for Keratherm® -pink

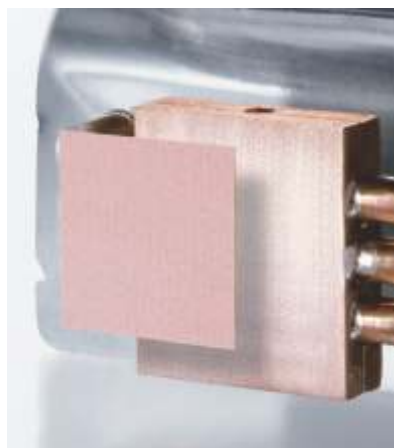
Type	Film structure	Overall thickness mm	Tensile strength N/mm ²	Thermal resistance	
				K/W	Kin^2/W
86/51	86/50 with adhesive coating	0.250	2.1	0.25	0.13
86/52	86/50 with fibre glass	0.225	15	0.28	0.14
86/53	86/50 with fibre glass and adhesive coating	0.250	15	0.31	0.15

The following thicknesses are available: 0,125 mm; 0,225 mm; 0,3 mm; 0,4 mm; 0,5 mm

Keratherm® - red Standard films

Applications:

- “High End” solutions
- Controll boards
- BGA applications
- Hard-disc-drives



Properties	Unit	86/81	86/82 with fibre glass	86/83 with fibre glass
Colour		red	red	red
Thermal properties				
Thermal resistance R_{th}	K/W	0.10	0.09	0.07
Thermal impedance R_{ti}	°Cmm ² /W Kin ² /W	39 0.07	35 0.05	31.2 0.04
Thermal conductivity	W/mK	5.5	6.5	8.0
Electrical properties				
Breakdown voltage $U_{d; ac}$	kV	1.0	1.0	1.0
Dielectric breakdown $E_{d; ac}$	KV/mm	4.0	4.0	4.0
Volume resistivity	cm	2.0×10^{14}	2.0×10^{14}	5.9×10^{15}
Dielectric loss factor tan	1	1.9×10^{-3}	1.4×10^{-3}	30×10^{-3}
Dielectric constant ϵ_r	1	2.3	2.4	1.83
Mechanical properties				
Overall thickness (+/-10%)	mm	0.200	0.250	0.250
Hardness	Shore A	30	65	55
Tensile strength	N/mm ²	0.6	20	10
Elongation	%	20	2	2
Physical properties				
Application temperature	°C	-40 to +200		
Density	g/cm ³	2.9	2.35	2.30
Flameclass	UL	-	94V-0	-

This film is especially suitable for high-power applications. It has excellent thermal and electrical properties. Thanks to its good performance, the Keratherm red can be used reliably in densely packed electronic applications.

Options for Keratherm® -red

Type	Film structure	Overall thickness mm	TML Ma.-%	Tensile strength N/mm ²	Thermal resistance	
					K/W	Kin ² /W
86/82lb	86/82 with fibre glass as low bleeding	0.250	< 0.29	10	0.14	0.09

The following thicknesses are available: 0,250 mm; 0,3 mm; 0,4 mm; 0,5 mm

Keratherm® - brown Standard films

Applications:

- Automotives
- Engine controllers
- LCD Displays
- Power converters (AC-DC, DC-DC)
- Audio and video components
- White Goods



Properties	Unit	70/50 with fibre glass
Colour		brown
Thermal properties		
Thermal resistance R_{th}	K/W	0.44
Thermal impedance R_{ti}	$^{\circ}Cmm^2/W$	178
	Kin^2/W	0.27
Thermal conductivity	W/mK	1.4
Electrical properties		
Breakdown voltage $U_{d; ac}$	kV	4.0
Dielectric breakdown $E_{d; ac}$	KV/mm	16
Volume resistivity	cm	1.0×10^{13}
Dielectric loss factor \tan	1	7.3×10^{-3}
Dielectric constant ϵ_r	1	3.6
Mechanical properties		
Overall thickness (+/-10%)	mm	0.250
Hardness	Shore A	85
Tensile strength	N/mm ²	10
Elongation	%	5
Physical properties		
Application temperature	$^{\circ}C$	-40 to +200
Density	g/cm ³	2.25
Flameclass	UL	94V-1

Keratherm®-brown with its very good thermal properties is an excellent choice for cost-effective solutions. These fibreglass reinforced films along with their very smooth surface has very good thermal resistance with a high insulation capacity at low mounting pressures.

Options for Keratherm® -brown

Type	Film structure	Overall thickness mm	Tensile strength N/mm ²	Thermal resistance	
				K/W	Kin^2/W
70/60	70/50 with reinforcement and adhesive coating	0.275	10	0.52	0.34

The following thicknesses are available: 0,250 mm; 0,3 mm; 0,4 mm; 0,5 mm

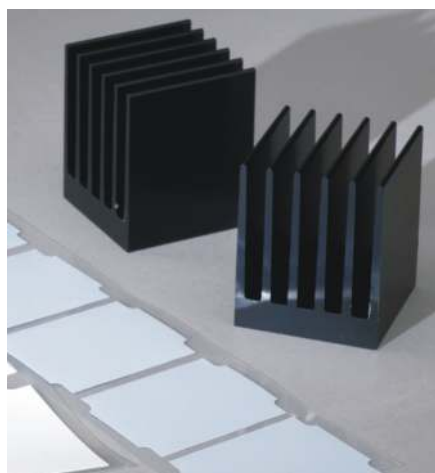
Keratherm® - silicone free Standard films

Applications:

- Medical applications
- Laser equipment
- Lighting systems
- CD-Rom drives
- Aero units
- Space units

Properties	Unit	U 23	U 80	U 90
Colour		white	light blue	blue
Thermal properties				
Thermal resistance R_{th}	K/W	0.52	0.20	0.09
Thermal impedance R_{ti}	$^{\circ}Cmm^2/W$	208	73	32.9
	kin^2/W	0.32	0.11	0.05
Thermal conductivity	W/mK	1.2	1.8	6.0
Electrical properties				
Breakdown voltage $U_{d; ac}$	kV	9.0	4.0	4.0
Volume resistivity	cm	4.9×10^{11}	1.44×10^{14}	2.0×10^{11}
Dielectric loss factor $\tan \delta$	1	8.0×10^{-2}	13.0×10^{-3}	13.7×10^{-3}
Dielectric constant ϵ_r	1	1.7	3.2	3.10
Mechanical properties				
Overall thickness (+/-10%)	mm	0.250	0.150	0.200
Hardness	Shore A	85	85	70
Tensile strength	N/mm ²	5.0	3.0	2.5
Elongation	%	250	130	150
Physical properties				
Density	g/cm ³	2.32	2.90	1.73
Application temperature	$^{\circ}C$	-40 to +90	-40 to +125	-40 to +125

Optional available with adhesive coating!



In case of concerns about using silicones, we offer you a ceramic-filled polyurethane film as an alternative material. Besides good thermal and outstanding electrical properties, these films are characterized by very good perforation strength.

These good physical properties are matched with an excellent price-performance ratio.

Thickness U23: 0,125 mm; 0,250 mm; 0,3 mm; 0,4 mm; 0,5 mm

Thickness U80: 0,15 mm; 0,3 mm

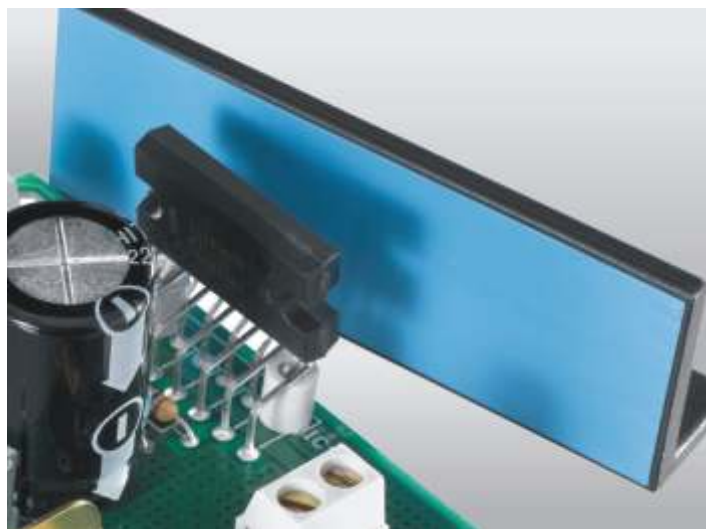
Thickness U90: 0,1 mm; 0,2 mm

Keratherm® - MT-Films MT 102, MT 103



Properties	Unit	MT 102	MT 103
Colour		blue	red
Thermal properties			
Thermal resistance R_{th}	K/W	0.50	0.31
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	200 0.28	124 0.17
Thermal conductivity	W/mK	1.1	1.8
Electrical properties			
Breakdown voltage $U_{d, ac}$	KV	10	10
Volume resistivity	cm	2.2×10^{10}	4.7×10^{10}
Dielectric loss factor $\tan \delta$ (1kHz)	1	1.0×10^{-3}	1.0×10^{-3}
Dielectric constant ϵ_r (1kHz)	1	2.68	2.61
Mechanical properties			
Thickness (+/-10%)	mm	0.225	0.225
Hardness	Shore A	70	60
Tensile strength	N/mm ²	2	2
Elongation	%	> 1000	> 200
Physical properties			
Application temperature	$^{\circ}\text{C}$	-40 to +125	-40 to +125
Flameclass	UL 94	being tested	being tested

Different thicknesses available on request!



Thermoplastic elastomer tape with very good isolating behaviour and excellent mechanical properties with at the same time good thermal characteristics.

Advantages:

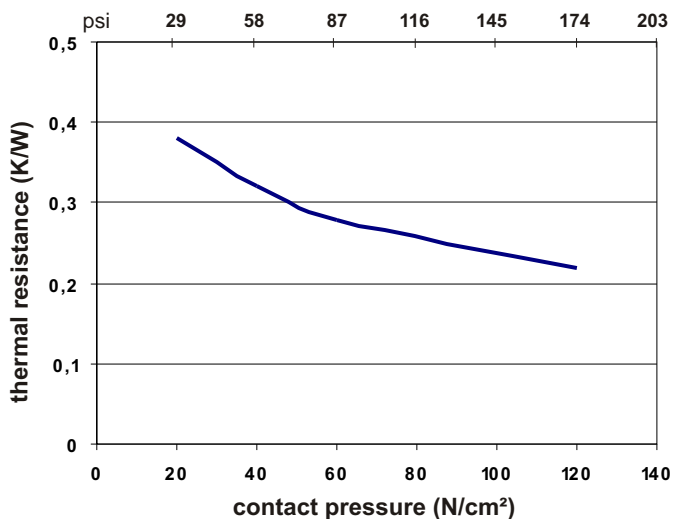
- very good mechanical properties
- very good insulating properties
- silicone free

Delivery forms:

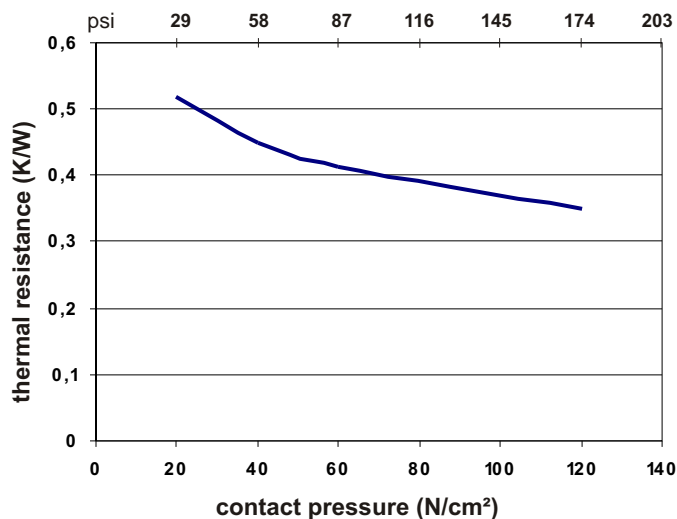
- 1) bulk good
- 2) optional with single sided adhesive coating
- 3) already punched geometries

KERATHERM® - Standard Films - Compressibilities

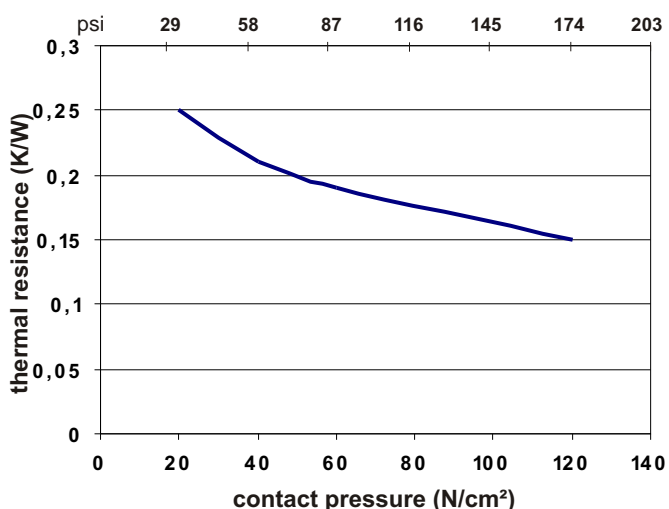
Compressibilities of Keratherm® White



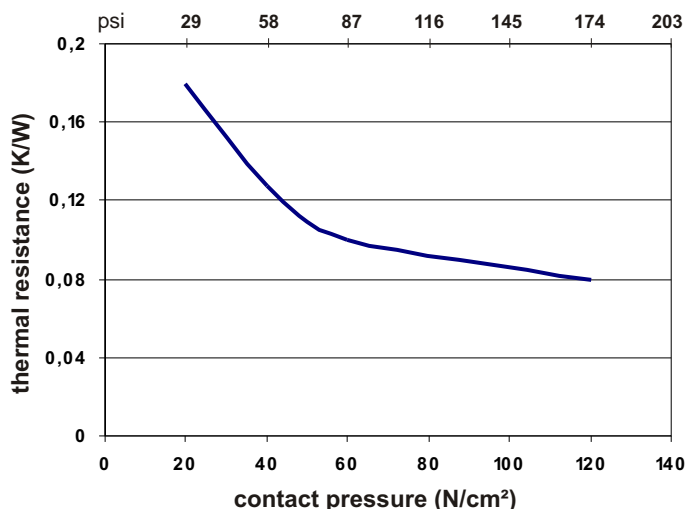
Compressibilities of Keratherm® Green



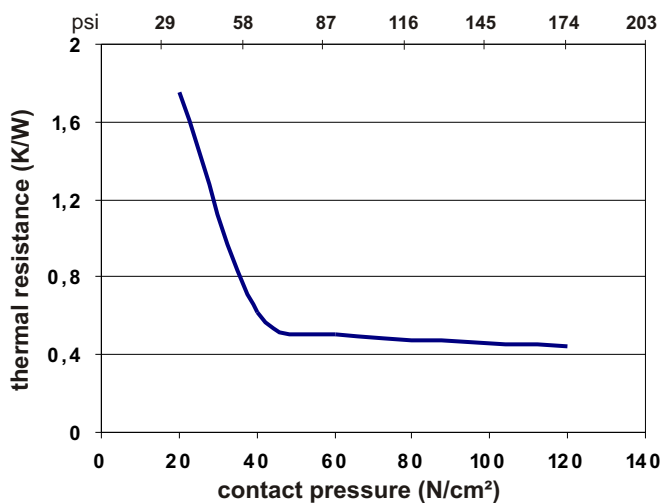
Compressibilities of Keratherm® Pink



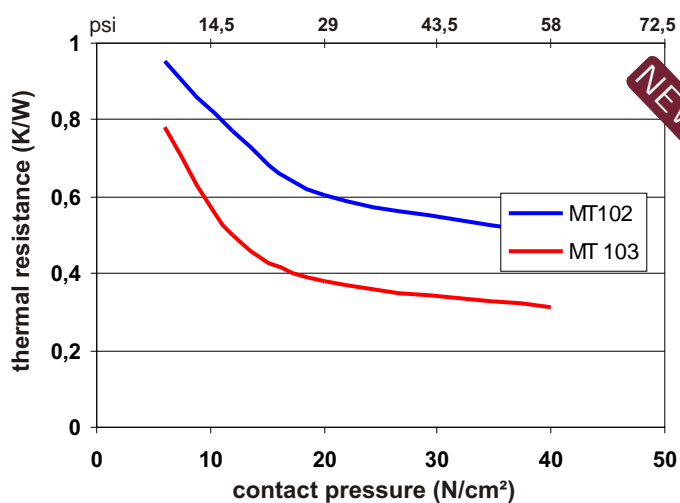
Compressibilities of Keratherm® Red



Compressibilities of Keratherm® Brown



Compressibilities of Keratherm® MT-Films



Keratherm[®] - PCE 86/114, 86/117

NEW



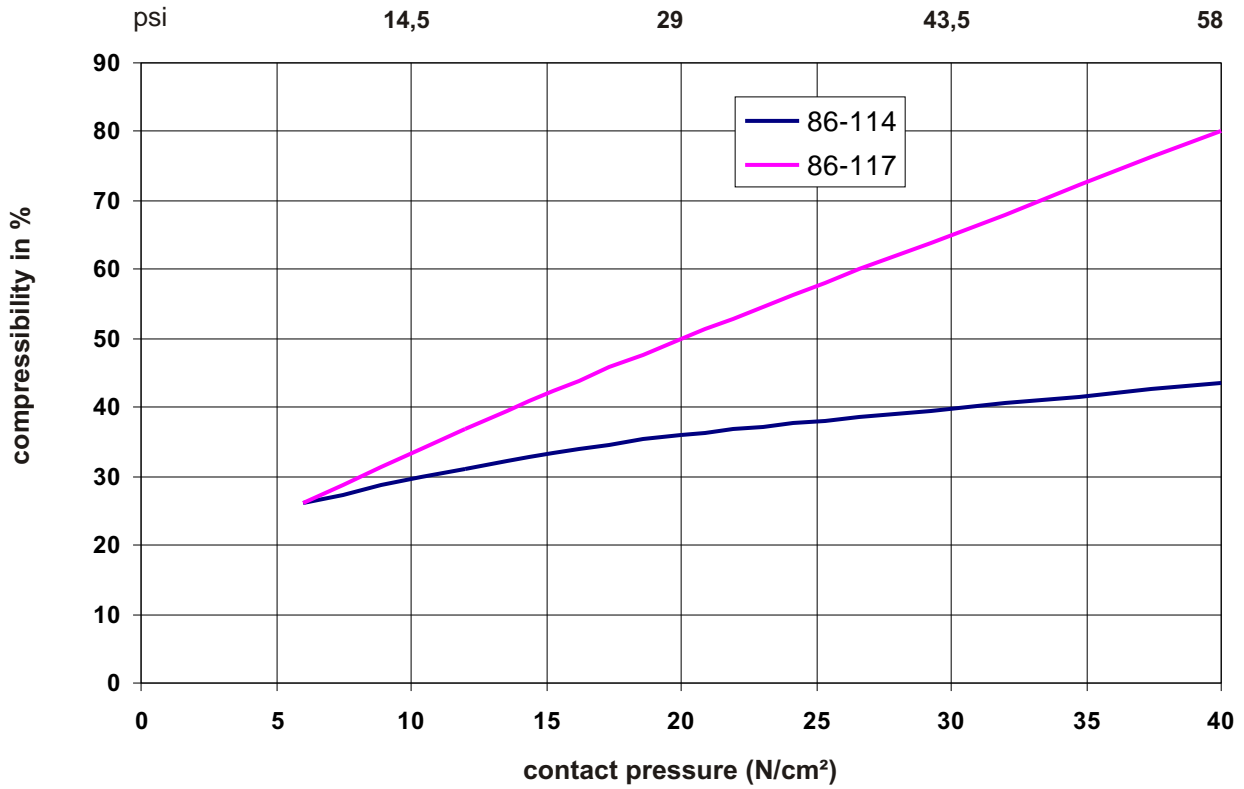
Properties	Unit	86/114	86/117
Colour		grey	grey
Thermal properties			
Thermal resistance R _{th}	K/W	0.15	0.06
Thermal impedance	°Cmm ² /W Kin ² /W	61 0.089	21.9 0.033
Thermal conductivity	W/mK	4.0	3.0
Electrical properties			
Dielectric breakdown E _{d; ac}	KV/mm	5.0	4.0
Volume resistivity	cm	0.2 x 10 ¹⁰	3.2 x 10 ¹⁰
Dielectric loss factor tan _(1kHz)	1	12 x 10 ⁻³	21 x 10 ⁻³
Dielectric constant (1kHz)	1	2.0	3.19
Mechanical properties			
Thickness (+/-10%)	mm	0.250	0.250
Hardness	Shore 00	70 - 90	55 - 75
Softening interval	°C	70 - 95	65 - 85
Physical properties			
Density	g/cm ³	1.2	1.2
Application temperature	°C	-40 to +125	-40 to +130
Falme class	UL-94	being tested	V-0

Applications: • Notebooks • Desktop CPU's • IGBT Units

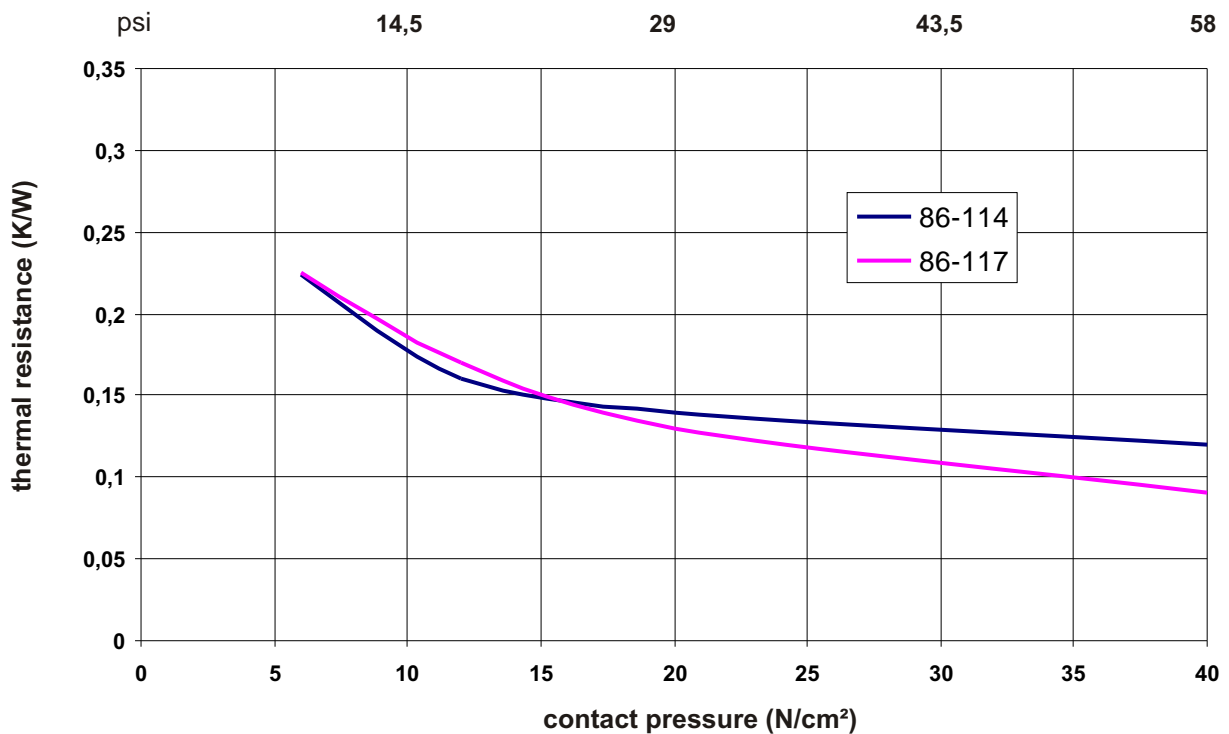
These new film do nota are special elastomers and do not consist of wax material. Because of there outstanding phase changing characteristics the PCE's have the following advantages:

- Very good compressibility thereby very good material adaptability
- Phase-change characteristic without containing wax material
- No melting point but softening interval - no liquidation throughout the whole temperature range
- Electrical insulating
- Excellent reworkability - disassembling without damaging the components
- Can be used for automatic production - easy automatic assembly
- Single-sided adhesive
- RoHS / environmently friendly
- Also suitable for dispensing

Compressibility of 86/114 and 86/117 in dependence on the contact pressure



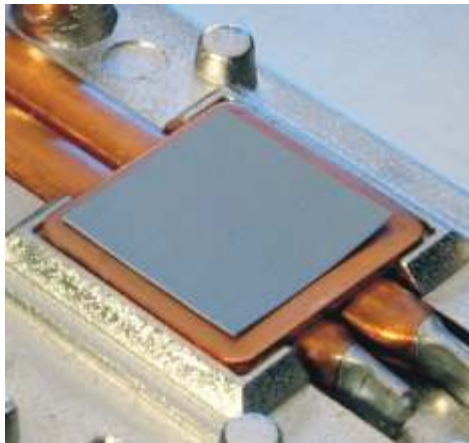
Thermal resistance of 86/114 and 86/117 in dependence on the contact pressure



Keratherm[®] - Phase Change Material PCM 471

Applications:

- Notebooks
- Desktop CPU's
- IGBT Units

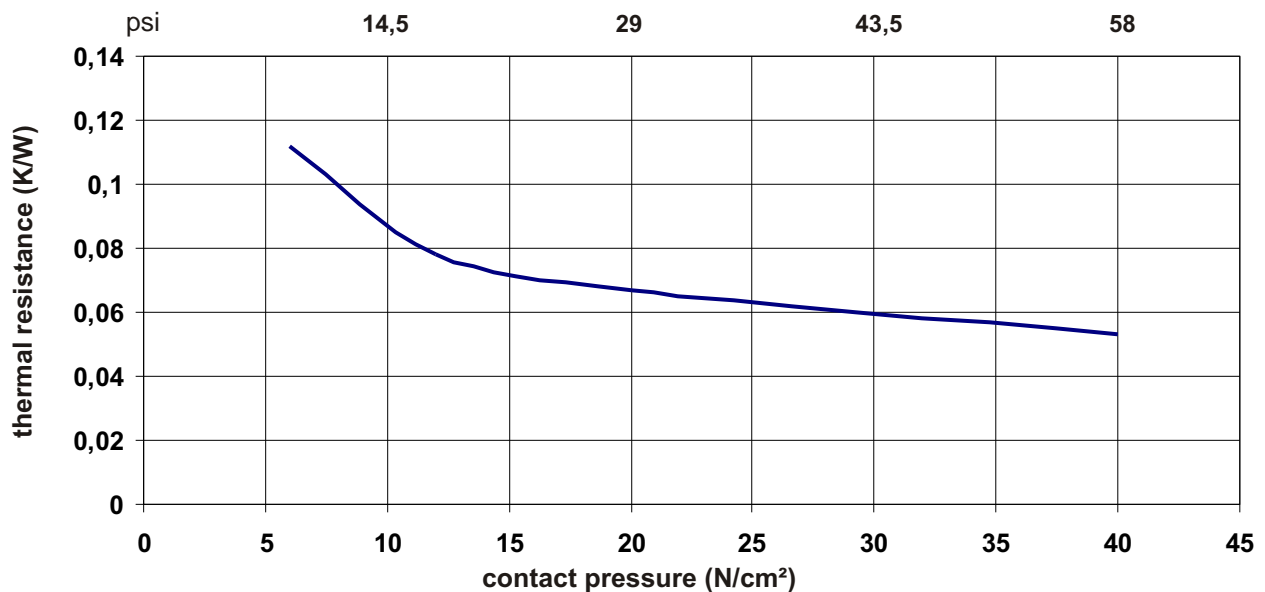


Properties	Unit	PCM 471
Colour		grey
Compound		filled hot-setting wax
Thermal properties		
Thermal resistance R_{th}	K/W	0.07
Thermal conductivity	W/mK	8.0
Electrical properties		
Dielectric breakdown $E_{d, ac}$	KV/mm	5.0
Mechanical properties		
measured thickness (+/-10%)	mm	0.2 *
Reinforcement		without
Wax melt-on temperature	°C	46
Continuous operation temperature	°C	+125

* optional film thicknesses available!

PCM 471 film is a combination of hot-melt waxes with or without support. The wax mixture in the PCM film melts at various temperatures depending on its dimensions thereby filling even the smallest irregularities between the power module and heat sink. This creates an improved contact between the surfaces and increases the heat transfer. Its special design makes it easy to use and store.

**Thermal resistance of PCM 471
in dependence on the contact pressure**



Keratherm® - Thermal Grease KP 92, KP 97, KP 12 (silicone free)

Applications:

- Notebooks
- Desktop CPU's
- IGBT Units

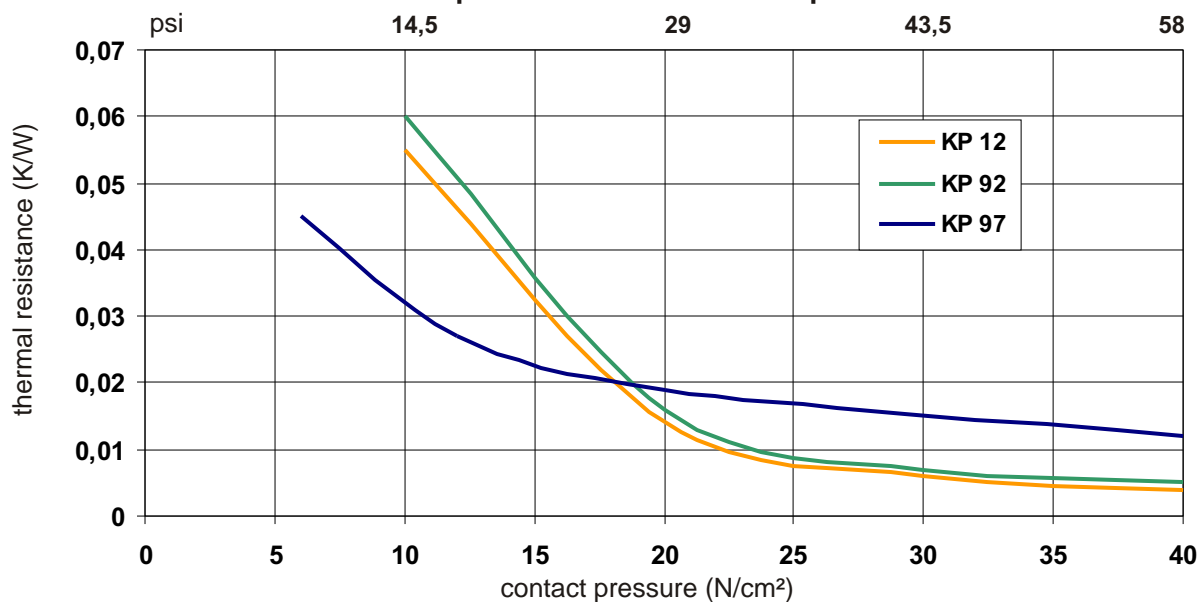


Properties	Unit	KP 92	KP 97	KP 12 silicone free
Colour		silver	white	silver
Compound		soft / pasty		
Thermal properties				
Thermal resistance R_{th}	K/W	0.007	0.012	0.006
Thermal conductivity	W/mK	10.0	5.0	10.0
Electrical properties				
Dielectric breakdown $E_{d; ac}$	KV/mm	-	2.0	-
Mechanical properties				
Coating thickness (+/-10%)	mm	0.03-0.06	0.03-0.06	0.03-0.06
Viscosity	Pas	65	90 - 120	76
Density	g/cm ³	2.6	2.10	1.4
Application temperature	°C	-60 to +200	-60 to +150	
Long term stability (1000h / 85°C / 85% relative humidity)				
Thermal resistance R_{th}	K/W	0.008	0.012	0,006
TML	Ma.-%	0.09	0.5	0.1

Technical data for KP 93, KP 77, KP 68 on request!

KP92 and KP97 are ceramic-filled single-component silicones with a high thermal conductivity. The non-crosslinked thermal compounds do not dry out. The silicone components do not leak out of the compound. The silicone-free thermal compound KP12 consists of synthetic, thermal polymer and is suitable for a fast and effective heat dissipation. The paste is particularly suitable for silicone sensitive applications. Its long-term stability guarantees a full operability during the entire life time of the product. Under normal application conditions the KP12 silicone-free does not cure, dry out or melt. Special storage of Keratherm "Thermal Grease" is not required, therefore they can be stored under normal climate conditions for up to 12 months. If any separation of the filler materials becomes evident, the KP's must be mixed thoroughly before use.

Comparison of the thermal resistance of different pastes in dependence on the contact pressure



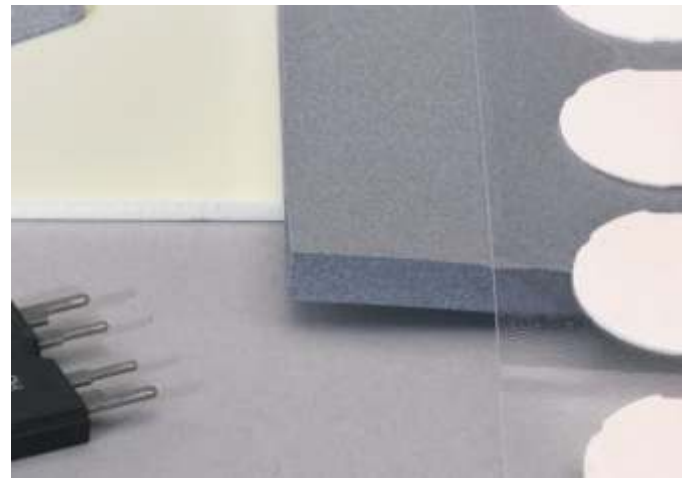
Keratherm® - Softtherm® is a group of highly elastic, ceramic-filled tapes. They are characterized by their extremely good compressibility, their optimum plasticity with good thermal conductivity, and good electrical properties. These films are especially suitable for compensating differences in planarity of the components or pressure-sensitive applications.

It is recommended, not to exceed the maximum compression of Softtherm® higher than 30% - 40% of the original thickness.



Softtherm® 86/200 and 86/210lb

A group of highly elastic, ceramic-filled films. They are characterized by their excellent compressibility, their optimum plasticity with good thermal conductivity and good electrical properties. These films are especially suitable for compensating differences in planarity of the components or pressure-sensitive applications. The film type 86/210lb is also characterized by its optimized outgassing and low bleeding behaviour.



Softtherm® 86/255 and 86/250

This group of Softtherm® was created as a result of intensive collaboration with our customers. They are characterized by their high thermal conductivity and the varying levels of hardness of the materials.

PROPERTIES

- highly flexible tapes
- outstanding flexibility
- graduated thermal conductivity
- good electrical insulation
- high temperature stability

BENEFITS

- compensates components size variations
- optimized thermal transition
- good compression behaviour
- UL-listed

FILM OPTIONS

- single-sided adhesive surface
- single-sided adhesive coating possible
- can be supplied as sheets or punched

APPLICATIONS

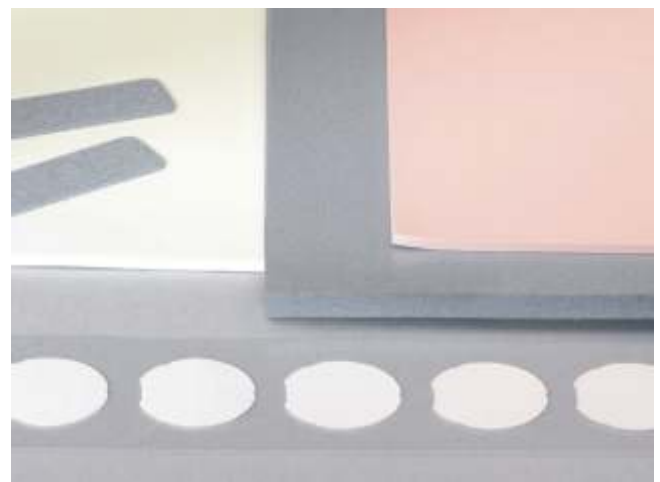
- RD-RAM memory model
- Heat pipe thermal solutions
- automotive engines
- control units
- plasma supply panels



Softtherm® 86/300, 86/500 and 86/600

This group of Softtherm® films has the best thermal behavior. The group is characterized by its low thermal resistance and best heat dissipation, as well as good dielectric strength.

The good compressibility and low shore hardness ensure reliable and simple processability.



Softtherm® 86/202 and 86/2121b

These films offer a cost-effective alternative to the standard films in the Softtherm® - 200 series.

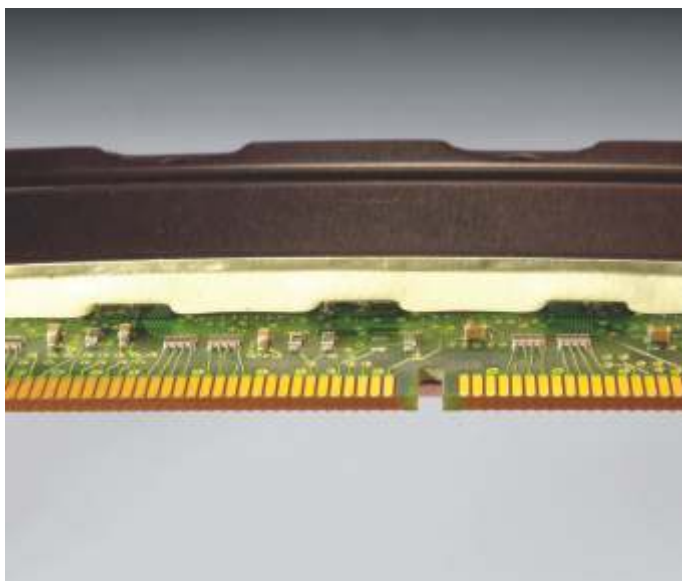
The films are characterized by their thermal and electrical properties and good plasticity.

Keratherm[®] - Softtherm[®] 86/200, 86/210lb

A group of highly elastic, ceramic-filled films. They are characterized by their excellent compressibility, their optimum plasticity with good thermal conductivity and good electrical properties. These films are especially suitable for compensating differences in planarity of the components or pressure-sensitive applications. The film type 86/210lb is also characterized by its optimized outgassing and low bleeding behaviour.

Properties	Unit	86/200	86/210 lb (low bleeding)
Colour		pink/yellow	pink/yellow
Thermal properties			
Thermal resistance R_{th}	K/W	1.50	1.50
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$	500	500
	Kin^2/W	0.77	0.77
Thermal conductivity	W/mK	1,0	1.0
Electrical properties			
Breakdown voltage $U_{d, ac}$	kV	8.0	8.0
Volume resistivity	cm	1.0×10^{11}	1.0×10^{11}
Dielectric loss factor tan	1	1.5×10^{-3}	1.5×10^{-3}
Dielectric constant ϵ_r	1	3.9	3.9
Mechanical properties			
Thickness (+/-10%)	mm	0.5	0.5
Hardness	Shore 00	10	15
Youngs modulus *	N/cm ²	200	696
Physical properties			
Application temperature	$^{\circ}\text{C}$	-60 to +200	-60 to +200
TML	Ma.-%	< 0.40	< 0.24
Flame class	UL	94V-0	94V-1

* Youngs modulus sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness



Applications:

- RD-RAM memory modules
- Heat pipe thermal solutions
- Automotive engine
- Control units
- Plasma supply console

Optional available with adhesive coating!

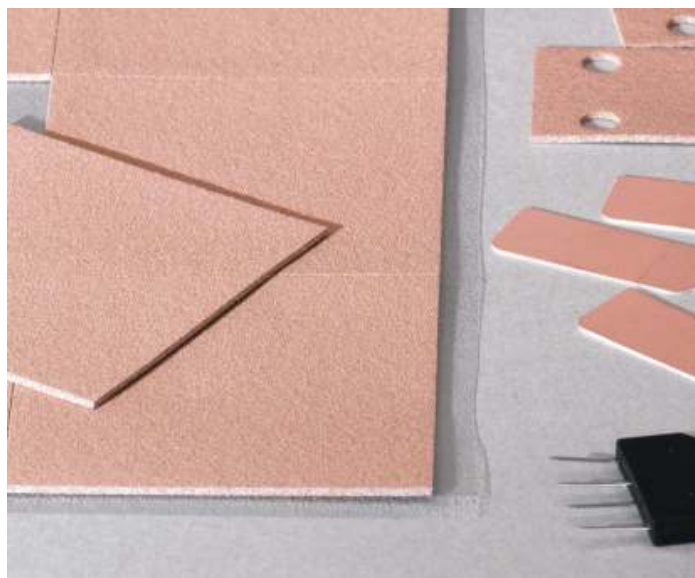
**The following thicknesses are available:
0.5 - 5.0 mm**

Keratherm® - Softtherm® 86/255, 86/250

This group of Softtherm® was created as a result of intensive collaboration with our customers. The films are characterized by their high thermal conductivity and the varying levels of hardness of the materials.

Properties	Einheit	86/255	86/250
Colour		white/red	white/red
Thermal properties			
Thermal resistance R_{th}	K/W	0.85	0.95
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	250 0.39	385 0.60
Thermal conductivity	W/mK	2.0	1.3
Electrical properties			
Breakdown voltage $U_{d, ac}$	kV	10.0	8.0
Volume resistivity	cm	1.0×10^{11}	1.0×10^{11}
Dielectric loss factor tan	1	2.5×10^{-3}	2.5×10^{-3}
Dielectric constant ϵ_r	1	3.8	3.8
Mechanical properties			
Thickness (+/-10%)	mm	0.5	0.5
Hardness	Shore 00	30	45
Youngs modulus *	N/cm ²	276	138
Physical properties			
Application properties	$^{\circ}\text{C}$	-60 to +200	-60 to +200
TML	Ma.-%	< 0.50	< 0.42
Flame class	UL	94V-1	-

* Youngs modulus- sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness



Applications:

- RD-RAM memory modules
- Heat pipe thermal solutions
- Automotive engine
- Control units
- Plasma supply console

Optional available with adhesive coating!

**The following thicknesses are available:
0.5 - 5.0 mm**

Keratherm® - Softtherm® 86/300, 86/500, 86/600

This group of Softtherm® films has the best thermal behavior. The films are characterized by low thermal resistance and best heat dissipation, as well as good dielectric strength. Good compressibility and low shore hardness ensure reliable and simple processability.

NEW

Properties	Unit	86/300	86/500	86/600
Colour		blue	brown	grey
Thermal properties				
Thermal resistance R_{th}	K/W	0.41	0.25	0.20
Thermal impedance R_{ti}	°Cmm ² /W Kin ² /W	166 0.25	100 0.15	80.0 0.12
Thermal conductivity	W/mK	3.0	5.0	6.0
Electrical properties				
Breakdown voltage $U_{d;ac}$	kV	8.0	1.0	1.5
Volume resistivity	cm	1.0×10^{11}	1.0×10^{11}	1.7×10^{10}
Dielectric loss factor tan	1	5.0×10^{-3}	1.5×10^{-3}	2.0×10^{-3}
Dielectric constant ϵ_r	1	3.3	3.9	2.5
Mechanical properties				
Thickness (+/-10%)	mm	0,5	0,5	0,5
Hardness	Shore 00	65	75	60 - 70
Youngs modulus *	N/cm ²	220	634	692
Physical properties				
Application temperature	°C	-60 to +200	-40 to +200	-60 to +150
TML	Ma.-%	< 0.35	< 0.24	< 0.40
Flame class	UL	94V-0	-	being tested

* Youngs modulus- sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness



Applications:

- RD-RAM memory modules
- Heat pipe thermal solutions
- Automotive engine
- Control units
- Plasma supply console

Optional available with adhesive coating!

The following film thicknesses are available:

86/300: 0.5 - 5.0 mm

86/500: 0.5 - 2.0 mm

86/600: 0.5 mm; 1.0 mm; 1.5 mm

Keratherm[®] - Softtherm[®] 86/202, 86/212lb

These films offer a cost-effective alternative to the standard films in the Softtherm[®] - 200 series. The films are characterized by their thermal and electrical properties and good plasticity.

Properties	Unit	86/202	86/212lb (low bleeding)
Colour		grey	grey
Thermal properties			
Thermal resistance R_{th}	K/W	0.90	0.90
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$	357	357
	Kin^2/W	0.55	0.55
Thermal conductivity	W/mK	1.4	1.4
Electrical properties			
Breakdown voltage $U_{d; ac}$	kV	2.5	2.0
Volume resistivity	cm	-	1.2×10^{15}
Dielectric loss factor \tan	1	6.0×10^{-3}	4.5×10^{-2}
Dielectric constant ϵ_r	1	4.2	2.6
Mechanical properties			
Thickness (+/-10%)	mm	0.5	0.5
Hardness	Shore 00	25	30
Youngs modulus *	N/cm ²	425	350
Physikalische Eigenschaften			
Application temperature	$^{\circ}\text{C}$	-60 to +200	-60 to +200
TML	Ma.-%	0.50	0.25
Flame class	UL	94V-0	-

* Youngs modulus- sample size 30 mm x 30 mm x 2.5 mm;
variable contact pressure; compression 50% of the measured thickness



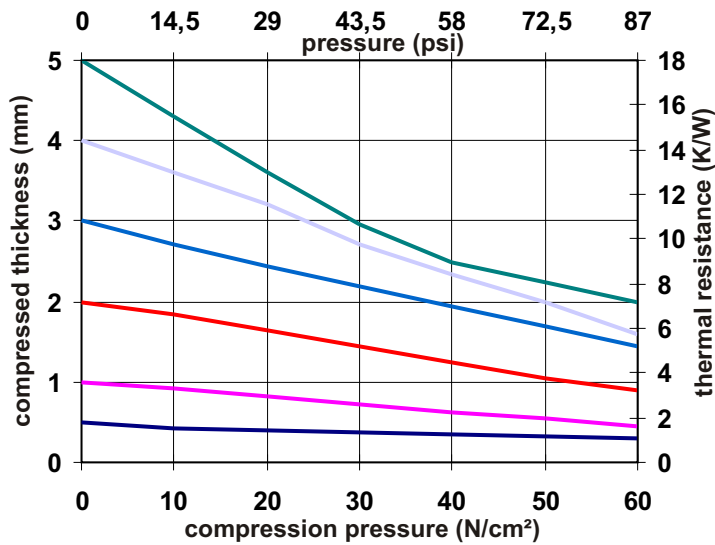
Applications:

- RD-RAM memory modules
- Heat pipe thermal solutions
- Automotive engines
- Control units
- Plasma supply console

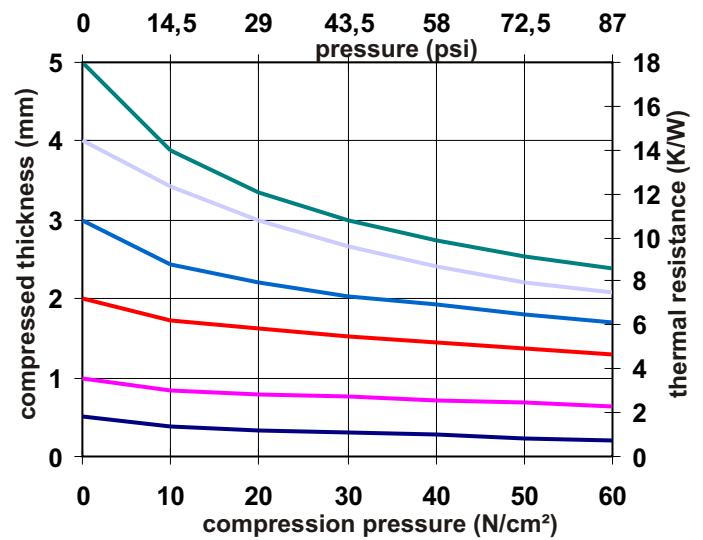
The following film thicknesses are available: 0.5 - 5.0 mm

KERATHERM® - Softtherm® - Compressibilities

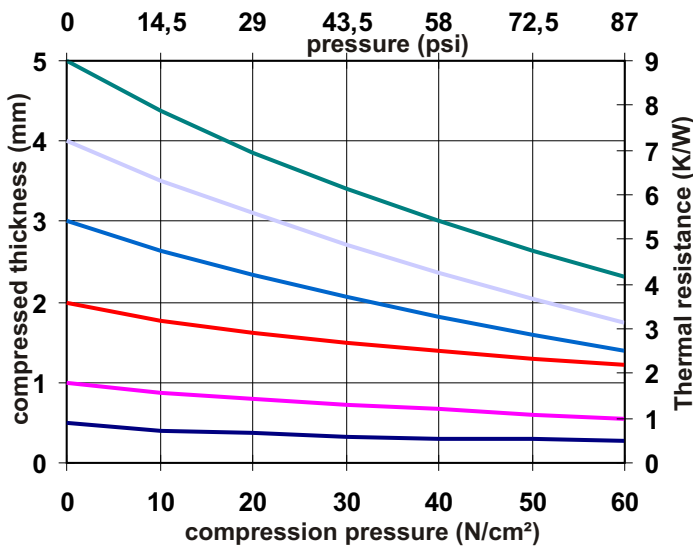
Compressibilities of Softtherm® 86/200



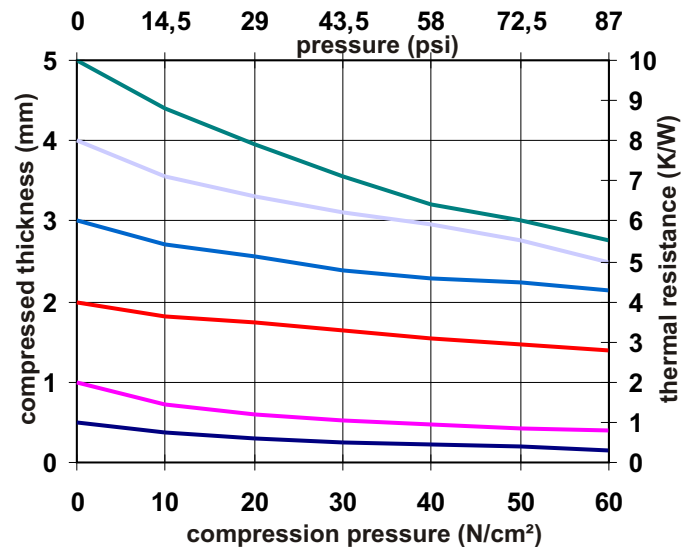
Compressibilities of Softtherm® 86/210 lb



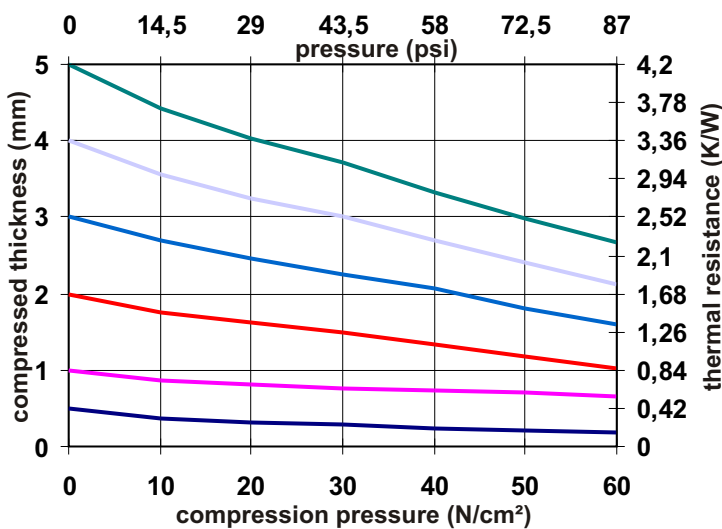
Compressibilities of Softtherm® 86/255



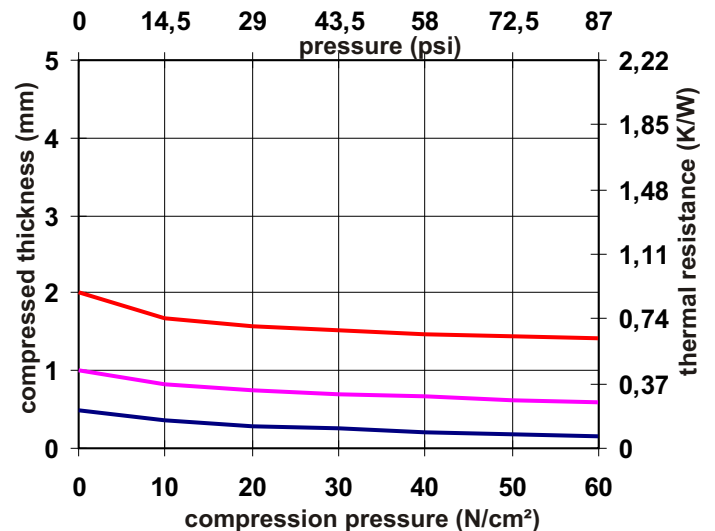
Compressibilities of Softtherm® 86/250



Compressibilities of Softtherm® 86/300



Compressibilities of Softtherm® 86/500



Keratherm[®] - Spaceform[®] Q

Applications:

- Mechanical engineering
- PCB-housings
- "Heat Pipe" applications
- Computer units



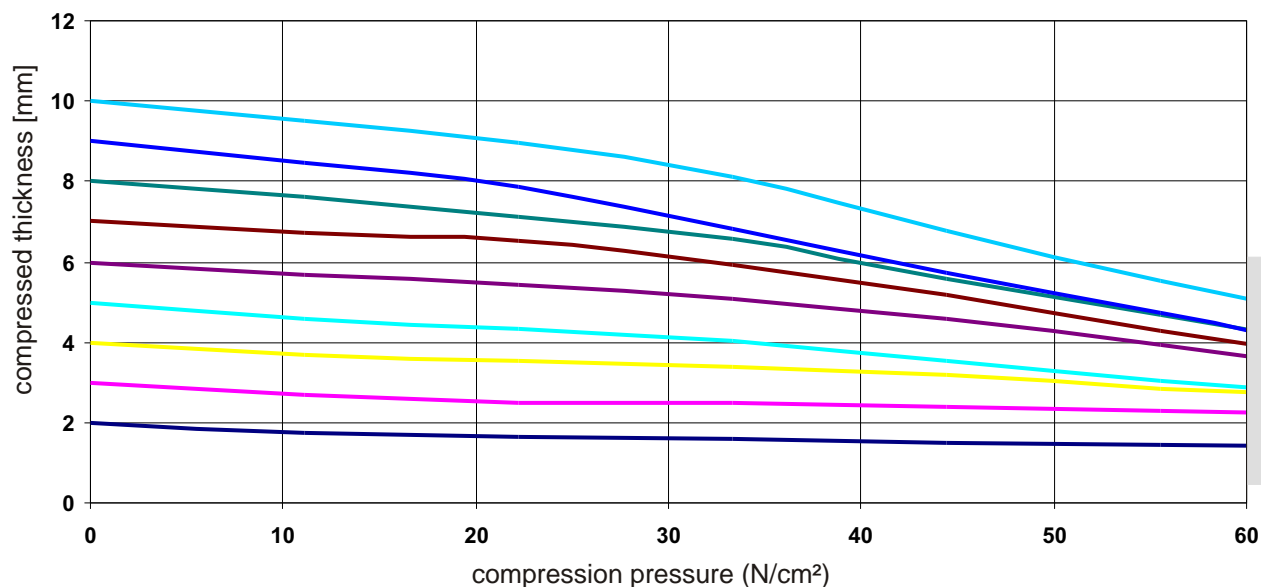
Properties	Units	Spaceform Q non-curing
Colour		brown
Thermal resistance R_{th}	K/W	1.80*
Thermal conductivity	W/mK	1.4
Breakdown voltage $U_{d, ac}$	kV	4.0
Thickness (+/-10%)	mm	2.0
Hardness	Shore 00	30
Density	g/cm ³	2.85
Application temperature	°C	-40 to +180
Tempering needed		no

* measured thickness 0.5 mm

The following thickness are available: 2.0 - 30.0 mm

Non-curing moulding compound for individual thermal solutions. Spaceform[®] is a highly filled, mouldable silicone compound that is applied by the customer and possesses exceptional mechanical, electrical and thermal properties. Thanks to its excellent ability to conform to any shape or size, there are no restrictions in dimensions or shapability. The Spaceform[®] "Q" is characterized by its exceptional flexibility, easy handling and recyclability.

Compressibilities of Spaceform[®] Q from a thickness of 2-10 mm



Advantages of Spaceform[®]:

- spotted heat dissipation
- good thermal properties
- extremely good compressibility
- good electrical properties
- excellent placticity
- good dielectrical properties

Keratherm® - Thermal compounds GF 200, GF 255, GF 300, GF 1000, GF 5000

Properties	Unit	GF 255	GF 300	GF 1000	GF 5000
Base material		Silicone	Silicone	Silicone	Silicone
Colour		red	blue	white	black
Mixing ratio		1 : 1	1 : 1	single component	single component
Viscosity	Pas	47.5	80	330	ca. 250
Curing		½ h;120°C		1 h;130°C	1 h;130°C ½h;150°C
Technical properties					
Thermal conductivity	W/mK	1.5	3.0	1.1	5.0
Dielectric breakdown E _{d; ac}	KV/mm	1.5	1.0	5.0	> 1.0
Hardness	Shore 00	10	50	55	65
Density	g/cm ³	2.62	2.40	2.45	2.5
Application temperature	°C	-40 to +200			-60 to +200

Applications:

- RD-RAM modules
- Memory chips
- Chipsets
- Micro BGA
- Heat pipe thermal solutions
- high voltage electronics components

Ceramic-filled, two-component silicone elastomers. Because of their various thermal conductivities and differing compressibility behavior, their good dielectric properties and being free of solvents, these materials are ideally suitable for encapsulating or dispensing. The wide range of different material viscosities available makes them of interest for "wet-in-wet" production.

Customer-specific solutions for the compound technology and processing technology are our strength.



Kerafol's® modern dispensing technologies allow the application of heat-conducting material onto the most diverse heat sinks or customized components. (More information on page 34!)

Just contact us and we will help you to find a solution!

Processing of Keratherm[®] Thermal Compounds

General information:

- Silicone thermal compounds are physiologically safe
- Silicone hardeners / curing agents are physiologically safe
- We recommend the use of protective industrial lotion
- Avoid contact with skin
- No irritation to the respiratory system when using thermal compounds

Pre-treatment: The parts to be sealed should be dry, clean and grease-free.

Preparation: The silicone thermal compounds contain filler materials which may show sedimentation, depending on the storage temperature. It is therefore necessary to stir the compound thoroughly before the actual mixing process.

Mixing: Kerafol's silicone thermal compounds and their silicone curing agents (component B) must be mixed in the prescribed proportions. After intensive mixing with a suitable stirrer, the compound is immediately ready for use.

The use of cartridges is not recommended, since mixing of the components by a static mixer can no longer be performed. During the mixing process, ensure that no air is brought into the material. Avoid long standby times. Pay attention to the specified processing times. Silicone thermal compounds are moisture-sensitive. After mixing, sealing compounds should always be evacuated for a period of at least 10 minutes at < 100mbar.

Applications: The processing time ranges from approx. 25 minutes up to 3 hours! The viscosity will increase slightly during this time, so you should only prepare as much material as you can process within this time. If the silicone thermal compound will be processed by means of dosing equipment, then it is possible to adjust the processing time with the aid of accelerators. Processing of the compound beyond this time should be avoided since the processing conditions will continuously change due to the curing process (viscosity increase, viscosity of the sealing compound, etc.).

Curing conditions: For specific curing times please refer to the datasheets. The heating regime from room temperature onwards should not climb faster than 5 K/min. When tempering or post-curing incompletely cured thermal compound, entrapped air can expand and cause smoke formation. It is therefore important to ensure that no bubbles are formed during dispensing. When curing at room temperature, please note that heat treatment can change the hardness slightly. Silicone thermal compounds that have been cured at room temperature should not be fully stressed mechanically and electrically before approx. 4 days waiting time.

Shelf life: At least 6 months in original packaging. When opened, the contents should be used as soon as possible since, due to the influence of humidity, the reactivity of the material can diminish.

Keratherm® - Graphite 90/10, 90/15, 90/20, 90/25

Applikationen:

- Chipsets
- Memory chips
- Micro BGA



Properties	Unit	90/10 basic film	90/25
Colour		black	black
Thermal Properties			
Thermal resistance R_{th}	K/W	0.09	0.05
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	36 0.05	21 0.03
Thermal conductivity (z/x-y)	W/mK	5.5 / 55	7.0 / 150
Electrical Properties			
Breakdown voltage $U_{d; ac}$	kV	not insulating	not insulating
Volume resistivity	cm	0.07	0.05
Mechanical Properties			
Overall thickness (+/-10%)	mm	0.200	0.125
Hardness	Shore D	30	30
Tensile strength	N/mm ²	5.5	4.0
Elongation	%	10	10
Physical Properties			
Application temperature	$^{\circ}\text{C}$	-40 to +500	-40 to +500
Density	g/cm ³	1.0	1.1
Flame class	UL	94V-0	94V-0

Die Keratherm® graphite films are based on 100% pure graphite. The films are available as uncoated types or for specific applications, coated with thermal wax, filled adhesive or standard adhesives. Because of their high thermal conductivity they are used e.g. in the CPU sector.

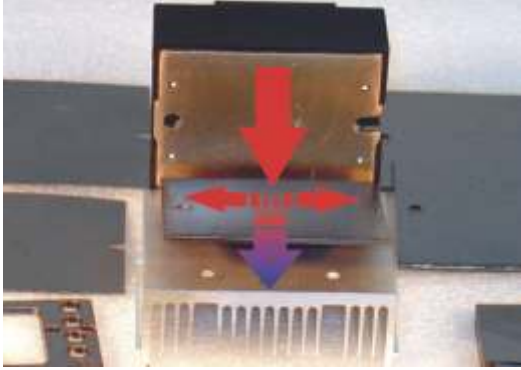
Available thicknesses:

0.200 mm,
0.250 mm,
0.350 mm,
0.750 mm,
1.00 mm

Options for Keratherm® - Graphite

Type	Tape assembling	Thickness mm	Tensile strength N/mm ²	Thermal resistance	
				K/W	Kin ² /W
90/15	90/10 with filled adhesives	0.175	6.0	0.07	0.04
90/20	90/10 with standard-adhesives	0.250	5.5	0.23	0.10

Keratherm® - Graphite S 900



Properties	Unit	S 900	
Colour		black	
Thermal properties			
Measurement method		horizontal plane	through the thickness
Thermal resistance R_{th}	K/W	0.002	0.080
Thermal conductivity	W/mK	450	7.5
Electrical properties			
Electrical resistance	μm	6.0	1000
Dielectric breakdown $E_{d, ac}$	KV/mm	electrical conductive	
Mechanical properties			
Overall thickness (+/-10%)	mm	0.3	
Hardness	Shore D	0,29	
Physical properties			
Application temperature	$^{\circ}\text{C}$	-40 to +400	
Density	g/cm^3	1.8	

Following thicknesses are available: 0.29 mm; 0.55 mm; 0.83 mm; 1.08 mm; 1.55 mm

Keratherm® - Grafit S 900 is a highly densed natural graphite without binding material which is rolled or pressed into films or plates.

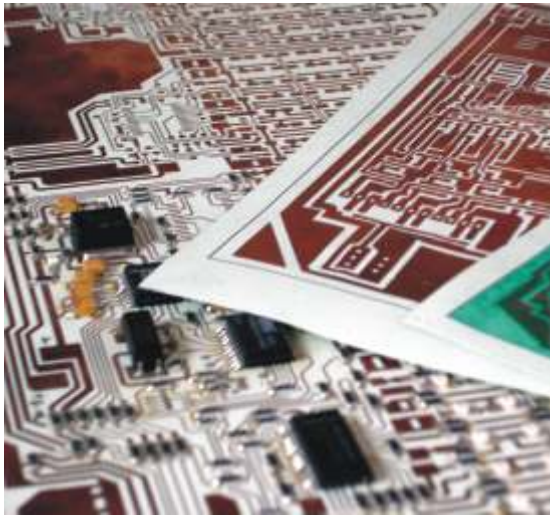
S 900 has exceptional qualities and is therefore used particularly as a cost-effective alternative to conventional heatspreader - systems. Especially the anisotropy of the thermal properties, coupled with a possible weight saving of up to 30% compared to conventional materials made of copper or aluminum, makes the S 900 interesting for heatspreader applications. In addition, applications in vacuum or even at high temperatures (400 ° C) are possible.

Graphite S 900 has no electrical insulation and can be customized with a single or double sided Kapton® film or adhesive coating.

Keratherm® - Copper FTC 86/77

Applications:

- Motor control units
- IGBT-controlling
- Powerfull LED-Arrays

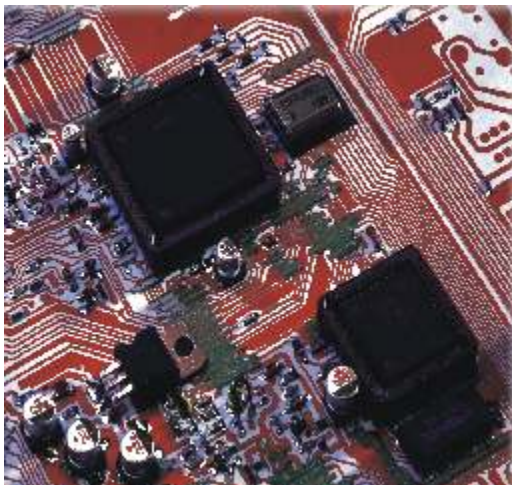


Properties	Unit	86/77 ¹⁾
Colour		green / copper
Thermal Properties		
Thermal resistance R_{th}	K/W	0.90
Thermal impedance R_{ti}	$^{\circ}\text{Cmm}^2/\text{W}$ Kin^2/W	227 0.35
Thermal conductivity	W/mK	1.1
Electrical Properties		
Breakdown voltage $U_{d; ac}$	kV	2.0
Breakdown strength $E_{d; ac}$	KV/mm	10.0
Mechanical Properties		
Overall thickness (+/-10%)	mm	0.300
Thickness of copper layer	mm	0.037
Hardness	Shore A	85
Tensile strength	N/mm ²	70
Elongation	%	15
Physical Properties		
Application temperature	$^{\circ}\text{C}$	-60 to +250

1) Options: with adhesive coating
with netting (one or two layers)

The following copper thicknesses are available: 17 μm ; 25 μm ; 37 μm ; 50 μm ; 75 μm and 101 μm

Heat conducting films manufactured by a special process with copper film (electrolyte) on one side. The beneficial properties of the heat conducting film and copper create entirely new application possibilities, for example, active EMC protection or as a system carrier for electronic switches.



On these system carriers, power densities of 5-10 W/cm² can be realized. In this case the heat conductive silicone film carries the electrical conducting circuit paths in copper etching technique. The second conductor path layer, for example in resistors, capacitors or coils, can be produced by applying polymer paste pressure. In contrast to conventional circuit board technology, this method allows efficient production from a roll. The outstanding flexibility of the film permits the formation of interfaces and cable harnesses.

These system carriers for electronic switches represent state-of-the-art design from an economical and ecological perspective.

Keratherm® - Ferrite F 96 (Film)

Applications:

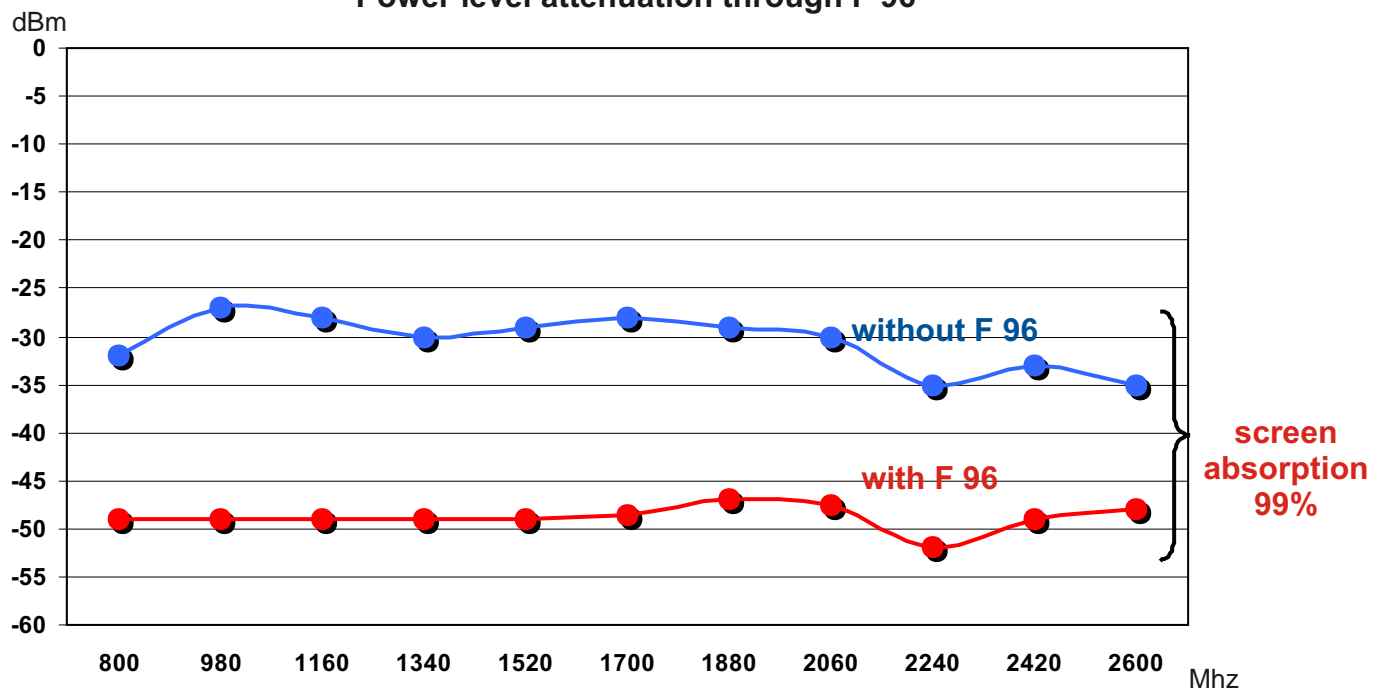
- EMC - absorption
- flexible PCB
- LED - arrays



Properties	Unit	F 96
Colour		black
Initial permeability μ_i		14 \pm 20%
Relative loss factor ($\tan \delta / \mu_i$)		
1,0 KHz		0.20
0,1 MHz		0.01
Dielectric constant ϵ_r		
1,0 KHz		2.80
0,1 MHz		0.20
Overall Thickness (+/-10%)	mm	0.225
Density	g/cm ³	2.8
Dielectric breakdown $E_{d,ac}$	KV/mm	1.0
Thermal conductivity	W/mK	1.0
Tensile strength	N/mm ²	0.7
Elongation	%	40
Hardness	Shore A	82
Application temperature	°C	-40 to +200

A new material made from soft-magnetic ferrite for electromagnetic shielding, flexible coils or other magnetic applications. The film has a very good shielding efficiency and a high EMC absorption capacity! Its high initial permeability ensures good magnetic properties. Its high flexibility allows preforms and customer-specific punching in all kinds of shapes.

Power level attenuation through F 96



Keratherm® - Ferrite Keramold® (compound)

Applications:

- EMC - shielding
- power supply interference suppression
- motor engine interference suppression



ohne Keramold®



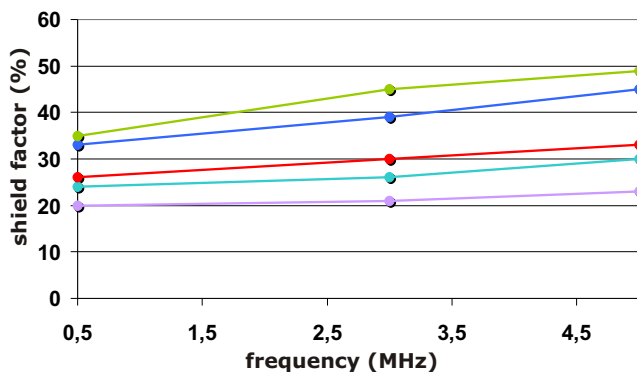
mit Keramold®

Properties	Unit	Keramold® PU basis	Keramold® silicone basis
Colour component A		white	black
Colour component B		black	black
Mix ratio A : B		4 : 1	1 : 1
Thermal conductivity	W/mK	1.0	0.6
Dielectric breakdown $E_{d, ac}$	KV/mm	4.0	0.4
Hardness	Shore A	95	55
Viscosity	mPas	80000	25000
Density	g/cm ³	2.35	2.40
Drip time at room temperature	Min.	85	85
Shrinkage	%	ca. 1	< 1
Application temperature	°C	-40 to +100	-40 to +180
Curing time at 80°C	Min.	30	30

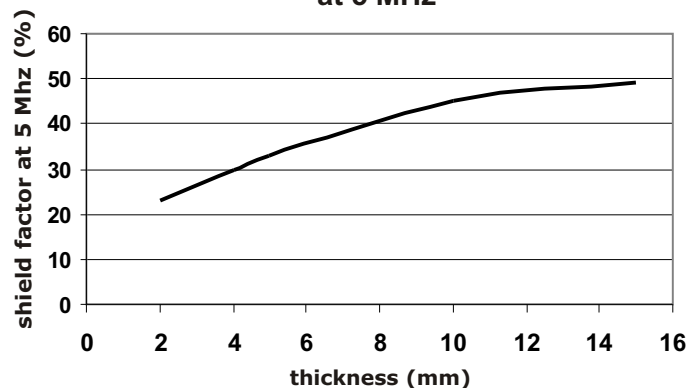
Keramold® consists of a two-component ferrite-sealing compound and is used to encapsulate or embed electronic components. Both components are already packed in the correct mixed proportions.

Keramold® shields electronic assemblies, acts as an electrical insulator, dissipates heat extremely well and exhibits very low shrinkage. The solvent-free Keramold® is characterized by its high mechanical strength and good impact and vibration protection.

Shield factor as function of the frequency
at different thicknesses



Shield factor as function of the thickness
at 5 MHz



Thickness: ● 2,0 mm ● 4,0 mm ● 5,0 mm ● 10,0 mm ● 15,0 mm

Our Adhesive Coatings

Each film type requires its own special adhesive system. Besides flexible adhesives with low adhesive strength, Kerafol® also offers adhesives with high adhesive strength or with various fillings for improved heat transfer.

Properties	Unit	Silicone PSA	Silicone GEL
Colour		transparent	transparent
Film type		Film with fiber glass	Film with or without fiber glass
Application temperature	°C	-60 to +250	-60 to +250
Hardness	Shore A	75	40
Adhesive properties		highly adhesive	slightly adhesive
Peel resistance ¹	N	7-15	4-8
Layer thickness	µm	10-20	20-35
Shelf Life ²	Month	8	8

Properties	Unit	Acrylate	Filled Acrylate-adhesive
Color		transparent	milky
Foil type		silicone-free foils	Graphite-film (90/15)
Application temperature	°C	-40 to +180	-40 to +180
Hardness	Shore A	70	80
Adhesive properties		highly adhesive	filled, conducting adhesive
Peel resistance ¹	N	10-25	4
Layer thickness	µm	10-20	25
Shelf Life ²	Month	12	12

¹ **Peel resistance:** Peeling at 180°C, peel speed: 300 mm/min.;
Width of test strip: 25 mm; length of test strip: 220 mm;
Finat test method in accordance with DIN 53375, 53282,53283.

² **Shelf Life:** **Silicone adhesive:** eight (8) months from date of manufacture provided the material has been stored in its original packaging and at max. 21°C (70°F) and 50% relative humidity.

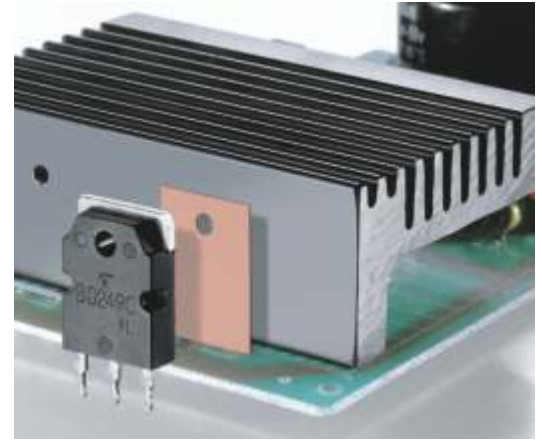
Acrylate adhesive: twelve (12) months from date of manufacture provided the material has been stored in its original packaging and at max. 21°C (70°F) and 50% relative humidity.

Notice:

By using adhesives as single-sided coating for Keratherm® thermal conductivity films the thermal impedance increases.

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, whereat 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.



Standard application of KERATHERM®

The various KERATHERM® products are crosslinked and cured to elastomers during the manufacturing process. KERATHERM® products involve none of the substances specified on the VDA list of declarable substances. Our products do not require labeling in accordance with "ChemG/Gefahrstoff V" (Act for the Protection against Hazard Substances / Hazardous substance V). 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.

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 any arbitrary size based on customer drawings (max. 400x400 mm). Roll goods can be supplied in widths of 15 mm up to 500 mm. All formats can also be ordered as bulk material. All flexible films - Softtherm® - can be delivered in thicknesses up to 1.0 mm or as roll goods up to 500 mm in width. Above a thickness of 1.5 mm, the Softtherm® films are supplied as sheets in sizes up to a maximum of 250 x 450 mm².

Tolerances

KERATHERM® Standard-Films: 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. Regarding the thickness, a deviation from the required dimension of +/- 10% of the total thickness is allowed

KERATHERM® 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-m. For holes or relevant recesses and outlines the following table applies:

	Thickness	Tolerances
up to	1.0 mm	±0.5 mm
up to	2.0 mm	±1.0 mm
up to	3.0 mm	±1.5 mm
up to	4.0 mm	±2.0 mm
up to	5.0 mm	±2.5 mm

Dimensions are measured with a Quick-Scope (QSPAK 3.0) image processing measurement system, or using a dial gauge or measuring microscope. All tools and punching are qualified by means of the first piece inspection report.

Batchwise determination of thermal properties

An equi-area measurement sample (4 cm² 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 dependance 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.

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 behaviour. 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 "Final Test Method No.1" (180°).

YOUNGS MODULUS studies

Kerafol® analyses the behaviour of flexible films under pressure, using the method described in ASTM D 575-91, to determine the so-called YOUNGS MODULUS. The sample geometry of the individual film types is 30x30mm at 2.5 mm thickness, and pressure is applied with a constant traverse path of 1mm/min (0.04 in/min). The pressure dependence of the films is shown on the graphs.

Determination of flame class

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 KERAFOLE® endeavours to test its products on the basis of the latest findings in research and development.

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 methodes

Description	Unit	Test method	
Thermal resistance R_{th}^{*1}	K/W	Kerafol®-test method	
Thermal conductivity λ^{*1}	W/mK	Kerafol®-test method	ASTM D 5470
Breakdown voltage ($U_{d; ac}$)	kV	IEC 243 1+2	ASTM D 149
Dielectric breakdown ($E_{d; ac}$)	kV/mm	IEC 243 1+2	ASTM D 149
Volume resistivity	cm	DIN 53482 - 3	ASTM D 257-3
Dielectric loss factor tan	1	DIN 53483	ASTM D 150
Dielectris constant ϵ_r	1	DIN 53483	ASTM D 150
Overall thickness	mm	DIN 53370	ASTM D 734
Tensile strength	N/mm ²	DIN 53455	ASTM D 412
Elongation	%	DIN 53455	ASTM D 412
Hardness	Shore (A,D) Shore 00	DIN 53505	ASTM D 2240
Compressibility λ^{*2}	mm	DIN 2039/ 53512 / 53517	ASTM D395/ASTM D695/M 1054
Youngs Modulus λ^{*2}	N/cm ²	-	ASTM D 575-91
Flame class	UL	UL 94 / E140693	UL 94 / E140693
Total mass loss (TML)	Ma.-%	-	ASTM E 595

* modified test geometry:

1. Thermal conductivity λ , thermal resistance R_{th} and thermal impedance R_{th} (4cm²)
2. Compressibility and "Youngs modulus" (3.0cm x 3.0cm = 9cm²)

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

RoHS - test report

Test-Methods:

RoHS - screening by means of RFA, (Cd), (Pb),(Hg), and (Br) by means of X-ray analysis.
 content of heavy metals - Decomposition; ICP-OES
 Chromiom(VI); Following DIN 53314

Flame retardants - Extraction, GC-MSD - PBB:

Tribrombiphenyl, Pentabrombiphenyl,
 Hexabrombiphenyl, Heptabromdiphenylether,
 Octabrombiphenyl, Nanobrombiphenyl,
 Decabrombiphenyl

Flame retardants - Extraction, GC-MSD - PBDE:

Tribromdiphenylether, Tetrabromdiphenylether,
 Pentabromdiphenylether, Hexabromdiphenylether,
 Heptabromdiphenylether, Octabromdiphenylether,
 Nanobromdiphenylether

Film Type	Heavy Metal				Flame protection agent		Chlorine-/ Bromine-concentration		Evaluation
	Cd mg/Kg	Cr(IV) mg/Kg	Hg mg/Kg	Pb mg/Kg	PBB mg/Kg	PBDE mg/Kg	Cl- mg/Kg	Br- mg/Kg	

Keratherm® white	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	63	< 20	passed
Keratherm® green	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	36	< 20	passed
Keratherm® pink	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	45	< 20	passed
Keratherm® red	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	130	< 20	passed
Keratherm® brown	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	58	< 20	passed
Keratherm® Graphite	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	< 20	n.b.	passed
Keratherm® Ferrite	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	60	< 20	passed
Keratherm® FTC	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	73	< 20	passed
Keratherm® U-series	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	49/58	< 20	passed
Keratherm® PCM	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	170	< 20	passed
Keratherm® PCE	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	190	< 20	passed

Keratherm® Spaceform®	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	24	< 20	passed
Softtherm® 200er-series	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	22	< 20	passed
Softtherm® 300er- series	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	35	< 20	passed
Softtherm® 500er- series	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	160	41	passed

thermal compound GF 86-255	< 100	< 1000	< 1000	< 1000	< 1000	< 1000	74	< 20	passed
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Kerafol® - Dispensing technology as a service



Consulting, development and production

With our knowledge in dispensing technology, we offer our customers not only customized solutions, but also consulting, developing and production services regarding the processing of Keratherm® sealing compounds.

Improved thermal, mechanical and electrical properties, which cannot be achieved by conventional products such as heat conducting pastes or thermal conducting tapes, can be generated by our specially developed dispensing materials.

Using the latest dispensing systems for sample production or prototyping and fully automated and robot-controlled manufacturing lines for serial production, we produce in fully air-conditioned



Technical characteristics of dispensed applications:

- outstanding adaptability and compressibility
- low mechanical stress
- high thermal conductivity
- long term stability
- compatible with industrial production sequences
- good electrical insulation



You benefit from:

- a professional service-provider for dispensing production and technology
- a more economical dispensing material compared to conventional thermal pastes and tapes
- a time-saving, easy assembly, due to the prefabricated ready-dispensed components

We look forward to receiving your inquiry!

Keratherm® - Gluey-Soft 100 adhesive pad

Versatile usable as:

- non-slip mat for car interior
- fit-up aid
- adhesive surface for notes or small parts e.g. on the refrigerator
- protection and mounting of delicate products
- vibration attenuation and acoustic insulation

Technical properties:

- residue-free removable
- electrical insulating
- high dielectric breakdown
- punchable and cuttable
- application temperature: -40 to +150°C

Properties	Unit	Gluey Soft
Colour		grey
Thickness (+/-10%)	mm	1.2
reinforcement		fiber glass
Hardness	Shore 00	45
Peel strength	side A	N
Peeling 180°C; peeling speed 300mm/min.	side B	N
Adhesive strength (25x25 mm adhesive surface)	kPa	300
Bonding strength *	N x mm	> 1.4
Adhesiv strength on surface *	mm	> 1.0
Dielectric breakdown E _{d,ac}	KV/mm	> 20
Thermal conductivity	W/mK	0.25
TML	Ma.-%	< 0.8
Elongation	%	40
Application temperature	°C	-40 to +150



This adhesive film with reinforcement made of fiberglass fixes parts on all smooth and slightly rough surfaces, even in extreme angled positions or perpendicular to walls - almost "magnetically"! Optimal e.g. as fixation of components for repairs, installation assistance, anti-slip mat for mobile phones, sunglasses in the car, adhesive surface for notes or small parts on the refrigerator etc. The non-toxic film guarantees the best adhesion without containing adhesives and an extremely long life. In addition, it can be used in a very large temperature range.

The adhesive strenght depends on the material, position and weight. The film can be cleaned with tap water if needed.



KERAFOL®
KERAMISCHE FOLIEN GMBH



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Customized solutions.

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RS 31390



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 broad range of products and take advantage of the diverse application possibilities!

We look forward to receiving your inquiry!

www.yegpowerline.co.uk