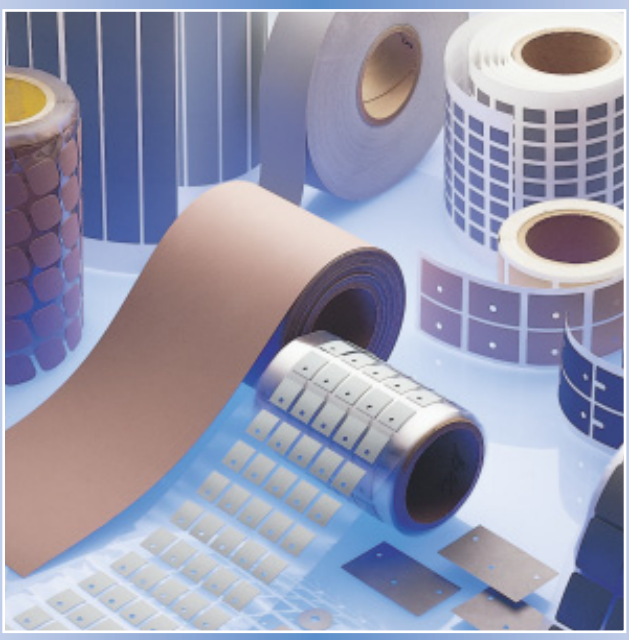
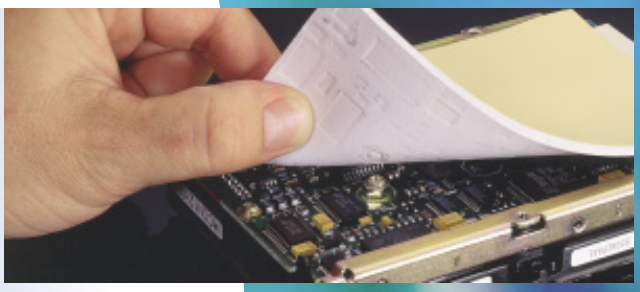
Thermally Conductive
Interface Materials for
Cooling Electronic Assemblies

Sil-Pad®

SELECTION GUIDE





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Financially Stable

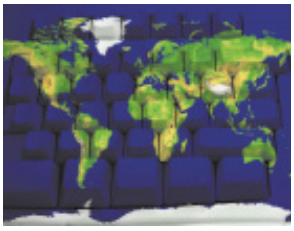
Customer Oriented

A World Leader in Thermal Management Through Technology, Innovation & Service

At Bergquist, developing high quality components for the electronics industry is our first priority. As a growing world leader with state-of-the-art facilities producing Thermal Products, Touchscreens and Membrane Switches, and distributing Electronic Components, we supply a multitude of industries worldwide including automotive, computer, military, aerospace, telecommunications and more.

We make it our business to know your business. We understand your problems. We also know that there will always be a better way to help you reach your goals and objectives. To that end, our company continually invests considerable time and money into research and development. The Bergquist Company is focused on a single purpose – discovering the need, then developing and delivering technologically advanced solutions backed by superior service.

Entrepreneurial Spirit



Worldwide Locations

High Demand Products

Committed to Quality

Bergquist Takes the Heat

Bergquist's Thermal Products Group is a world leading developer and manufacturer of thermal management materials which provide product solutions to control and manage heat in electronic assemblies and printed circuit boards. Used by many of the world's largest OEMs in various industries including automotive, computer, power supply, military and motor control, these materials include:

Sil-Pad® – Thermally Conductive Insulators
Gap Pad® – Thermally Conductive Gap Filling Materials
Hi-Flow® – Phase Change Interface Materials
Sterling™-7500 – Thermal Interface Compound
Thermal Clad® – Insulated Metal Substrates

World Class Operations Around the Globe

In the United States, the Thermal Products Group's 75,000 square foot primary manufacturing facility is located in Cannon Falls, Minnesota. A 40,000 square foot facility in Prescott, Wisconsin, houses the Thermal Clad printed circuit board operations. A new 130,000 square foot facility in Chanhassen, Minnesota is the location for Bergquist's new corporate headquarters and state of the art research and development facilities. Worldwide, Bergquist has facilities in The Netherlands, Germany, the United Kingdom, Taiwan, Korea, Hong Kong and China with sales representatives in 30 countries to support worldwide growth.

A Legacy of Industry-Leading Technology

For over 35 years, outstanding quality, innovation and engineering have been hallmarks of the Bergquist Company. Today, developing innovative products for the electronics industry remains our first priority. Bergquist has developed over 260 materials which provide thermal solutions for a wide variety of electronic applications. Many of our products were originally developed to satisfy a customer request for a specific material designed to perform to their particular specifications. This kind of "can do" attitude and customized technology has earned The Bergquist Company these coveted industry certifications: ISO 9001, QS 9000, Ford Q1 and GM Targets For Excellence.

Research and Development at the Speed of Change

Keeping pace in the incredibly aggressive electronics industry demands continual anticipation of change and the ability to develop solutions quickly and efficiently for our customers. At our Chanhassen, MN, headquarters, we house a state-of-the-art development laboratory and engineering department staffed with highly skilled chemical engineers, laboratory technicians and manufacturing engineers – all dedicated to researching, developing and testing new materials. From such dedication has come many industry-standard proprietary products including Thermal Clad®, Sil-Pad®, Gap Pad®, Sterling™ and Hi-Flow® materials.

Thermal Properties and Testing

Thermal Conductivity

The time rate of heat flow through a unit area producing a unit temperature difference across a unit thickness.

$$k = \frac{dq \bullet z}{dt \bullet A \bullet \Delta T}$$

Thermal conductivity is an inherent or absolute property of the material.

Thermal Resistance

The opposition to the flow of heat through a unit area of material across an undefined thickness.

$$R_\theta = \frac{z}{k}$$

Thermal resistance varies with thickness.

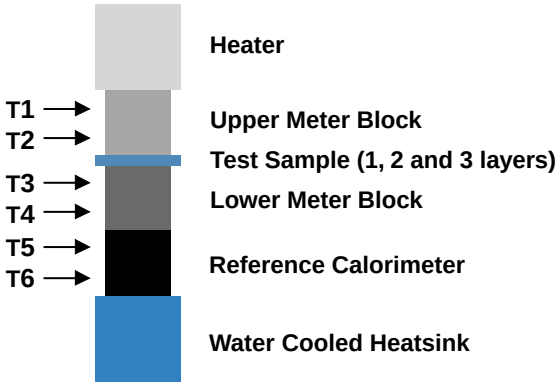
Thermal Impedance

A property of a particular assembly measured by the ratio of the temperature difference between two surfaces to the steady state heat flow through them.

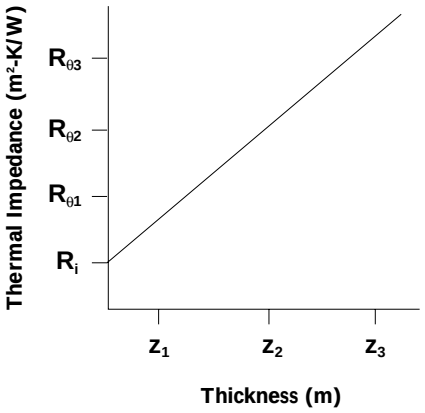
$$Z_\theta = \frac{z}{k \bullet A} + R_i$$

Factors affecting thermal impedance include:
Area: Increasing the area of thermal contact decreases thermal impedance.
Thickness: Increasing the insulator thickness increases thermal impedance.
Pressure: Increasing mounting pressure under ideal conditions decreases thermal impedance.
Time: Thermal impedance decreases over time.
Thermal impedance is affected by the method of temperature measurement.

Test Methods – ASTM D5470



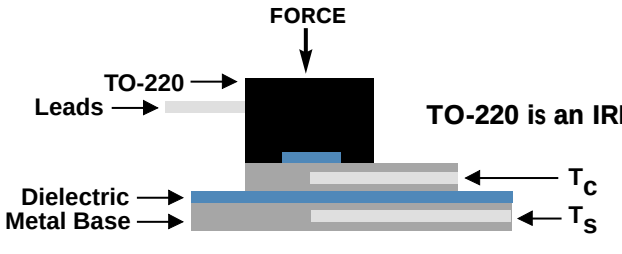
2 in. diameter stack (ref. 3.14 in²) – 10-500* psi, 1 hour per layer
*** Bergquist modified**



$$k = \frac{\Delta z}{\Delta R} \text{ (W/m-K)}$$

$$R_\theta = \frac{\overline{z}}{k} \text{ (m}^2\text{-K/W)}$$

Thermal Impedance Per Bergquist TO-220 Thermal Performance (25°C Cold Plate Testing)



TO-220 is an IRF 840

$$Z_\theta = \frac{\Delta T}{P_D}$$

Shortest thermal path from die to sink

Interface Material Selection Guide

Product Overview		Interface Applications						Mounting Methods			Typical Converted Options					
Market Applications	Products	Discrete Power Devices for Power Supplies, Computers, Telecom (Thru-Hole)	Active Power Compensators: Capacitors, Inductors, Resistors	Electronic Modules for Automotive: Motor & Wiper Controls, Anti-Lock, etc.	Electronic Modules for Telecom and Power Supplies	Computer Applications: CPU, GPU, ASICs, Hard Drives	Electrical Insulator	Clip, Low Pressure	Screw / Rivets, High Pressure	Not Applicable	Sheet Stock	Roll-Form Continuous	Standard Configurations	Custom External Shapes	Custom Internal Features	Adhesive PSA Availability
Grease Replacement Materials	Q-Pad II	T		T	T	T		T	T		A	A	A	A	A	A
	Q-Pad 3	T		T	T	T		T	T		A	A	A	A	A	A
	Hi-Flow 105	T			AS	AS		T			A	A	A	A	A	A
	Hi-Flow 115-AC	T			T	T		T			A	A	A	A	A	A
	Hi-Flow 200G	T			T	T		T	AS		A	A	A	A		A
	Hi-Flow 225F-AC	T			T			T			A	A	A	AS		NA
	Hi-Flow 225UT					T		T			A	A	A	AS		NA
	Hi-Flow 225U					T		T			A	A	A	AS		
Grease Replacement Materials, Insulated	Hi-Flow 625	T					T	T			A	A	A	A	A	A
	Hi-Flow 818	T					T	T			A	A	A	A	A	A
Thin-Film Bonding	Bond-Ply 660	T			T	T	T			T	A	A	A	A	A	A
Bonding (Fiber-Glass)	Bond-Ply 100 - 5 mil	T			T	T	T			T	A	A	A	A	A	A
	Bond-Ply 100 - 8 mil	T			T	T	T			T	A	A	A	A	A	A
	Bond-Ply 100 - 11 mil	T			T	T	T			T	A	A	A	A	A	A
Sil-Pad (Fiber-Glass)	Sil-Pad 400	T		T	T		T	T	T		A	A	A	A	A	A
	Sil-Pad 800	T		T	T		T	T			A	A	A	A	A	A
	Sil-Pad 900S	T		T	T		T	T	T		A	A	A	A	A	A
	Sil-Pad 980			T	T		T		T		A	A	A	A	A	A
	Sil-Pad 1500	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad A1500	T		T	T		T	T	T		A	A	A	A	A	A
	Sil-Pad 2000 - 10 mil	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad 2000 - 15 mil	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad 2000 - 20 mil	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad A2000 - 11 mil	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad A2000 - 15 mil	T		T	T		T	AS	T		A	A	A	A	A	A
	Sil-Pad A2000 - 20 mil	T		T	T		T	AS	T		A	A	A	A	A	A
Thin-Film Sil-Pad (Kapton)	Sil-Pad K4	T		T	T		T	T	T		A	A	A	A	A	A
	Sil-Pad K6	T		T	T		T	T	T		A	A	A	A	A	A
	Sil-Pad K10	T		T	T		T	T	T		A	A	A	A	A	A
Gap Pad	Gap Pad VO	T	T	T	T	T	T	T			A	A*	A	A	AS	A
	Gap Pad VO Soft	T	T	T	T	T	T	T			A	A*	A	A	AS	A
	Gap Pad VO Ultra Soft	T	T	T	T	T	T	T			A	A*	A	A	AS	A
	Gap Pad HC1000	T	T			T	T	T			A	A*	A	A	A	
	Gap Pad HC1100	T	T			T	T	T			A	A*	A	A	A	
	Gap Pad 1500	T	T		T	T	T	T			A	A*	A	A	AS	
	Gap Pad 1500R	T	T	T		T	T	T			A	A*	A	A	A	
	Gap Pad A2000	T	T		T	AS	T	T			A	A*	A	A	A	
	Gap Pad A3000	T	T	T	T	AS	T	T			A	A*	A	A	A	
Gap Filler	Gap Filler 1000	T	T	T	T		AS	T					A			
	Gap Filler 2000	T	T	T	T		AS	T					A			

T= Typical , AS= Application Specific (please contact Bergquist Sales) , A= Available, * = up to 40 mils only

Note: For Hi-Flow 225UT and Hi-Flow 225F-AC the adhesive is not a PSA.

Gap Pad® Thermally Conductive Materials

SOLUTION-DRIVEN THERMAL MANAGEMENT PRODUCTS FOR ELECTRONIC DEVICES

A complete range of choices for filling air gaps and enhancing thermal conductivity

The Bergquist Company, a world leader in thermal interface materials, developed the Gap Pad family to meet the electronics industry's growing need for interface materials with greater conformability, higher thermal performance and easier application.

The extensive Gap Pad family provides an effective thermal interface between heat sinks and electronic devices where uneven surface topography, air gaps and rough surface textures are present. Bergquist application specialists work closely with customers to specify the proper Gap Pad material for each unique thermal management requirement.

FEATURES

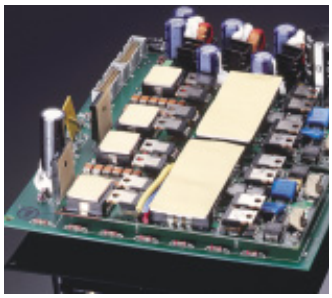
Each of the many products within the Gap Pad family is unique in its construction, properties and performance. Following is an overview of the important features offered by the Gap Pad family.

- Low-modulus polymer material
- Fiberglass, rubber carriers or non-reinforced
- Special fillers to achieve specific performance characteristics
- Highly conformable to uneven and rough surfaces
- Electrically isolating
- Naturally tacky one-side or tacky on both sides with protective liner
- Variety of thicknesses and hardnesses
- Range of thermal conductivities
- Available in sheets and die-cut parts

BENEFITS

Gap Pad thermal products are designed to improve an assembly's thermal performance and reliability while saving time and money. Specifically:

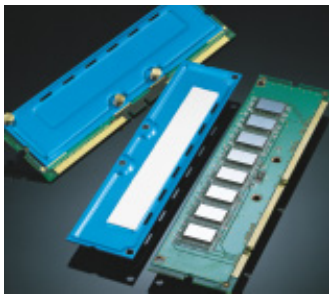
- Eliminates air gaps to reduce thermal resistance
- High conformability reduces interfacial resistance
- Replaces messy grease
- Low-stress vibration dampening
- Shock absorbing
- Easy material handling
- Simplified application
- Puncture, shear and tear resistance
- Improved performance for high-heat assemblies
- Compatible with automated dispensing equipment



OPTIONS

Some Gap Pad products have special features for particular applications, including:

- Available with or without adhesive
- Rubber-coated fiberglass reinforcement
- Thicknesses from 0.010" to 0.250"
- Available in custom die-cut parts, sheets and rolls (converted or unconverted)
- Custom thicknesses and constructions



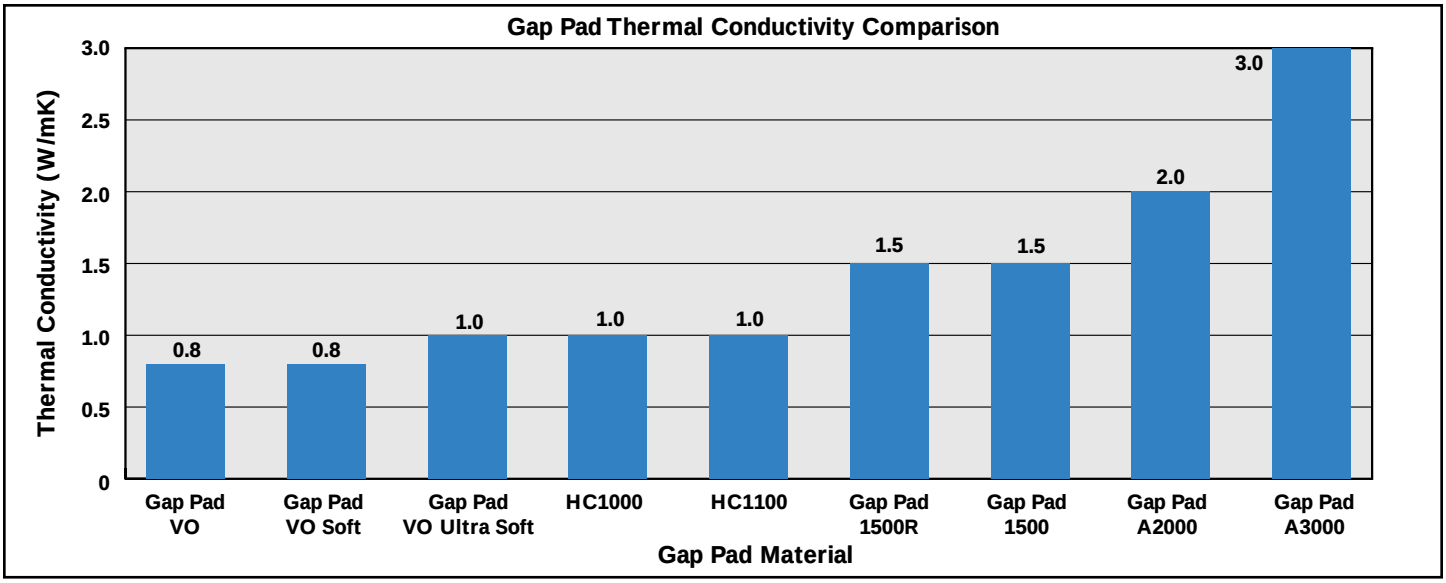
APPLICATIONS

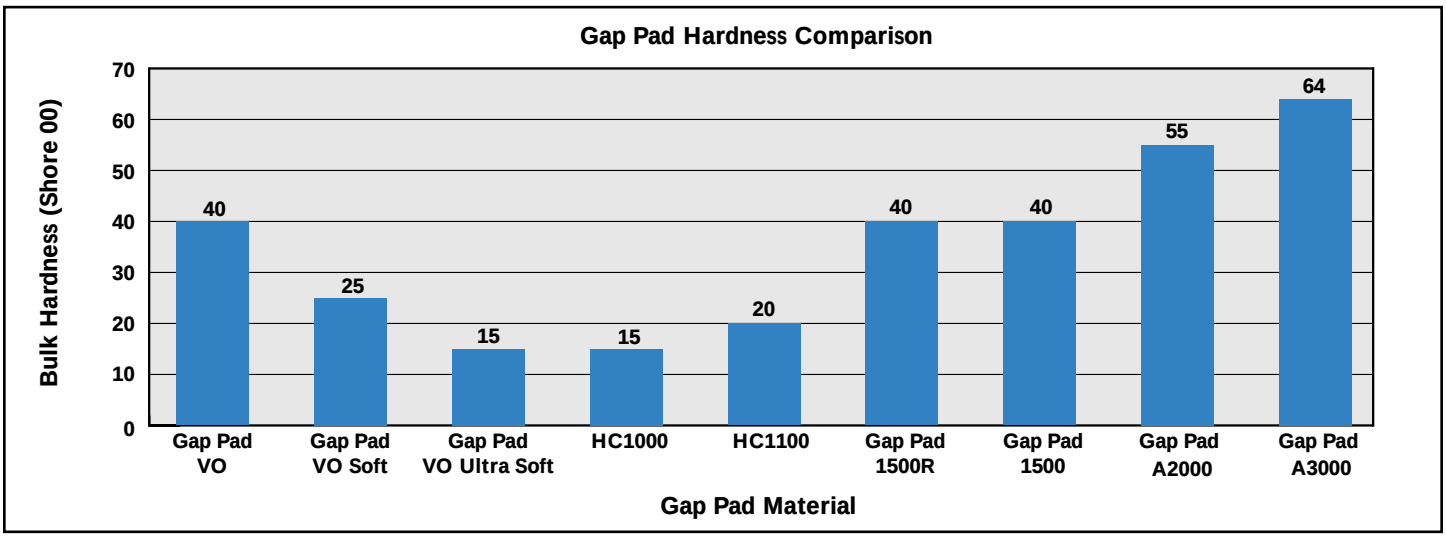
Gap Pad products are well suited to a wide variety of electronics, automotive, medical, aerospace and military applications such as:

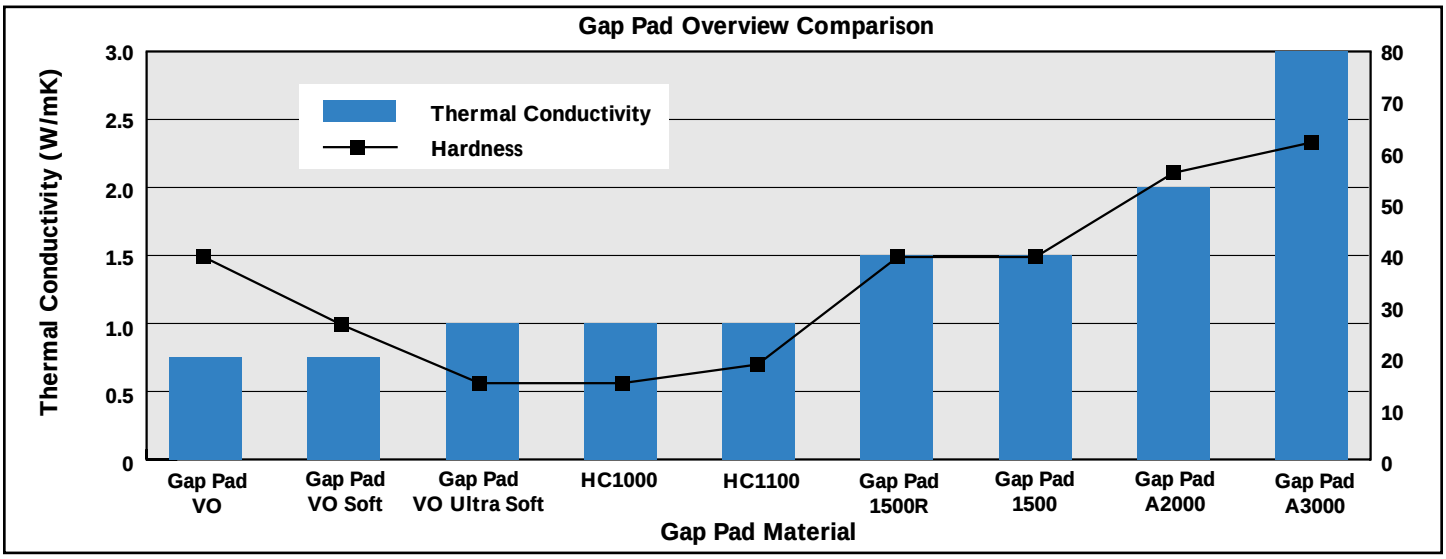
- Between a CPU and heat spreader
- Between a semiconductor and heat sink
- CD-ROM cooling
- Between heat generating devices and chassis
- Heat pipe assemblies
- RDRAM memory modules
- Drive cooling
- Power supply
- Fiber optic pumps
- Signal amplifiers

Gap Pad® Comparison Data

Conductivity, Hardness and General Overview







Frequently Asked Questions

Q What thermal conductivity test method was used to achieve the values given on the data sheets?

A The Anter Quickline 10 was used to run this test. Bergquist has published an application note about the modifications to the ASTM D5470 test method to appropriately test Gap Pad materials at low 10 psi pressure; see Bergquist Application Note #112.

Q Is Gap Pad offered with an adhesive?

A Currently the standard Gap Pads, which include Gap Pad VO, Gap Pad VO Soft, and Gap Pad VO Ultra Soft are offered with or without an adhesive on the SP800/900 carrier side of the material. All other surfaces on the standard Gap Pad as well as the higher performance Gap Pads, have naturally tacky surfaces.

Q Is the adhesive repositionable?

A Depending on the surface being applied to, if care is taken, the pad may be repositioned. Special care should be taken when removing the pad from aluminum or anodized surfaces to avoid tearing or delamination.

Q What is meant by naturally tacky?

A The characteristic of the rubber itself has a natural inherent tack, without the addition of an adhesive. As with adhesive backed products, the naturally tacky surfaces may help in the assembly process to temporarily hold the pad in place while the application is being assembled. Natural tack varies from one material to another and is greatest for the Gap Pad VO Ultra Soft, Gap Pad VO Soft, HC1000, Gap Pad 1500 and Gap Pad 1500R materials. Gap Pad A2000 and Gap Pad A3000 have less natural tack due to their high filler levels.

Q Is the naturally tacky side of the Gap Pad repositionable?

A Again, depending on the material that the pad is applied to, in most cases they are repositionable. Again, care should be taken when removing the pad from aluminum or anodized surfaces as to avoid tearing or delaminating the pad. The naturally tacky side is always easier to reposition then an adhesive side.

Q Is Gap Pad reworkable?

A Depending on the application and the pad being used, Gap Pad has been reworked in the past. Bergquist has customers that are currently using the same pad for reassembling their applications after burn-in processes and after fieldwork repairs. However, this is left up to the design engineer's judgment as to whether or not the Gap Pad will withstand reuse.

Q Will heat make the material softer?

A In the temperature range of -60 C to 200 C, there is no significant variance in hardness.

Q What is the life expectancy of Gap Pad?

A The silicone rubber industry recognizes a twenty-year life for silicone rubber when used within specified operation parameters. Bergquist has made pad material that has been in applications for some thirty years without any known signs of deterioration.

Q What is the shelf life of Gap Pad?

A Average shelf life is three (3) years, dependent upon the specific material, tack requirements and type of liner. Please contact Bergquist Sales for more information.

Q What is the shelf life of Gap Pad with adhesive?

A The standard Gap Pad VO materials come with an optional silicone adhesive, which has a shelf life of six (6) months.

Q What are the upper processing temperature limits for Gap Pad and for how long?

A Gap Pads that are pink, mauve or gold in color are more stable at elevated temperatures. Gap Pad in general can be exposed to temporary processing temperatures of 250 C for 5 minutes and 300 C for 1 minute.

Q Is Gap Pad electrically isolating?

A Yes, all Gap Pad materials are electrically isolating. However, it has to be remembered that Gap Pad is designed to FILL gaps, not for guaranteeing them in high stress applications.

Q How much force will the pad place on my device?

A Refer to the pressure vs. deflection charts on the data sheet for an approximation and refer to Bergquist Application Note #116. Carefully read the side notes on the data sheet regarding the test method used.

Q Will Gap Pad work in my application (what size gaps will Gap Pad accommodate)?

A Wherever air can be replaced with a Gap Pad, such as between a heat generating device and a heat sink, heat spreader or housing. This can be done by using one sheet of Gap Pad or individual pieces of appropriate thicknesses if stack-up tolerances and height variations are significant.

Q What is meant by compliance and conformability, why is this important?

A The better a Gap Pad complies and conforms to a rough or stepped surface, the less interfacial resistance will be present due to air voids and air gaps. This leads to a lower overall thermal resistance of the pad between the two interfaces.

Q Is anything given off by the material (i.e. extractables, outgassing)?

A 1: Gap Pad, like all silicone pads, can extract silicone fluid; refer to Bergquist Application Note #56. It must also be noted that Gap Pad has the lowest extraction value for gap filling products on the market.
2: Primarily for aerospace applications, Gap Pad outgassing data is detailed in Bergquist Application Note #117, tested per ASTM E595.

Q How is extraction testing performed?

A The test method used is the Bellcore Extraction method #TR-NWT-000930; refer to Bergquist Application Note #56.

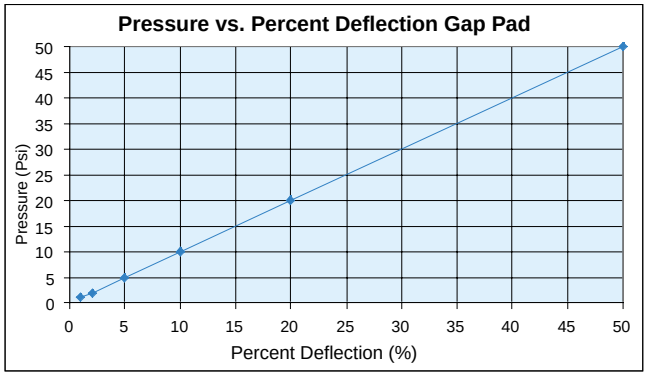
Gap Pad® VO

Conformable, Thermally Conductive Material for Filling Air Gaps

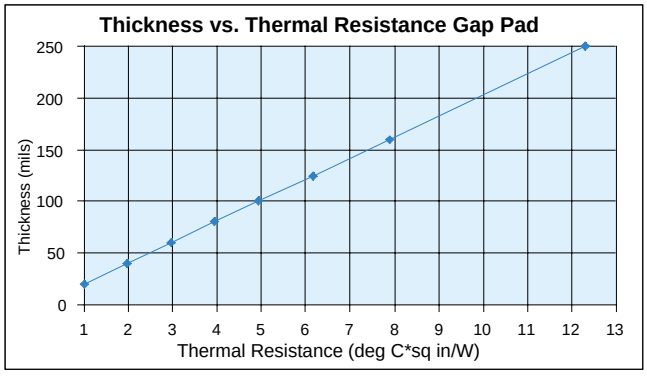
Gap Pad VO is a thermally conductive cost effective material that acts as a thermal interface between a heat sink and an electronic device. The conformable nature of Gap Pad VO allows the pad to fill in air gaps between PC boards and heat sinks or a metal chassis.

Gap Pad VO is a filled thermally conductive polymer supplied on a rubber coated fiberglass carrier allowing for easy material handling and enhanced puncture, shear, and tear resistance. The material is available in thickness from 0.020" to 0.250" with a removable liner applied to the light pink side of the material. The range in thickness and the materials flexibility allow Gap Pad VO to be used in a variety of applications where surface texture vary and the space between surfaces is uneven.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of Gap Pad VO

Property	Typical Value		Test Method
Color	Gold / Pink		Visual
Thickness	0.020" to 0.250"		ASTM D374
Specific Gravity	1.6 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	Thickness	Hardness	ASTM D2240
	.020" - .250"	80 - 40	
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	100	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>6 kV		ASTM D149
Dielectric Constant	5.5		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	0.8 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

Gap Pad VO is available in die-cut parts and sheets. Standard sheet size is 8" X 16", with or without adhesive.

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Pad® VO Soft

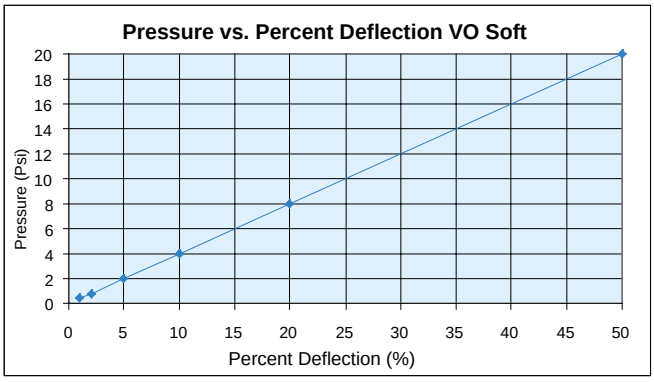
Highly Conformable, Thermally Conductive Material for Filling Air Gaps

Gap Pad VO Soft is a cost-effective material recommended for low stress applications. These include applications where the material is used as an interface and one side is in contact with a leaded device.

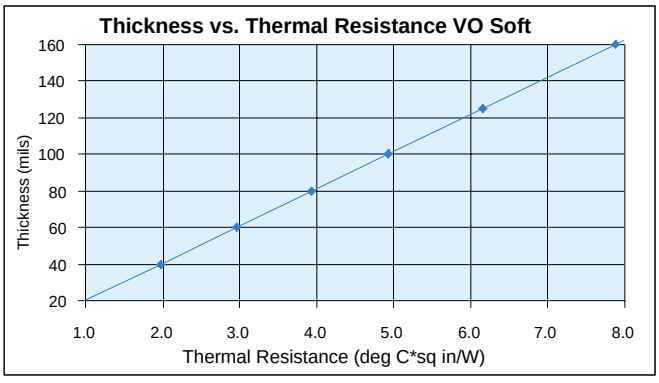
Gap Pad VO Soft is a thermally conductive material that acts as a thermal interface between a heat sink and an electronic device. The conformable nature of Gap Pad VO Soft allows the pad to fill in air gaps between PC boards and heat sinks or a metal chassis.

Gap Pad VO Soft is a highly conformable, low modulus filled silicone polymer on a rubber coated fiberglass carrier. The material is available in thickness from 0.020" to 0.160" with a removable liner applied to the light pink side of the material.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of Gap Pad VO Soft

Property	Typical Value		Test Method
Color	Mauve / Pink		Visual
Thickness	0.020" to 0.160"		ASTM D374
Specific Gravity	1.6 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	Thickness	Hardness	ASTM D2240
	.020" - .160"	65 - 25	
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	40	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>6 kV		ASTM D149
Dielectric Constant	5.5		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	0.8 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

The range in thickness and the materials flexibility allow Gap Pad VO Soft to be used in a variety of applications where surface texture vary and the space between surfaces is uneven. The material is available in die-cut parts and sheets. Standard sheet size is 8" X 16", with or without adhesive.

Typical Applications

- Between chassis wall and other surface
- CDROM Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.
- Between CPU and Heat Spreader
- Between a semiconductor and heat sink

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Pad® VO Ultra Soft

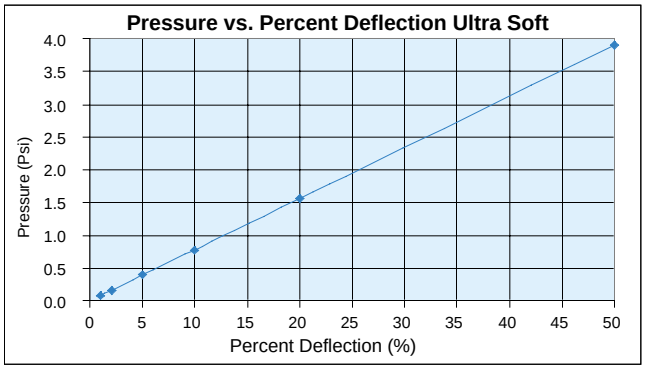
Additional Conformability & Thermal Conductivity for Filling Air Gaps

Gap Pad VO Ultra Soft is recommended for extremely low stress applications that require a thermally conductive interface material. The highly conformable nature of the material allows the pad to fill in air voids and air gaps between PC boards and heat sinks or metal chassis with steps, rough surfaces, and high stack up tolerances. The viscoelastic nature of the material also gives excellent low stress vibration dampening and shock absorbing characteristics.

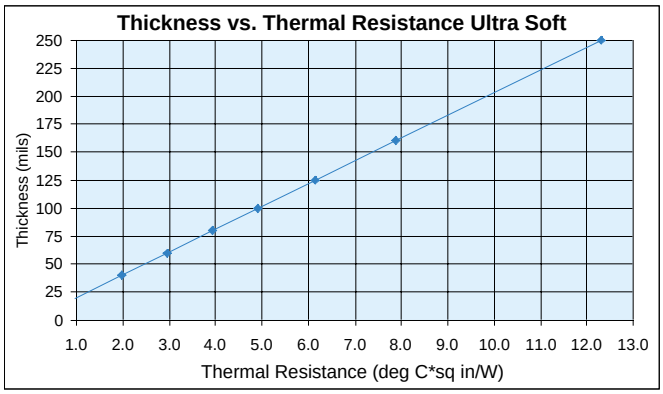
GP Ultra Soft is an electrically isolating material, which allows its use in applications requiring isolation between heat sinks and high voltage, bare leaded devices.

GP Ultra Soft is a filled thermally conductive polymer supplied on a rubber coated fiberglass carrier allowing for easy material handling and enhanced puncture, shear, and tear resistance.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of Gap Pad VO Ultra Soft

Property	Typical Value		Test Method
Color	Mauve / Pink		Visual
Thickness	0.020" to 0.250"		ASTM D374
Specific Gravity	1.6 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	Thickness	Hardness	ASTM D2240
	.020" - .250"	73 - 5	
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	8	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>6 kV		ASTM D149
Dielectric Constant	5.5		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	1 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

GP Ultra Soft is offered in thickness from 0.020" to 0.250" with the rubber-coated carrier on one side and removable protective liner on the naturally tacky side of the material. Material is available in die-cut parts and sheets, 0.020" material is also offered in roll form. Standard sheet size is 8" X 16", with or without adhesive.

Typical Applications

- Between chassis wall and other surface
- CDROM Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.
- Between CPU and Heat Spreader
- Between a semiconductor and heat sink

Gap Pad®: U.S. Patent 5,679,457 and others.

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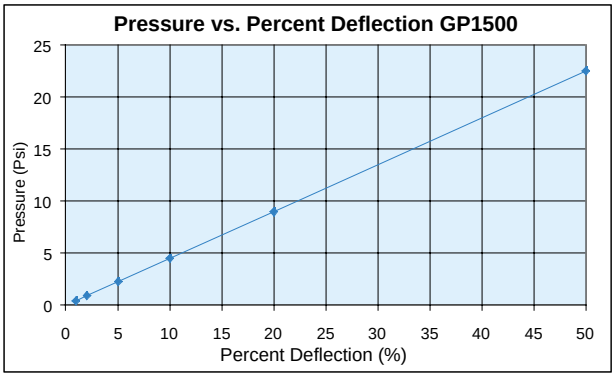
Gap Pad® 1500

High Thermally Conductive Gap Filling Material

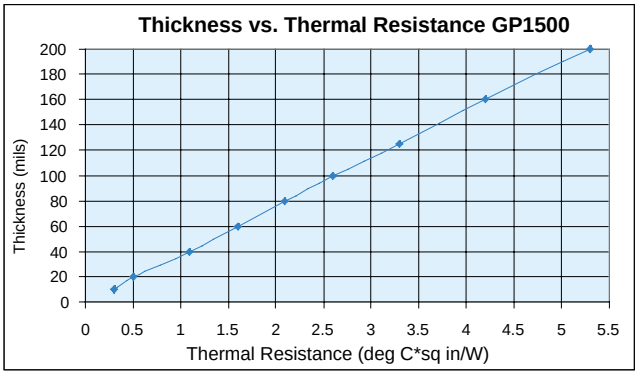
Gap Pad 1500 is designed to cost-effectively maximize heat transfer from electronic components to heat sinks or heat spreaders. The material has an ideal filler blend that gives its low modulus characteristic yet maintains optimal thermal performance, the combination of which minimizes thermal resistance between heat generating devices and heat sinks. GP1500 is an electrically isolating material that allows its use in applications requiring isolation between heat sinks and high voltage, bare leaded devices.

GP1500 is a highly conformable low-modulus material that fills air gaps due to steps, rough surfaces, and high stack-up tolerances. The softness relieves stress and absorbs shocks minimizing damage to delicate leads. The tacky nature of both sides of the material allows for good compliance to adjacent surfaces of components, minimizing interfacial resistance.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of Gap Pad 1500

Property	Typical Value		Test Method
Color	Black		Visual
Thickness	0.020" to 0.200"		ASTM D374
Specific Gravity	2.1 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	40		ASTM D2240
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	45	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>6 kVAC		ASTM D149
Dielectric Constant	5.5		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	1.5 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

GP1500 is available in thickness from 0.020" to 0.200". The standard material is offered without reinforcement, however, 0.010", 0.015" and 0.020" thick materials are also offered with reinforcement denoted as GP1500R.

Gap Pad 1500 is available in die-cut or sheet form with protective liners on both sides. The material is compatible with dispensing equipment for high volume production.

Typical Applications

- Heat Pipe Assemblies
- RDRAM™ Memory Modules
- CDROM Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.
- Between CPU and Heat Spreader

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Pad® 1500R

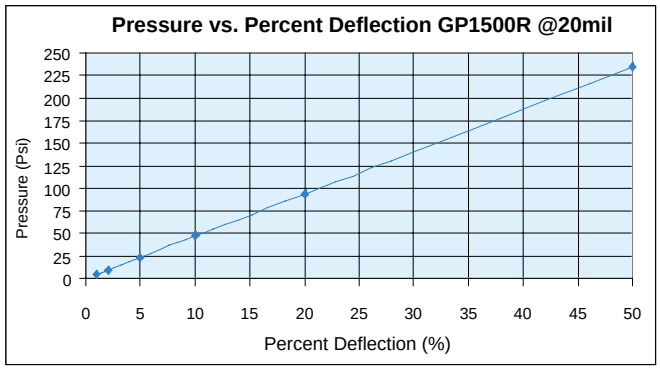
High Thermally Conductive Gap Filling Material

Gap Pad 1500R has the same highly conformable low modulus polymer as the standard GP1500 family of products with the addition of a fiberglass reinforcing substrate in the center. The fiberglass enforcement allows for easy material handling and enhances puncture, shear, and tear resistance.

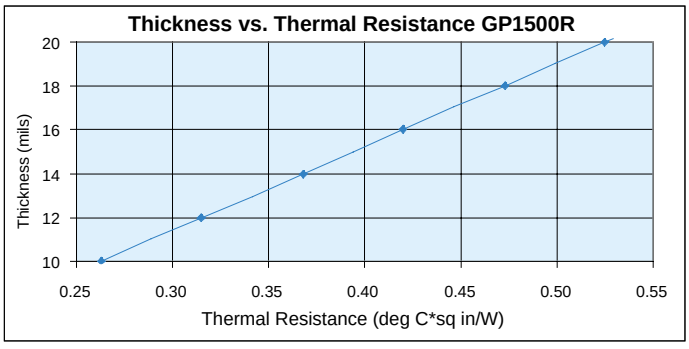
GP1500R is an electrically isolating material that allows its use in applications requiring isolation between heat sinks and high voltage, bare leaded devices.

GP1500R has an ideal polymer and filler blend that gives its low modulus characteristic yet maintains optimal thermal performance, minimizing thermal resistance. The highly conformable low-modulus nature of the material fills air gaps due to rough surfaces and high stack-up tolerances and is also vibration dampening. The tacky nature of both sides of the material allows for good compliance to mating surfaces of components, further reducing thermal resistance.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of Gap Pad 1500R

Property	Typical Value		Test Method
Color	Black		Visual
Thickness	0.010" to 0.020"		ASTM D374
Specific Gravity	2.1 g/cc		ASTM D792
Heat Capacity	1.3 J/g-K @ 85 C		ASTM C351
Hardness (Shore Type 00)	75 (@ 20 mils)		ASTM D2240
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	45	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>6 kVAC		ASTM D149
Dielectric Constant	6.0		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	1.5 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus @ 10% deflection, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2 and 20 mils thick. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

GP1500R is available in 0.010", 0.015", & 0.020" thickness and is available in 8" x 16" sheets, die-cut parts, and rolls in converted or unconverted form. GP1500R is offered with removable protective liners on both sides of the material. GP1500R is compatible with dispensing equipment for high volume production.

Typical Applications

- Heat Pipe Assemblies
- RDRAM™ Memory Modules
- CDROM Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.
- Between CPU and Heat Spreader

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Pad® A2000

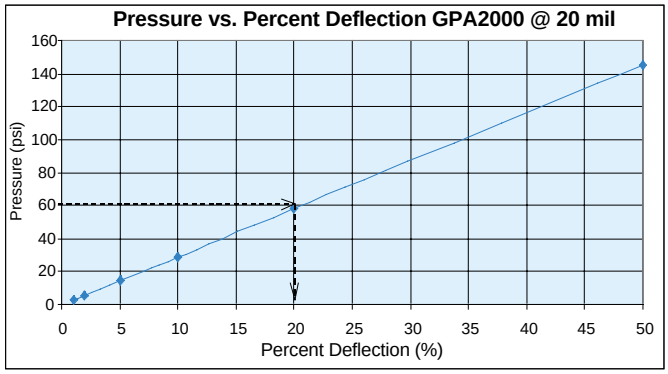
High Performance Thermally Conductive Gap Filling Material

Gap Pad A2000 is a highly conductive low modulus material that acts as a thermal interface between electrical components and heat sinks. The conformable nature allows the material to fill air gaps to enhance the thermal performance of electrical systems.

This high thermally conductive reinforced material is available in thickness from 0.010" to 0.040". Material in the thickness range of 10 to 20 mil is supplied with natural tack on both sides of the material, allowing for excellent compliance to the adjacent surfaces of components. The 40 mil material thickness is supplied with tack on one side only, allowing for burn-in processes and easy rework.

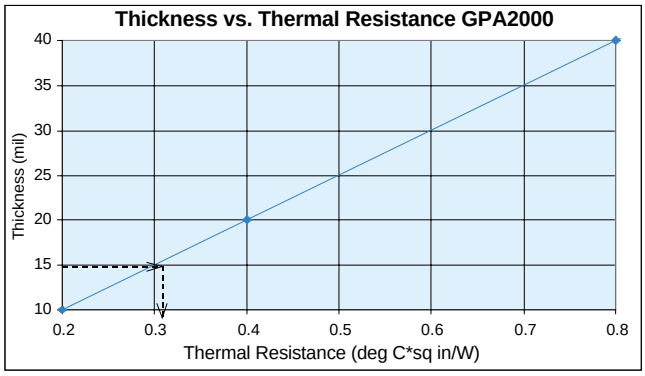
To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.

Example: 0.020" thickness at 60psi yields 20% (0.20) deflection.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.

Example: 0.020" * 0.20 = 0.004" Deflection
Resultant Thickness: 0.020" – 0.004" = 0.016"
Thermal Resistance: 0.32 °C in^2/watt



Typical Properties of Gap Pad A2000

Property	Typical Value		Test Method
Color	Grey		Visual
Thickness	0.010" to 0.040"		ASTM D374
Specific Gravity	2.9 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	Thickness	Hardness	ASTM D2240
	0.020"	80	
Young's Modulus (1) (psi)	Modulus	Rate	ASTMD575
	55	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>3 kV		ASTM D149
Dielectric Constant	5		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	2.0 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 $inch^2$on 20-mil material. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

Gap Pad A2000 is available in die-cut parts and in roll form (converted or unconverted). The material is compatible with dispensing equipment for high volume production.

Typical Applications

- Heat Pipe Assemblies
- RDRAM™ Memory Modules
- CDROM Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.
- Between CPU and Heat Spreader

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Pad® A3000

Improved High Performance Gap Pad Material, One Side Tacky

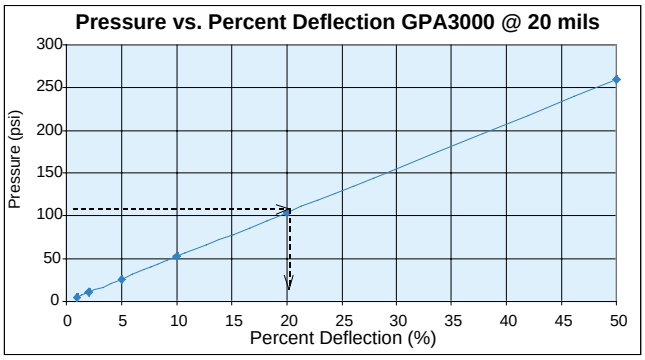
Gap Pad A3000 is a highly conductive gap filling material that acts as a thermal interface between electrical components and heat sinks. This material maintains a conformable nature, which allows it to fill air gaps and enhance the thermal performance of electrical systems.

Gap Pad A3000 is an electrically isolating material, which allows its use in applications requiring isolation between heat sinks and high voltage, bare leaded devices.

Gap Pad A3000 is a thermally conductive filled polymer laminate, supplied on a reinforcing mesh for easy material handling and enhanced puncture, shear, and tear resistance.

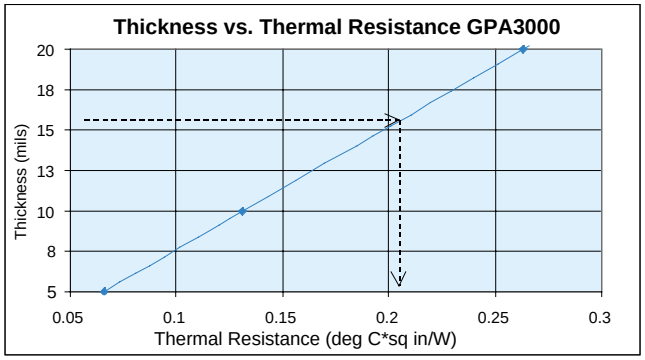
To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.

Example: 0.020" thickness at 100psi yields 20% (0.20) deflection.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.

Example: 0.020" * 0.20 = 0.004" Deflection
Resultant Thickness: 0.020" – 0.004" = 0.016"
Thermal Resistance: 0.22 °C in^2/watt



Typical Properties of Gap Pad A3000

Property	Typical Value		Test Method
Color	Gold		Visual
Thickness	0.010" to 0.020"		ASTM D374
Specific Gravity	3.2 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	Thickness	Hardness	ASTM D2240
	0.020"	80	
Young's Modulus (1) (psi)	Modulus	Rate	ASTMD575
	50	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>5 kV		ASTM D149
Dielectric Constant	7		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O (pending)		U.L.
Thermal			
Thermal Conductivity	3.0 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 $inch^2$ on 20 mil material. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

Gap Pad A3000 is inherently tacky on one side for stick-in-place characteristics while offering a non blocking surface on the other for burn-in and rework processes.

Gap Pad A3000 is available in 0.010", 0.015", & 0.020" thickness and is offered in 8" x 16" sheets, die-cut parts, and rolls in converted or unconverted form. Gap Pad A3000 is offered with removable protective liners on both sides of the material.

Typical Applications

- CPU & Heat Pipe Assemblies
- CDROM Cooling
- Burn-in Processes
- Graphic Chip Cooling
- Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.

Gap Pad®: U.S. Patent 5,679,457 and others.

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HC1000

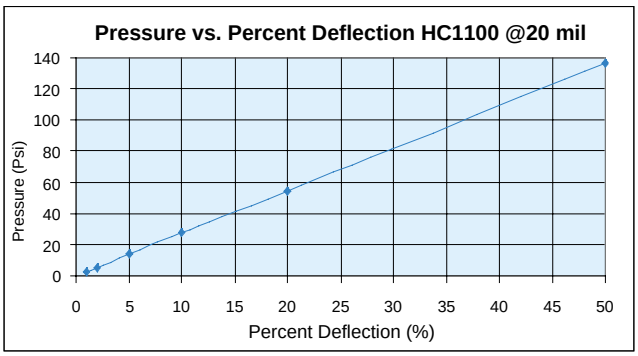
"Gel-Like" Modulus Gap Filling Material

Gap Pad HC 1000 is an extremely conformable low modulus polymer that acts as a thermal interface between electrical components and heat sinks. The "gel-like" modulus allows this material to fill air gaps to enhance the thermal performance of electrical systems.

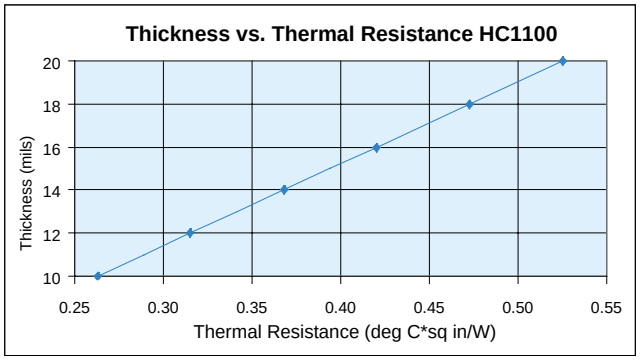
The tacky nature of both sides of the material allows for good compliance and excellent conformability to adjacent surfaces of components.

This thermally conductive reinforced material is available in thickness from 0.010" to 0.020".

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of HC1000

Property	Typical Value		Test Method
Color	Grey		Visual
Thickness	0.010" to 0.020"		ASTM D374
Specific Gravity	1.6 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	60 (@ 20 mils)		ASTM D2240
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	15	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>5 kVAC		ASTM D149
Dielectric Constant	6.0		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-O		U.L.
Thermal			
Thermal Conductivity	1.0 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus @ 10% deflection, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2 and 20 mils thick. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

Gap Pad HC1000 is available in 0.010", 0.015", & 0.020" thickness and is offered in 8" x 16" sheets, die-cut parts, and rolls in converted or unconverted form. Gap Pad HC1000 is offered with removable protective liners on both sides of the material.

Typical Applications

- Areas where irregular surfaces need to make a thermal interface to a heat sink.
- RDRAM™ Memory Modules
- Heat interfaces to frames, chassis, or other heat spreading devices.
- CDROM Cooling
- Between CPU and Heat Spreader

Gap Pad®: U.S. Patent 5,679,457 and others.

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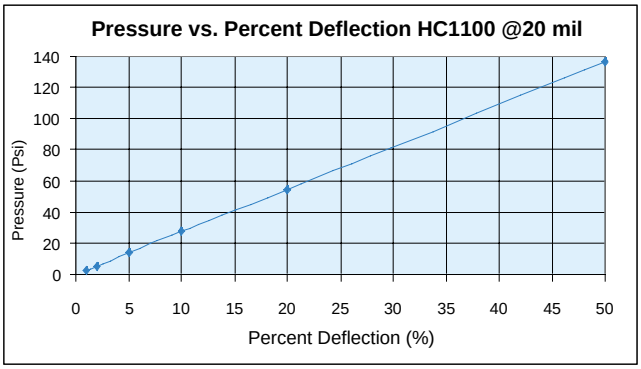
HC1100

Gap Filling Material with "Gel-Like" Modulus, One Sided Tack

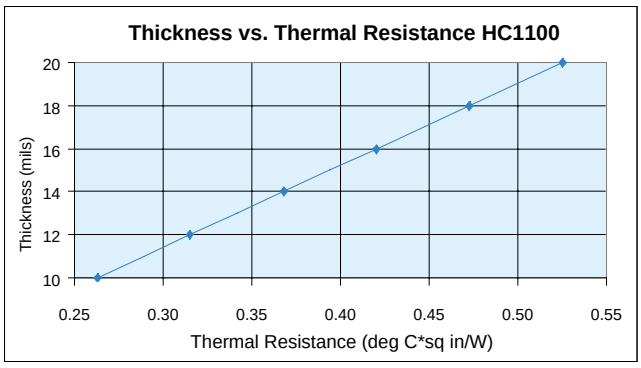
HC1100 is a cost-effective material, recommended for extremely low stress applications that require a thermally conductive interface material. The highly conformable nature of the material allows the pad to fill in air voids and air gaps between heat generating devices and heat sinks or metal chassis with rough surfaces, steps, and high stack up tolerances. This thermally conductive reinforced material is available in thickness from 0.015" & 0.020".

HC1100 is offered with tack on the bottom side only! This material simplifies material handling for part dispensing and pick-and-place automation. The top, tack-free surface does not require a protective liner since it does not attract dust and dirt from surrounding areas.

To calculate the approximate amount of deflection for a specific material thickness, at a given pressure, refer to the graph below. Multiply the thickness of the material by the percentage at the given pressure.



The resultant thickness of the Gap Pad will determine the thermal resistance. Subtracting the initial gap pad thickness by the deflection value, obtained above, will give the resultant thickness. Refer to the graph below to obtain the thermal resistance of the material.



Typical Properties of HC1100

Property	Typical Value		Test Method
Color	Grey		Visual
Thickness	0.015" to 0.020"		ASTM D374
Specific Gravity	1.6 g/cc		ASTM D792
Heat Capacity	1.0 J/g-K		ASTM C351
Hardness (Shore Type 00)	60 (@ 20 mils)		ASTM D2240
Young's Modulus psi (1)	Modulus	Rate	ASTMD575
	15	0.01"/min.	
Continuous Use Temp.	-60°C to 200°C		
Electrical			
Dielectric Breakdown Voltage	>5 kVAC		ASTM D149
Dielectric Constant	6.0		ASTM D150
Volume Resistivity	10^{11} Ohm-meter		ASTM D257
Flame Rating	94 V-1		U.L.
Thermal			
Thermal Conductivity	1.0 W/m-K		ASTM D5470

(1) Graphs and data generated from Young's Modulus @ 10% deflection, calculated using 0.01 inch/min. step rate of strain with a sample size of 0.79 inch^2 and 20 mils thick. For more information on Gap Pad modulus refer to Bergquist Application Note #116.

HC1100 is viscoelastic, which gives it excellent low stress vibration dampening and shock absorbing characteristics. HC1100 is an electrically isolating material, allowing for its use between high voltage, bare leaded devices and metal sinks.

HC1100 is a filled thermally conductive polymer supplied with an imbedded reinforcement resulting in improved material handling and enhanced puncture, shear, and tear resistance.

Gap Pad HC1100 is available in 0.015" & 0.020" thickness and is available in 8" x 16" sheets, die-cut parts, and rolls in converted or unconverted form. Gap Pad HC1100 is offered with removable protective liners on both sides of the material. Gap Pad HC1100 is compatible with dispensing equipment for high volume production.

Typical Applications

- Areas where irregular surfaces need to make a thermal interface to a heat sink.
- RDRAM™ Memory Modules
- Heat interfaces to frames, chassis, or other heat spreading devices.
- For ASIC and PC Cooling
- Between CPU and Heat Spreader

Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Filler 1000

Thermally Conductive Liquid Gap Filling Material

Gap Filler 1000 is a high performance thermally conductive liquid GAP FILLING MATERIAL. It is supplied as a two-component, room or elevated temperature curing system. It is formulated to provide a balance of cured material properties highlighted by "gel-like" modulus and good compression set (memory). These properties result in a soft, **thermally conductive,** form-in-place elastomer ideal for coupling "hot" electronic components mounted on PC boards with an adjacent metal case or heat sink. The viscosity of the mixed uncured material also makes it suitable as a **thermally conductive** alternative in the following applications:

- Replacement for thermal grease – Before cure, it flows under pressure like a grease. After cure, it does not pump from the interface as a result of thermal cycling. Unlike thermal grease, the cured product is dry to the touch.
- As a low modulus **thermally conductive** potting material.
- As a **thermally conductive** vibration dampening material.

Gap Filler 1000 is supplied as a two-part kit comprised of Part A and Part B components. The two components are colored to assist as a mix indicator (1:1 ratio by weight or volume). The mixed system will cure at either ambient or elevated temperature to form a soft **thermally conductive** interface material. Unlike cured Gap Filling materials, the liquid approach offers infinite thickness with little or no stress during displacement. It also eliminates the need for specific pad thickness and die-cut shapes for individual applications.

Gap Filler 1000 is intended for use in thermal interface applications where a structural bond is not a requirement. This material is formulated for low cohesive strength and "gel-like" properties.

This product is characterized by these special properties:

- High Thermal Conductivity – 1.0 W/m-K
- Stress Absorbing Flexibility (low modulus)
- "Clean-Release" from many heat sink and electronic packaging materials (re-workable)
- Excellent Low and High Temperature Mechanical and Chemical Stability
- 100% Solids – No Cure By-Products
- Versatile Cure Schedules – Both Ambient and Accelerated Cure Schedules

Gap Filler 1000 is available in standard 50 cc, 200 cc, or 400 cc MixPac™ cartridges. It is also available in 2 Gallon and 10 Gallon Kits.

Typical Properties of Gap Filler 1000

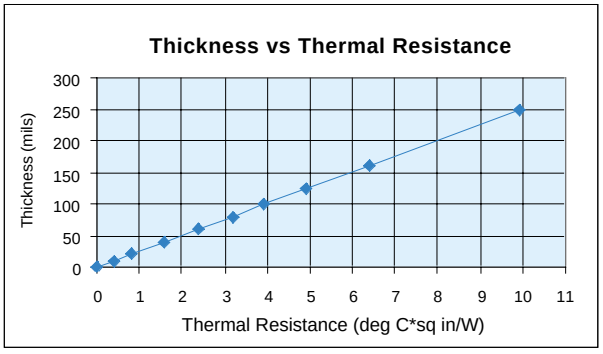
Property	Typical Value	Test Method
As Supplied		
Appearance Part A	Grey	Visual
Appearance Part B	White	Visual
Viscosity As Mixed (1)	100,000 cps	ASTM
Specific Gravity	1.63	ASTM D792
Mix Ratio	1:1	
Shelf Life @ 25°C	6 months	
As Cured – Physical		
Appearance	Grey	Visual
Hardness Shore Type "00"	30	ASTM D2240
Continuous Use Temp	-60°C - +175°C	
Heat Capacity	1 J/g-K	ASTM C351
Thermal Conductivity	1.0 W/mK	ASTM D5470
Flame Rating	94 V-O	U.L.
As Cured-Electrical		
Dielectric Strength	500 Volts/mil	ASTM D149
Volume Resistivity	1E +14 ohm-cm	ASTM D257
Dielectric Constant	5 @ 1 MHz	ASTM D150
Cure Schedule		
Pot Life @ 25 °C	15 min (2)	
Cure @ 25 °C	60 – 120 min (3)	
Cure @ 100 °C	5 min (3)	

(1) Brookfield RV, Heli-Path, Spindle TF @ 20 rpm, 25 °C
(2) Time for viscosity to double
(3) Cure Schedule (Rheometer – Time to reach 90% cure)

Application

Gap Filler 1000 can be applied using the following methods:

- Mixed and dispensed using dual tube cartridge packs with static mixers and a manual or pneumatic gun
- Mixed and dispensed using industry standard high volume mixing and dispensing equipment



Gap Pad®: U.S. Patent 5,679,457 and others.

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Gap Filler 2000

High Performance Thermally Conductive Liquid Gap Filling Material

Gap Filler 2000 is a high performance thermally conductive liquid GAP FILLING MATERIAL. It is supplied as a two-component, room or ele vated temperature curing system. It is formulated to provide a balance of cured material properties highlighted by "gel-like" modulus and good compression set (memory). These properties result in a soft, **thermally conductive,** form-in-place elastomer ideal for coupling "hot" electronic components mounted on PC boards with an adjacent metal case or heat sink. The viscosity of the mixed uncured material also makes it suitable as a **thermally conductive** alternative in the following applications:

- Replacement for thermal grease – Before cure, it flows under pressure like a grease. After cure, it does not pump from the interface as a result of thermal cycling. Unlike thermal grease, the cured product is dry to the touch.
- As a low modulus **thermally conductive** potting material.
- As a **thermally conductive** vibration dampening material.

Gap Filler 2000 is supplied as a two-part kit comprised of Part A and Part B components. The two components are colored to assist as a mix indicator (1:1 ratio by weight or volume). The mixed system will cure at either ambient or elevated temperature to form a soft **thermally conductive** interface material. Unlike cured Gap Filling materials, the liquid approach offers infinite thickness with little or no stress during displacement. It also eliminates the need for specific pad thickness and die-cut shapes for individual applications.

Gap Filler 2000 is intended for use in thermal interface applications where a structural bond is not a requirement. This material is formulated for low cohesive strength and "gel-like" properties.

This product is characterized by these special properties:

- High Thermal Conductivity – 2.0 W/m-K
- Stress Absorbing Flexibility (low modulus)
- "Clean-Release" from many heat sink and electronic packaging materials (re-workable)
- Excellent Low and High Temperature Mechanical and Chemical Stability
- 100% Solids – No Cure By-Products
- Versatile Cure Schedules – Both Ambient and Accelerated Cure Schedules

Gap Filler 2000 is available in standard 50 cc, 200 cc, or 400 cc MixPac™ cartridges. It is also available in 2 Gallon and 10 Gallon Kits.

Typical Properties of Gap Filler 2000

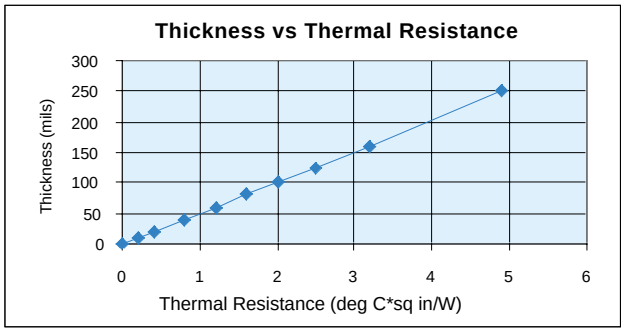
Property	Typical Value	Test Method
As Supplied		
Appearance Part A	Pink	Visual
Appearance Part B	White	Visual
Viscosity As Mixed (1)	300,000 cps	ASTM
Specific Gravity	2.8	ASTM D792
Mix Ratio	1:1	
Shelf Life @ 25°C	6 months	
As Cured – Physical		
Appearance	Pink	Visual
Hardness Shore Type "00"	70	ASTM D2240
Continuous Use Temp	-60°C - +200°C	
Heat Capacity	1 J/g-K	ASTM C351
Thermal Conductivity	2.0 W/mK	ASTM D5470
Flame Rating	94 V-O Pending	U.L.
As Cured-Electrical		
Dielectric Strength	500 Volts/mil	ASTM D149
Volume Resistivity	1E +14 ohm-cm	ASTM D257
Dielectric Constant	7 @ 1 MHz	ASTM D150
Cure Schedule		
Pot Life @ 25 °C	15 min (2)	
Cure @ 25 °C	60 – 120 min (3)	
Cure @ 100 °C	5 min (3)	

(1) Brookfield RV, Heli-Path, Spindle TF @ 20 rpm, 25 °C
(2) Time for viscosity to double
(3) Cure Schedule (Rheometer – Time to reach 90% cure)

Application

Gap Filler 2000 can be applied using the following methods:

- Mixed and dispensed using dual tube cartridge packs with static mixers and a manual or pneumatic gun
- Mixed and dispensed using industry standard high volume mixing and dispensing equipment



Gap Pad®: U.S. Patent 5,679,457 and others.

GAP PAD®

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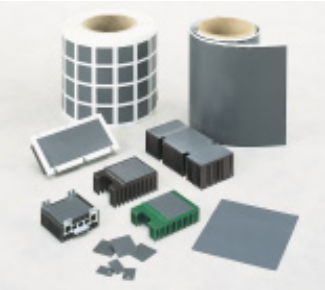
Hi-Flow® Phase Change Interface Materials

Solution-Driven Thermal Management Products For Electronic Devices

Use phase change materials for excellent thermal performance without the mess of grease

Hi-Flow® "phase change" materials are an excellent replacement for grease as a thermal interface between a CPU or power device and a heat sink. Hi-Flow materials change from a solid at specific phase change temperatures and flow to assure a total wet-out of the interface – without overflow. The result is a thermal interface comparable to grease, without the mess, contamination and hassle.

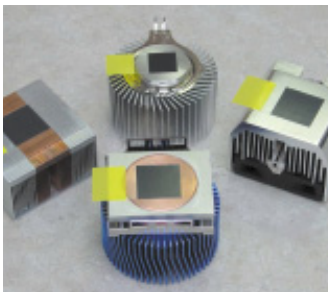
The Hi-Flow family of phase change thermal interface materials covers a wide range of applications. The Bergquist Company is a leader in thermal management solutions and works closely with customers to ensure that the proper Hi-Flow material is specified.



Features

Hi-Flow handles like Bergquist's famed Sil-Pad® materials at room temperature, but flows like grease at its designed phase change temperature. Following is an overview of the important features shared by the Hi-Flow family.

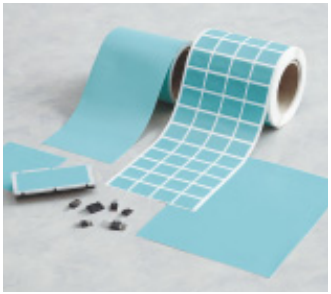
- Comparable thermal performance to mica or grease assemblies
- Thermally conductive phase change compound
- Aluminum, film or fiberglass carriers
- Low volatility
- Easy to handle and apply in the manufacturing environment
- Tack-free and scratch-resistant at room temperature



Benefits

Using Hi-Flow materials instead of grease can save time and money without sacrificing thermal performance. Here are some other benefits:

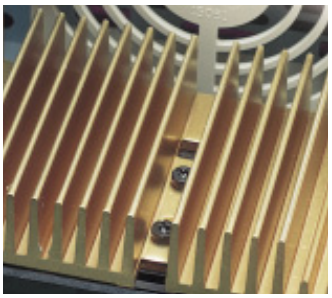
- No mess – thixotropic characteristics of the materials keep it from flowing out of the interface
- Easier handling – not tacky at room temperature
- Does not require protective liner
- High thermal performance helps ensure CPU reliability
- Does not attract contaminants
- Easier material handling and shipping
- Simplified application process



Options

The broad Hi-Flow family offers a variety of choices to meet the customer's performance, handling and process needs. Some of the choices include:

- Available with or without adhesive
- Aluminum carrier for applications not requiring electrical isolation
- Film or fiberglass carrier for electrical isolation
- Dry, non-reinforced material
- Tabbed parts, punch parts, sheets or rolls
- Adhesive specifically for cold application without preheating heat sink



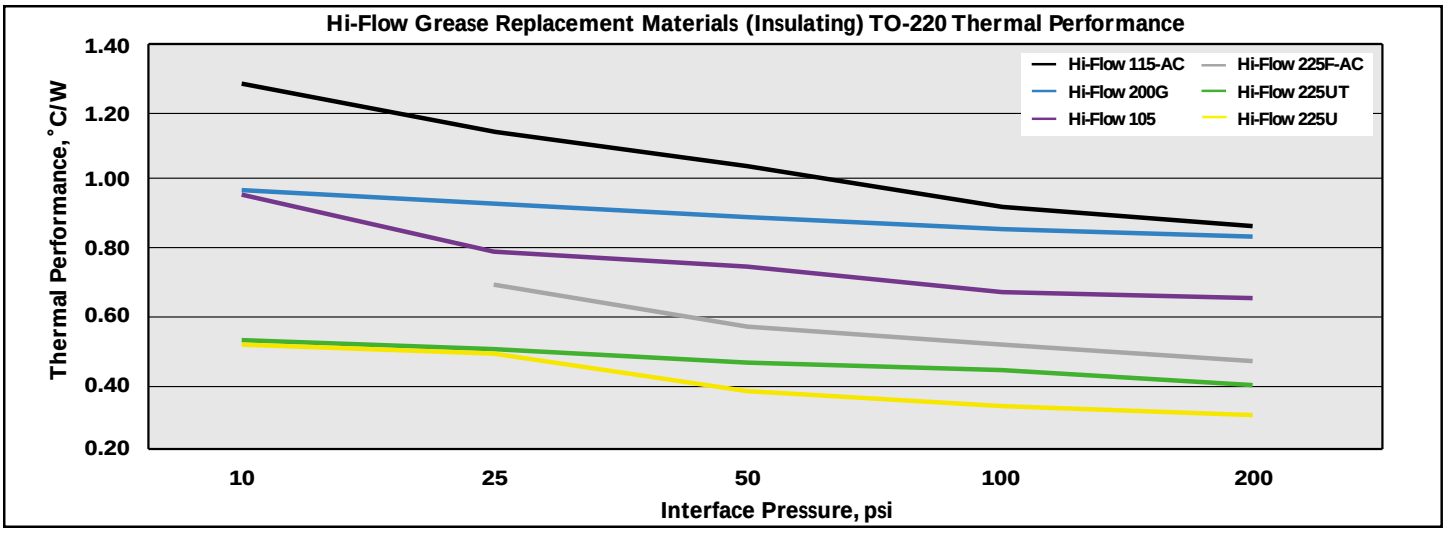
Applications

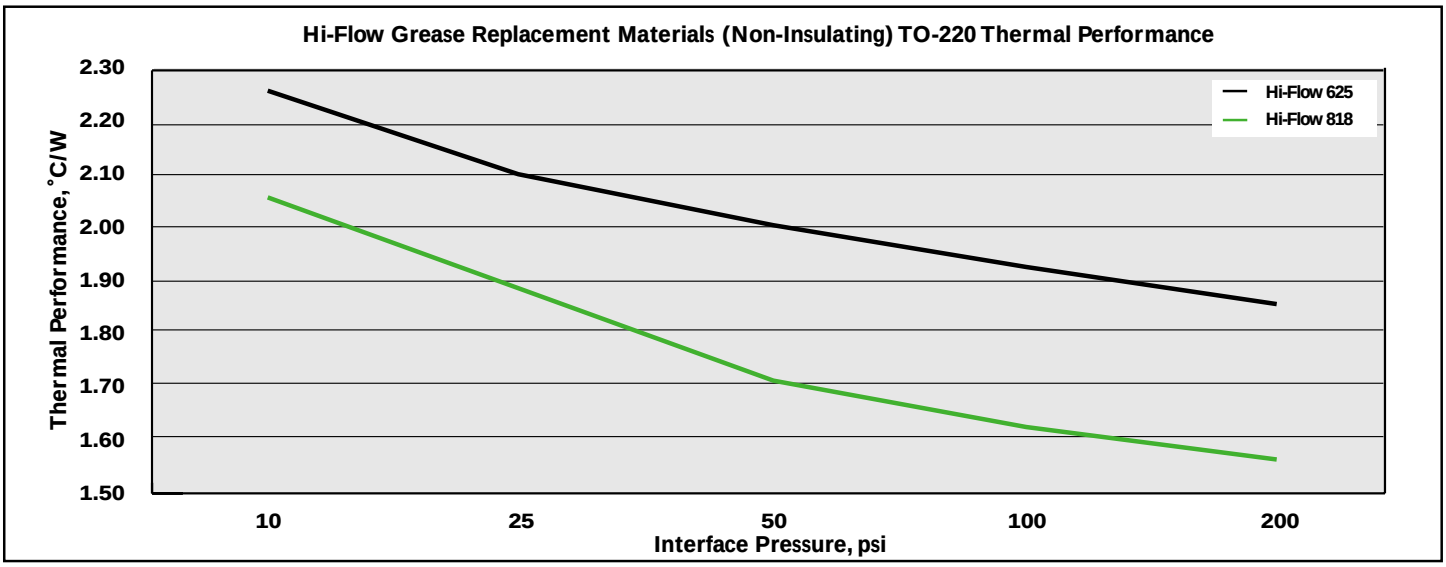
Hi-Flow materials are suited for consumer and industrial electronics, automotive, medical, aerospace and telecommunications applications such as:

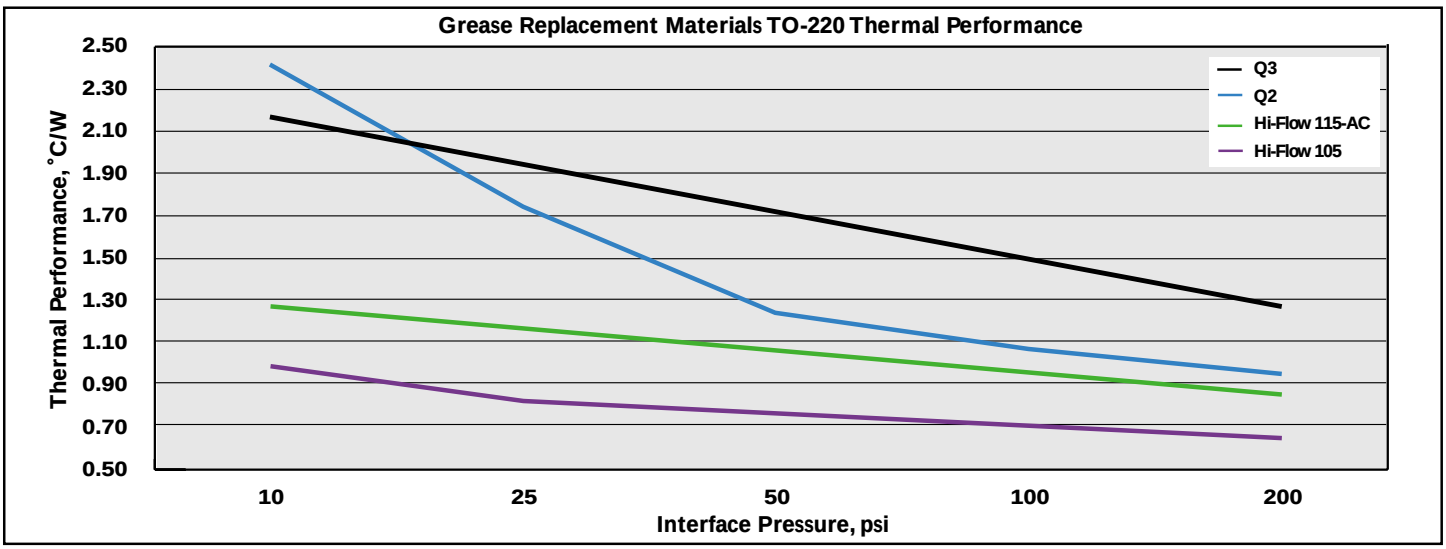
- UPS and SMPS AC/DC, DC/DC or linear power supplies
- Between a CPU and heat sink, including 700+ MHz chips
- Power conversion devices
- Fractional and integral motor control
- Leaded, surface mount and power module assemblies

Hi-Flow® Comparison Data

TO-220 Thermal Performance





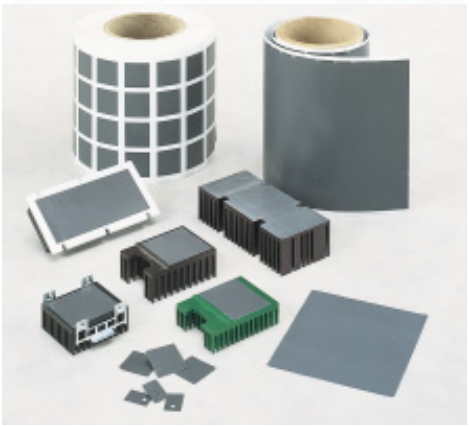


Hi-Flow® 105

Hi-Flow Coated Aluminum

Hi-Flow 105 is a “phase change” material designed specifically to replace grease as a thermal interface. Hi-Flow 105 is a filled polymer and is available in a pad form for easier handling and installation.

At 65 ºC (Phase Change Temperature), Hi-Flow 105 changes from a solid and flows thereby assuring total wet-out of the interface. The thixotropic characteristics of the material keep Hi-Flow 105 from flowing out of the interface. The result is a thermal interface comparable to grease, without the mess, contamination and difficult handling associated with grease.



Hi-Flow 105 has thermal performance equal to grease with 0.10 ºC-in^2 / W contact thermal resistance. Hi-Flow 105 is used in applications where electrical isolation is not required.

Typical applications for Hi-Flow 105 include CPUs mounted on a heat sink, power conversion modules or any other spring or clip mount application where grease is used.

Hi-Flow 105 is coated on both sides of the aluminum substrate. The product is available with or without thermal acrylic adhesive to aid in positioning.

Typical Properties of Hi-Flow 105

Physical Property	Typical Value	Test Method
Color	Dark Gray	Visual
Thickness	0.0055"	ASTM D374
Phase Change Temperature	65 ºC	DSC
Continuous use Temp.	-30 ºC to +130 ºC	
Electrical		
Dielectric Constant, 100Hz	3.2	ASTM D150
Flame Rating	94 V-O	U.L.
Thermal		
Thermal Conductivity (2)	0.9 W/m-K	ASTM D5470

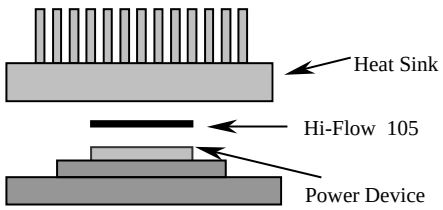
Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	0.95	0.80	0.74	0.69	0.64
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.39	0.37	0.36	0.33	0.30

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 70 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the Hi-Flow coating. It represents one conducting layer in a three-layer laminate. The Hi-Flow coatings are phase change compounds. These layers will respond to heat and pressure induced stresses. The overall conductivity of the material in post-phase change, thin film products is highly dependent upon the heat and pressure applied. This characteristic is not accounted for in ASTM D5470. Please contact Bergquist Product Management if additional specifications are required.

Hi-Flow 105 features include:

- Available in pad form as punched parts, sheets or rolls
- Low volatility – less than 1%
- Easy to handle in the manufacturing environment
- Flows but doesn’t run like grease or wax under continuous heat or in vertical applications.
- Tack Free & Scratch Resistant at room temperature. Does not require a protective liner in shipment when attached to heat sink.



Hi-Flow®: U.S. Patent 4,950,066 and others.

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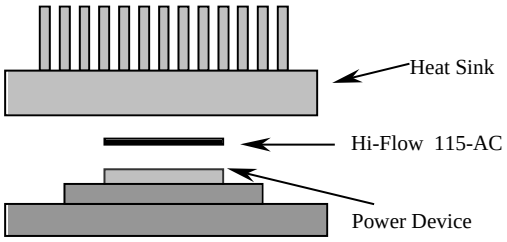
Hi-Flow® 115-AC

Phase Change Thermal Interface Material for Computer Processors

Bergquist Hi-Flow 115-AC is a thermally conductive fiber reinforced phase change material. The product consists of a thermally conductive 65ºC phase change compound coated on a fiberglass web, and an adhesive coating one side for attachment to cold heat sink.

Hi-Flow 115 is designed as a thermal interface material between an computer processor and a heat sink. The pressure sensitive adhesive makes it simple to apply in high volume to heat sinks and the 65ºC phase change temperature eliminates shipping and handling problems.



Hi-Flow 115-AC can be applied directly to a cold heat sink. No need to preheat the heat sink to apply the Hi-Flow 115 AC.

Hi-Flow 115-AC requires no protective liner for shipping or handling. The Hi-Flow coating is tough at room temperature, and it can withstand the handling and shipping process without protection.

Hi-Flow 115-AC handles like a Sil Pad® at room temperature and flows like high quality grease at elevated temperature.

Hi-Flow 115-AC thermal resistance of 0.18 °C in^2/watt at 50 psi.

Typical Properties of Hi-Flow 115-AC

Physical Property	Typical Value	Test Method
Color	Gray	Visual
Thickness	0.0055"	ASTM D374
Tensile Strength	900 psi	ASTM D882A
Elongation	40%	ASTM D882A
Phase Change Temperature	65 ºC	DSC
Continuous use Temp.	150 ºC	
Electrical		
Breakdown Voltage	300 volt	ASTM D149
Dielectric Constant, 100Hz	3.5	ASTM D150
Volume Resistivity, Ohm-meter	> 10^{10}	ASTM D257
Adhesive		
Peel Strength	70 g/in	ASTM D1876
Release Peel	25 g/in	ASTM D1876
Thermal		
Thermal Conductivity (2)	0.8 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	1.28	1.16	1.04	0.94	0.85
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.44	0.37	0.35	0.27	0.15

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 70 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the Hi-Flow coating. It represents one conducting layer in a three-layer laminate. The Hi-Flow coatings are phase change compounds. These layers will respond to heat and pressure induced stresses. The overall conductivity of the material in post-phase change, thin film products is highly dependent upon the heat and pressure applied. This characteristic is not accounted for in ASTM D5470. Please contact Bergquist Product Management if additional specifications are required.

Hi-Flow 115-AC is available without adhesive for slightly better thermal performance. The thermal resistance is 0.15 °C in^2/watt at 50 psi.

Hi-Flow®: U.S. Patent 4,950,066 and others.

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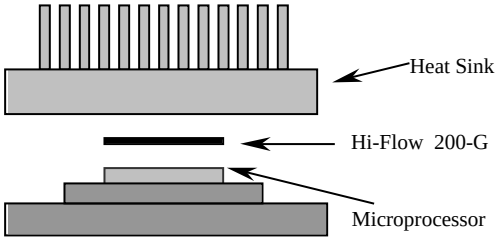
Hi-Flow® 200G

Fiberglass Reinforced, Phase Change Thermal Interface Material

Thermal Interface Material for High Performance Computer Processors

Hi-Flow 200-G is a thermally conductive phase change material. The product consists of a thermally conductive 55 ºC phase change compound coated on a fiberglass web. Hi-Flow 200-G is designed as a thermal interface material between a computer processor and a heat sink.

Above the phase change temperature, Hi-Flow 200-G wets out the thermal interface surfaces and flows to produce the lowest thermal impedance. Hi-Flow 200-G requires pressure of the assembly to cause flow. Hi-Flow 200-G will not drip or run like grease.



Bergquist suggests the use of spring clips to assure constant pressure on the interface. The spring pressure that will deliver the optimum thermal performance is 50 psi as shown by the Table #1.

Application Methods:

Hand-apply to 40-50 ºC heat sink. The heat sink is heated in oven or heat gun to between 40-50º C, and then the Hi-Flow 200-G pad is applied like and adhesive pad. The heat sink is cooled to room temperature and packaged.

Hand-apply to 20-35 ºC heat sink. Hi-Flow 200-G can be applied to a room temperature heat sink with the assistance of a foam roller. The pad is positioned onto the heat sink and a hand roller is used to apply pressure of 30psi.

Automated equipment with 30 psi pressure. A pick and place automated dispensing unit can be used to apply Hi-Flow 200-G to a room temperature heat sink. The placement head should have a soft silicone rubber pad, and apply 30psi pressure to the pad on transfer to the 20-35 ºC heat sink.

Typical Properties of Hi-Flow 200-G

Physical Property	Typical Value	Test Method
Color	Blue	Visual
Thickness	0.006"	ASTM D374
Tensile Strength	400 psi	ASTM D882A
Elongation	40%	ASTM D882A
Phase Change Temperature	55 ºC	DSC
Continuous use Temp.	100 ºC	
Electrical		
Breakdown Voltage	300 volt	
Dielectric Constant, 100Hz	3.5	ASTM D150
Volume Resistivity, Ohm-meter	$> 10^8$	ASTM D257
Flame Rating	V-O	U.L.
Thermal		
Thermal Conductivity (2)	1.6 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure / Table #1					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	0.96	0.92	0.88	0.86	0.83
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.17	0.16	0.16	0.14	0.14

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 60 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the High Flow coating. It represents one conducting layer in a three-layer laminate. The High Flow coatings are phase change compounds. These layers will respond to heat and pressure induced stresses. The overall conductivity of the material in post-phase change, thin film products is highly dependent upon the heat and pressure applied. This characteristic is not accounted for in ASTM D5470. Please contact Bergquist Product Management if additional specifications are required.

Hi-Flow 200-G has a patent pending design that eliminates the need for a protective liner on the material during shipping.

Hi-Flow®: U.S. Patent 4,950,066 and others.

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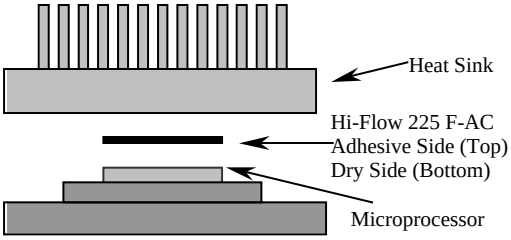
Hi-Flow® 225F-AC

Reinforced Phase Change Thermal Interface Material

Hi-Flow 225 F-AC (HF225 F-AC) is designed as a foil-reinforced, adhesive backed version of HF225 F. HF225 F-AC is a high performance, thermal interface material for use between a computer processor and a heatsink. HF225 F-AC consists of a soft, thermally conductive 55ºC phase change compound coated to the top surface of an aluminum carrier with a soft, thermally conductive adhesive compound coated to the bottom surface to improve adhesion to the heatsink.



HF225 F-AC, above the 55ºC phase change temperature, wets out the thermal interface surfaces and flows to produce the lowest thermal impedance. HF225 F-AC requires pressure from the assembly to cause material flow. The Hi-Flow coatings will not drip in vertical orientation.

Bergquist suggests the use of spring clips, or the like, to assure constant pressure on the interface. Minimal thermal performance gains are seen with increasing interfacial pressures above 50 psi.

HF225 F-AC is available in roll form with kiss-cut parts. The material as delivered will include a base carrier liner with differential release properties to facilitate simplicity in roll form packaging and application assembly. Please contact Product Management for applications that are less than 0.7" square.

Typical Properties of Hi-Flow 225 F-AC

Physical Property	Typical Value	Metric Value	Test Method
Color	Black	Black	Visual
Total Thickness	0.004 inch	0.102 mm	ASTM D374
Aluminum Foil Thickness	0.0015 inch	0.038 mm	ASTM D374
Phase Change Temperature	131 ºF	55 ºC	DSC
Continuous Use Temperature	248 ºF	120 ºC	TGA Kinetics
Thermal	Material	Value	
Thermal Conductivity (2)	Hi-Flow	1.0 W/m-K	ASTM D5470
	Adhesive	0.7 W/m-K	

Thermal Impedance vs Pressure				
Pressure, psi	25	50	100	200
TO-220 Thermal Performance, ºC/W	0.68	0.57	0.50	0.45
Thermal Impedance Per ASTM D5470, (1) ºC-in^2 / W	0.10	0.09	0.08	0.07

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 60 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the Hi-Flow coating only (per Bergquist Modified ASTM-D5470). The lamination typically includes a base layer of 1.5 mil aluminum foil with a top coating of 2-mil Hi-Flow compound and bottom coating of 2-mil adhesive compound. The Hi-Flow coatings are phase-change, thixotropic compounds and thus respond via compressive flow to heat and pressure induced stress. Knowing the average final thickness of the interface, the overall apparent thermal conductivity of the laminate can be estimated via back-calculation (ref: L = K θ) of the Bergquist Modified ASTM-D5470 test results stated. This statement assumes negligible interfacial thermal resistance. Please contact your Bergquist Sales Representative or Bergquist Inside Sales if additional specifications are required.

Application Methods:

HF225 F-AC roll form piece parts can be manually or automatically applied to the surfaces of room temperature heat sinks. The adhesive side (or bottom side) of the HF225 F-AC pad will adhere with low level tack to a heat sink surface. See Product Management for additional information concerning automated dispensing applications.

Hi-Flow®: U.S. Patent 4,950,066 and others.

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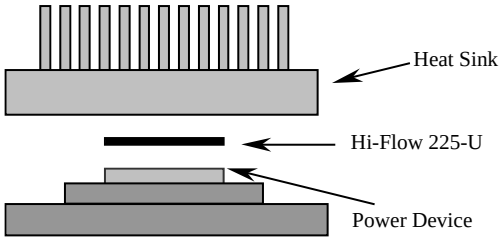
Hi-Flow® 225U

Non-Reinforced Phase Change Thermal Interface Material

Thermal Interface Material for High Performance Computer Processors

Hi-Flow 225-U is designed as a thermal interface material between a computer processor and a heat sink. Hi-Flow 225-U is a thermally conductive phase change material supplied on carrier liner. The product consists of a thermally conductive 55ºC phase change compound coated on red release liner. Hi-Flow 225-U is available in tab parts. See the diagram below.



Hi-Flow 225-U, above its phase change temperature, wets out the thermal interface surfaces and flows to produce the lowest thermal impedance. Hi-Flow 225-U requires pressure of the assembly to cause flow. Hi-Flow 225-U coatings will not drip.

Hi-Flow 225-U is available in roll form with kiss-cut parts. Hi-Flow 225-U is limited to a square or rectangle parts design. Dimensional tolerance is +/- 0.020 inch or 0.5mm. The Hi-Flow 225-U soft layer prohibits the availability of a hole being punched. The unsupported construction prohibits the availability of a space between the parts on the roll.

Please contact your Bergquist Sales Representative or Bergquist Inside Sales if additional specifications are required.

Hi-Flow®: U.S. Patent 4,950,066 and others.

Typical Properties of Hi-Flow 225-U

Physical Property	Typical Value		Test Method		
Color	Black		Visual		
Thickness	0.0015" / 0.036mm		ASTM D374		
Phase Change Temperature	55 ºC / 132ºF		DSC		
Continuous use Temp.	150 ºC / 212 ºF				
Electrical					
Flame Rating	Pending				
Thermal					
Thermal Conductivity	1.0 W/m-K		ASTM D5470		
Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	0.53	0.47	0.39	0.34	0.32
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.08	0.07	0.06	0.05	0.04

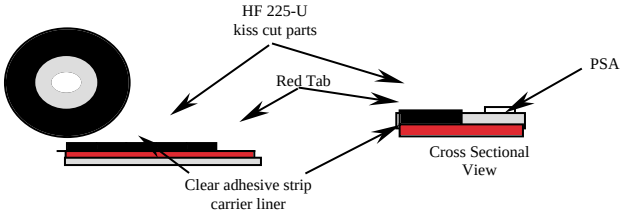
1). The ASTM D5470 (Bergquist Modified) test fixture was used and the test sample was conditioned at 60 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

Bergquist suggests the use of spring clips, or the like, to assure constant pressure on the interface. Minimal thermal performance gains are seen with increasing interfacial pressures above 50 psi.

Application Methods:

Hand-apply to 35-45 °C heat sink. The heat sink is heated in an oven or via heat gun to between 35 - 45 °C, and then the HF 225-U part is applied like an adhesive pad. The heat sink is cooled to room temperature and packaged. Protective tab liner remains in place until unit is it is ready for final assembly. Protective tab can be readily removed from the applied HF 225-U pad at a maximum temperature of 28 °C.

Automated equipment with 30-psi pressure. A pick and place automated dispensing unit can be used to apply the HF 225-U pad to a room temperature heat sink. The placement head should have a silicone rubber pad, and should apply approximately 30-psi pressure to the pad on transfer to the 25 - 35 °C heat sink. Once applied, the protective tab can be readily removed from the HF 225-U pad at a maximum temperature of 28 °C.



Hi-Flow™

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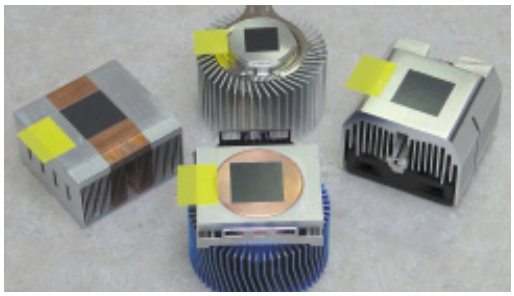
Hi-Flow® 225UT

Non-Reinforced Pressure Sensitive Phase Change Thermal Interface Material

Thermal Interface Material for High Performance Processors

Hi-Flow 225UT is designed as a pressure sensitive, thermal interface material for use between a high performance processor and a heat sink. Hi-Flow 225UT is a thermally conductive, inherently tacky, 55 ºC phase change composite. HF225UT is supplied on a polyester carrier liner. Hi-Flow 225UT is available with high visibility protective tabs.



Hi-Flow 225UT, above its phase change temperature, wets out the thermal interface surfaces and flows to produce the lowest thermal impedance. Hi-Flow 225UT requires pressure of the assembly to cause flow. Hi-Flow 225UT coatings will not drip.

Application Methods:

Hand-apply HF 225UT to a room temperature heat sink. The HF 225UT pad exhibits inherent tack and can be hand-applied similar to an adhesive pad. The tab liner can remain on the heat sink and pad throughout shipping and handling until is it is ready for final assembly.

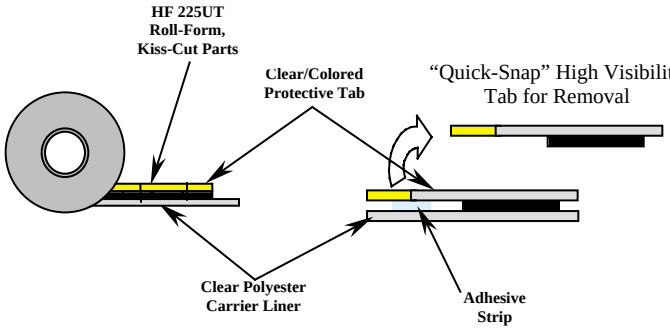
Typical Properties of Hi-Flow 225-UT

Physical Property	Typical Value	Metric Value	Test Method
Color	Black	Black	Visual
Total Thickness	0.003 inch	0.077 mm	ASTM D374
Phase Change Temperature	131 ºF	55 ºC	DSC
Continuous Use Temperature	248 ºF	120 ºC	TGA Kinetics
Thermal			
Thermal Conductivity (2)	0.7 W/m-K	0.7 W/m-K	ASTM D5470

Thermal Impedance vs Pressure					
Pressure, psi	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	0.60	0.53	0.46	0.40	0.35
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.09	0.08	0.07	0.06	0.05

1). The ASTM D5470 (Bergquist Modified) test fixture was used with the material sample conditioned at 60 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application thermal performance using Hi-Flow, thin film interface materials is primarily controlled via surface "wet-out" and material "bond-line" or thickness. Within the application, these are directly related to surface roughness, flatness and pressure applied. Competitive "side by side" thermal performance summaries are available upon request. Please contact your Bergquist Sales Representative for additional information and summaries.

2). This is the measured thermal conductivity of the Hi-Flow coating. Since the Hi-Flow coating is a phase change compound, it will respond to heat and pressure induced stresses. The overall thermal conductivity of post-phase change Hi-Flow material is highly dependent upon the heat and pressure applied. These characteristics are not accounted for in ASTM D5470. To request additional information, please contact your Bergquist Sales Representative.



Note: Bergquist suggests the use of spring clips to assure constant pressure on the interface. Spring pressure as low as 10 to 20 psi will ensure complete "wet-out" of the interface material.

Hi-Flow®: U.S. Patent 4,950,066 and others.

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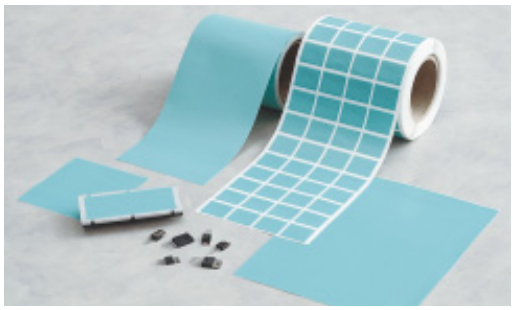
Hi-Flow® 625

Electrically Insulating, Thermally Conductive Phase Change Material

Bergquist Hi-Flow 625 (HF 625) is a film reinforced phase change material. The product consists of a thermally conductive 65 °C phase change compound coated on Bergquist T-600 film. HF 625 is designed to be used as a thermal interface material between electronic power devices which require electrical isolation and a heat sink. The T-600 reinforcement makes HF 625 easy to handle, and the 65 °C phase change temperature of the coating material eliminates shipping and handling problems. Bergquist T-600 film has a continuous use temperature of 150 °C.



HF 625 handles like a Sil-Pad® at room temperature, and flows like high quality grease at elevated temperature.

HF 625 is Tack Free and Scratch Resistant at production temperature and does not require a protective liner in most shipping situations.

HF 625 has the thermal performance of 2-3 mil mica and grease assemblies. HF 625 is available in punch parts, sheets or rolls, with or without pressure sensitive adhesive.

Typical Properties of Hi-Flow 625

Physical Property	Typical Value					Test Method
Color	Green					Visual
Thickness	0.005"					ASTM D374
Tensile Strength	30 Kpsi					ASTM D882A
Elongation	60%					ASTM D882A
Phase Change Temperature	65 °C					DSC
Continuous use Temp.	150 °C					
Electrical						
Breakdown Voltage	4000 volt					ASTM D149
Dielectric Constant, 100Hz	3.5					ASTM D150
Volume Resistivity, Ohm-meter	$> 10^{10}$					ASTM D257
Flame Rating	94 V-O					U.L.
Adhesive						
Peel Strength	70 g/in					ASTM D1876
Release Peel	25 g/in					ASTM D1876
Thermal						
Thermal Conductivity (2)	Hi-Flow	1.0 W/m-K				ASTM D5470
	T-600	0.16 W/m-K				
Thermal Impedance vs. Pressure						
Pressure (psi)	10	25	50	100	200	
TO-220 Thermal Performance, °C/W	2.26	2.10	2.00	1.93	1.87	
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.79	0.71	0.70	0.67	0.61	

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 70 °C prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the Hi-Flow coating only (per Bergquist Modified ASTM-D5470). This compound is equally coated to both surfaces of Bergquist's T-600 film carrier. This lamination typically includes two layers (one to each side) of 2-mil Hi-Flow compound coated to 1.0-mil T-600 film. The Hi-Flow coatings are phase-change, thixotropic compounds and thus respond via compressive flow to heat and pressure induced stress. Knowing the average final thickness of the interface, the overall apparent thermal conductivity of the laminate can be estimated via back-calculation (ref: L = K θ) of the Bergquist Modified ASTM-D5470 test results stated. This statement assumes negligible interfacial thermal resistance. Please contact your Bergquist Sales Representative or Bergquist Inside Sales if additional specifications are required.

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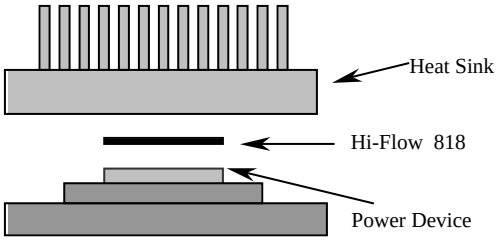
Hi-Flow® 818

Electrically Insulating, Thermally Conductive Phase Change Material

Hi-Flow 818 is a film reinforced phase change material. The product consists of a thermally conductive 65ºC phase change compound coated on a 150ºC continuous use temperature thermally conductive film. Hi-Flow 818 is available with and without pressure sensitive adhesive. Hi-Flow 818 is typically used as a thermal interface material between electronic power devices that requires electrical isolation to its heat sink. The film reinforcement makes the Hi-Flow 818 easy to handle, and 65ºC phase change temperature eliminates shipping and handling problems.



Application Notes:

1. Best thermal results are obtained using a spring clip for attachment.
2. In screw mount applications we suggest wave or other type of spring washer to maintain pressure between device and the heat sink.
3. If the spring washers are not used in screw mount assembly, then use a thread lock to prevent screw from vibrating out.

Typical Properties of Hi-Flow 818

Physical Property	Typical Value	Test Method
Color	Mauve	Visual
Thickness	0.0055"	ASTM D374
Tensile Strength	25 Kpsi	ASTM D882A
Elongation	82%	ASTM D882A
Phase Change Temperature	65 ºC	DSC
Continuous use Temp.	150 ºC	
Electrical		
Breakdown Voltage	4000 volt	ASTM D149
Dielectric Constant, 100Hz	3.5	ASTM D150
Volume Resistivity, Ohm-meter	$> 10^{10}$	ASTM D257
Flame Rating	(pending)	U.L.
Thermal		
Thermal Conductivity (2)	Hi-Flow 1.0 W/m-K T-800 0.25 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	2.05	1.85	1.71	1.62	1.57
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	0.73	0.69	0.63	0.60	0.56

1). The ASTM D5470 (Bergquist Corrected) test fixture was used and the test sample was conditioned at 70 ºC prior to test. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

2). This is the measured thermal conductivity of the Hi-Flow coating only (per Bergquist Modified ASTM-D5470). This compound is equally coated to both surfaces of Bergquist's T-800 film carrier. This lamination typically includes two layers (one to each side) of 2-mil Hi-Flow compound coated to 1.0-mil T-800 film. The Hi-Flow coatings are phase-change, thixotropic compounds and thus respond via compressive flow to heat and pressure induced stress. Knowing the average final thickness of the interface, the overall apparent thermal conductivity of the laminate can be estimated via back-calculation (ref: L = K θ) of the Bergquist Modified ASTM-D5470 test results stated. This statement assumes negligible interfacial thermal resistance. Please contact your Bergquist Sales Representative or Bergquist Inside Sales if additional specifications are required.

Hi-Flow®: U.S. Patent 4,950,066 and others.

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Frequently Asked Questions

Q How is the ASTM D5470 test modified to characterize Phase Change Thermal Performance?

A Bergquist uses the Anter Quickline 10 to characterize our ASTM D5470 test results. The method is modified to condition the phase change material to 5 C over the stated phase change temperature. Understanding that time is also a key variable for material displacement or flow, the over-temperature conditioning is limited to 10 minutes and then allowed to cool, prior to initiating the actual test at the given pressure. The 10-minute time period has been demonstrated to be an acceptable time period for the thermal mass inherent in the Anter setup. Note: Actual application testing may require more or less time to condition, depending upon the heat transfer and thermal mass associated. The performance values are recorded and published at 10, 25, 50, 100, 200 and 500 psi to give the designer a broad-based understanding of our products' performance. Reference the original ASTM application note here.

Q What is the minimum pressure required to optimize the thermal performance of the Hi-Flow material?

A Upon achieving phase change temperature (i.e. pre-conditioning), Bergquist has demonstrated that 10 psi provides adequate pressure to achieve exceptional thermal performance. Bergquist continues to research lower pressure wet-out characteristics in an effort to minimize interfacial losses associated with ultra-thin material interfaces.

Q Will the Hi-Flow replace a mechanical fastener?

A Mechanical fasteners are required. Bergquist recommends the use of spring clips to maintain consistent pressure over time.

Q Can I use screw mount devices with Hi-Flow material?

A Hi-Flow works best with a clip or spring washer mounted assembly. The continuous force applied by these devices allows the Hi-Flow material to flow and reduce the cross sectional gap. Bergquist suggests that design engineers evaluate whether a screw mount assembly will have acceptable performance. See TO-220 Technical Note.

Q Is the adhesive in Hi-Flow 225F-AC repositionable?

A The adhesive in the current construction does adhere more to the heat sink aluminum than to the Hi-Flow material. There is the potential that the adhesive will be removed by the heat sink surface when it is removed to reposition on the heat sink. Time and/or pressure will increase the bond to the aluminum increasing the potential for the adhesive to adhere to the heat sink.

Q Is there any surface preparation required before applying the adhesive backed Hi-Flow to the heat sink?

A Standard electronics industry cleaning procedures apply. Remove dirt or other debris. Best results are attained when the Hi-Flow material is applied to heat sink at a temperature of 25 +/- 10 C. If the heat sink has been surface treated (i.e. anodized or chromated), it is typically ready for assembly. For bare aluminum, mild soap and water wash cleaning processes are typically used to eliminate machine oils and debris.

Q Is the Hi-Flow material re-workable?

A If the material has not gone through phase change, the material will readily release from the device surface. For this situation, the Hi-Flow material will not likely have to be replaced.

If the material has gone through the phase change, the material will adhere very well to both surfaces. In this case, Bergquist suggests warming the heat sink to soften the Hi-Flow compound. This allows for easier removal from the processor. In this case, Bergquist suggests replacement with a new piece of Hi-Flow material.

Q What is meant by easy to handle in manufacturing?

A Our insulated Hi-Flow products are manufactured with inner film support. This film stiffens the material, allowing parts to be more readily die-cut as well as easier to handle. This also allows for ease of manual or automated assembly.

Q What is meant by tack free? And why is this important?

A Many of our Hi-Flow materials have no surface task at room temperature. The Softer materials will pick up dirt more readily. Softer resins are more difficult to clean if any dirt is on the surface. If you try to rub the dirt away, the dirt is easily pushed into the soft phase change materials. Our Hi-Flow coatings are typically hard at room temperature rendering them easier to clean off without embedding dirt.

Q What does more scratch resistance mean on Hi-Flow 625?

A Our Hi-Flow 625 does not require a protective film during shipment. There are two issues with competitors' materials: 1. Melt point of the material is low enough that it can go through phase change in shipment and be very tacky. Bergquist Hi-Flow has a higher phase change temperature and remains hard to a higher temperature. It can be shipped much like our SoftFace material. 2. The Hi-Flow material is harder and is not as easy to scratch or dent in shipping and handling.

Q Why is our product phase change temperature 65˚ C?

A The 65˚ C phase change temperature was selected for two reasons. First, it was a low enough temperature for the phase change to occur in applications. Second, it would not phase change in transport. Bergquist studies show that shipping containers can reach 60˚ C in domestic and international shipments. The higher phase change temperature eliminates the possibility of a product being ruined in shipment. We offer a standard line of Hi-Flow 225 series products with 55˚ C phase change for those customers wanting the lower phase change temperature.

Q What applications should I avoid using Hi-Flow?

A Applications where the device will not reach operation at above phase change temperature. Applications where the operating temperature exceeds the maximum recommended operating temperature of the compound.

Sterling™-7500

Thermal Interface Compound

Thermal Interface Material for High Performance Computer Processors

Sterling-7500 is a thermally conductive grease compound and is designed as a thermal interface material between a computer processor and a heat sink. Other high watt density applications will benefit from the extremely low thermal impedance of Sterling-7500.

Sterling-7500 compound wets out the thermal interface surfaces and flows to produce the lowest thermal impedance. The Sterling-7500 compound requires pressure of the assembly to cause flow. The Sterling-7500 compound will not drip.

For microprocessor applications, traditional screw fastening or clamping methods will provide adequate force to optimize the thermal performance of Sterling-7500.

Sterling-7500 has a patented technology.

For a typical 0.5 x 0.5-inch application at 0.005 inches thick, Bergquist estimates approximately 0.02 ml (cc) of Sterling-7500.

Although Bergquist estimates a 0.02 ml (cc) volumetric requirement for a 0.5 x 0.5-inch component interface, dispensed at a thickness of 0.005 inches, Bergquist also recognizes that an optimized application would utilize the minimum volume of Sterling-7500 material necessary to ensure complete wet-out of both mechanical interfaces.

Typical Properties of Sterling-7500

Property	Typical Value	Test Method
Color	Gray	Visual
Density (Grams/cc or Grams/ml)	4.0	ASTM D374
Viscosity at 25°C	cps	Viscometer
2 RPM	500,000	
10 RPM	150,000	
Continuous Use Temp.	100°C	TGA Kinetics
Electrical		
Electrical Resistivity	>1.0 X10 E10 W-cm^{-1}	ASTM D257
Thermal		
Thermal Impedance	.035 °C-in^2/W	ASTM D5470
Thermal Conductivity	>7.5 W/m-K	ASTM D5470
Thermal Impedance T0-220 @ 50 psi	°C/W	Bergquist thermal Test Set Up
Sterling-7500	0.25	
HF 225	0.45	
HF 200 U	0.65	
Dow 340 Grease	0.60	

Application Cleanliness:

1. Pre-clean heatsink and component interface with Isopropyl Alcohol prior to assembly or repair.

Application Methods:

1. Dispense the Sterling-7500 compound onto the processor or heat sink surface like thermal grease.
2. Assemble the processor and heat sink with clip or screws

Environmental Testing:

Sterling-7500 compound has been exposed to the following environmental conditions without loss of thermal performance.

> 500 h at 125 C		Pass
> 500 h at 85 RH/85 °C		Pass
> 500 cycles	-55/125 C	Pass

Sterling-7500 is typically supplied in 1-milliliter syringes. Please contact your local Bergquist representative for additional packaging information.

Sterling™: Patent issuing 1-2002 SER. NO. 09/543661.

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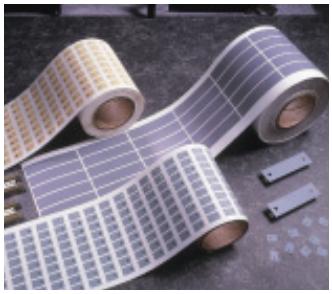
Sil-Pad® Thermally Conductive Insulators

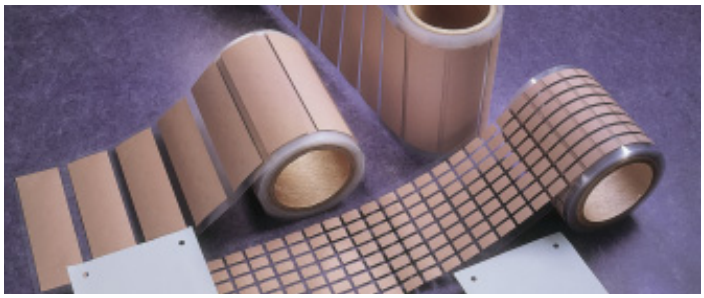
Solution-Driven Thermal Management Products for Electronic Devices

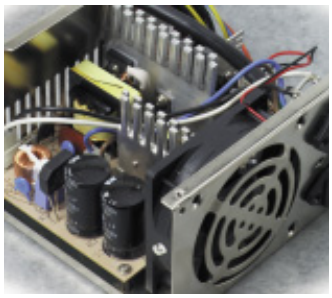
Comprehensive choices for a cleaner and more efficient thermal interface

More than 20 years ago, Bergquist set the standard for elastomeric thermal interface materials with the introduction of Sil-Pad. Today, Bergquist is a world leader with a complete family of Sil-Pad materials to meet the critical needs of a rapidly changing electronics industry.

Sil-Pad thermally conductive insulators, in their many forms, continue to be a clean and efficient alternative to mica, ceramics or grease for a wide range of electronic applications. Bergquist application specialists work closely with customers to specify the proper Sil-Pad material for each unique thermal management requirement.







Features

The Sil-Pad family encompasses dozens of products, each with its own unique construction, properties and performance. Here are some of the important features offered by the Sil-Pad family.

- Binders of proven silicone rubber
- Fiberglass, dielectric film or polyester film carriers
- Special fillers to achieve specific performance characteristics
- Flexible and conformable
- Smooth and textured surfaces
- Reinforcements to resist cut-through
- Variety of thicknesses
- Wide range of thermal conductivities and dielectric strengths

Benefits

Choosing Sil-Pad thermal products saves time and money while maximizing an assembly's performance and reliability. Specifically:

- Excellent thermal performance
- Eliminates the mess of grease
- More durable than mica
- Less costly than ceramic
- Resistant to electrical shorting
- Easier and cleaner to apply
- Under time and pressure, thermal resistance will decrease
- Better performance for today's high-heat compacted assemblies
- A specific interfacial performance that matches the need
- Efficient "total applied cost" that compares favorably with other alternatives

Options

Some Sil-Pad products have special features for particular applications. Options include:

- Available with or without adhesive
- Aluminum foil or imbedded graphite construction for applications not requiring electrical insulation
- Copper shield layer
- Polyester binder material for silicone sensitive applications
- Polyester film carrier for increased voltage breakdown
- Materials with reduced moisture sensitivity
- Available in rolls, sheets, tubes and custom die-cut parts
- Custom thicknesses and constructions

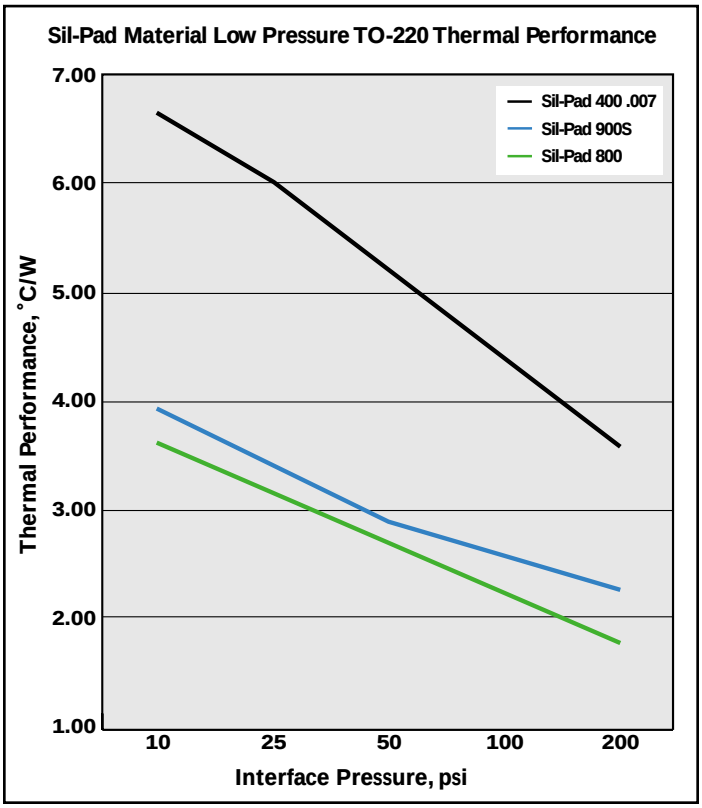
Applications

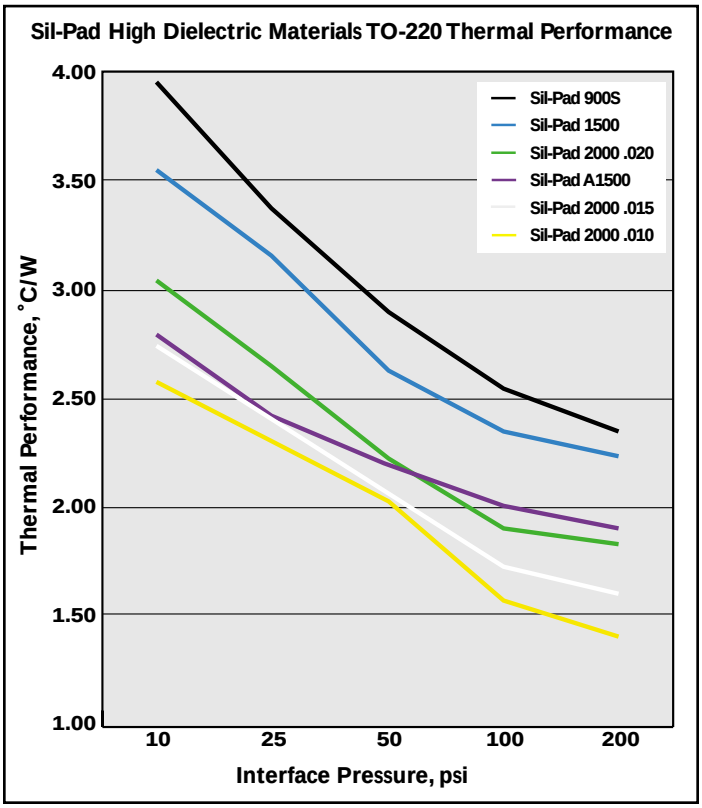
The large family of Sil-Pad thermally conductive insulators is extremely versatile. In today's marketplace, Sil-Pads are used in virtually every component of the electronics industry, including:

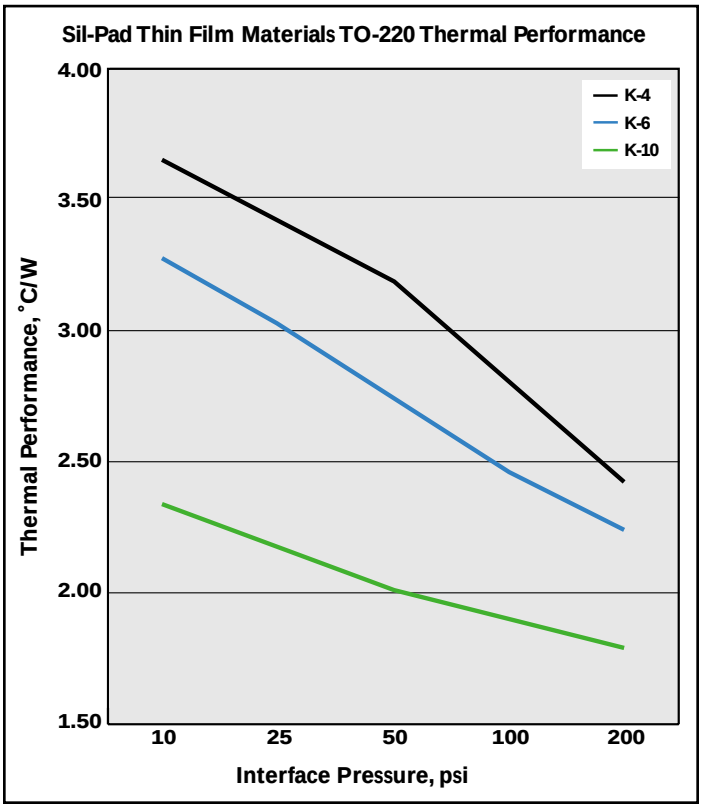
- Interface between a power transistor, CPU or other heat-generating component and a heat sink or rail
- Isolate electrical components and power sources from heat sink and/or mounting bracket
- Interface for discrete semiconductors requiring low pressure spring clamp mounting
- Consumer electronics
- Automotive systems
- Telecommunications
- Aerospace
- Military
- Medical devices
- Industrial controls

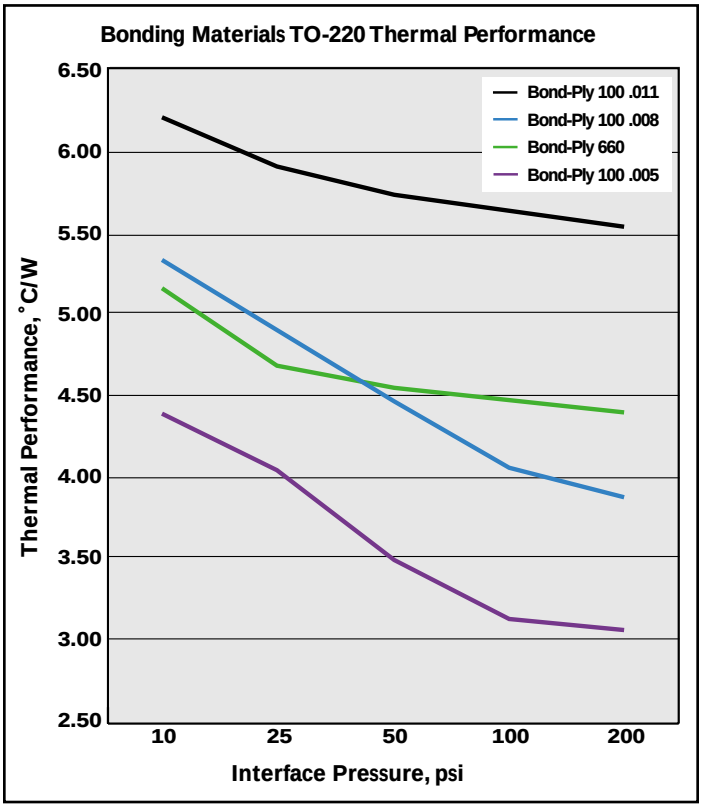
Sil-Pad® Comparison Data

TO-220 Thermal Performance









The Bergquist Company established the standard for elastomeric thermally conductive insulation materials with the development of Sil-Pads® over 20 years ago. Sil-Pads were developed as a clean, grease-free alternative to mica and grease. Now, a complete family of materials is available to meet the diverse and changing requirements of today's design engineer.

Mica and Grease

Mica insulators have been in use for over 30 years and are still commonly used as an insulator. Mica is inexpensive and has excellent dielectric strength, but it is brittle and is easily cracked or broken. Because mica used by itself has high thermal impedance, thermal grease is commonly applied to it. The grease flows easily and excludes air from the interface to reduce the interfacial thermal resistance. If the mica is also thin (2-3 mils), (50-80 µm), a low thermal impedance can be achieved.

However, thermal grease introduces a number of problems to the assembly process. It is time-consuming to apply, messy, and difficult to clean. Once thermal grease has been applied to an electronic assembly, solder processes must be avoided to prevent contamination of the solder. Cleaning baths must also be avoided to prevent wash-out of the interface grease, causing a dry joint and contamination of the bath. Assembly, soldering and cleaning processes must be performed in one process while the greased insulators are installed off-line in a secondary process. If the grease is silicone based, migration of silicone molecules occurs over time, drying out the grease and contaminating the assembly. Silicone migration onto electrical contacts can result in pitting of the contacts and loss of electrical conductance. For this reason, silicone based thermal grease has not been used in telecommunications systems.

Why Choose Sil-Pad® Thermally Conducti

At Bergquist's Cannon Falls, MN, manufacturing facility, a Sil-Pad material runs through a 3-story coating press.

Polyimide Films

Polyimide films can also be used as insulators and are often combined with wax or grease to achieve a low thermal impedance. These polyimide films are especially tough and have high dielectric strength. Sil-Pad® K-4, K-6 and K-10 incorporate polyimide film as the carrier material.

Ceramic Insulators

Other insulation materials include ceramic wafer insulators which have higher thermal conductivity than mica. They are often used thicker (20-60 mils), (.5 to 1.5 mm) to reduce capacitive coupling while maintaining a low thermal impedance.

Drawbacks to ceramic insulators are high cost and they are rigid like mica and crack easily. Also, ceramic beryllia use requires careful handling since inhalation of beryllia dust can cause lung inflammation (berylliosis).

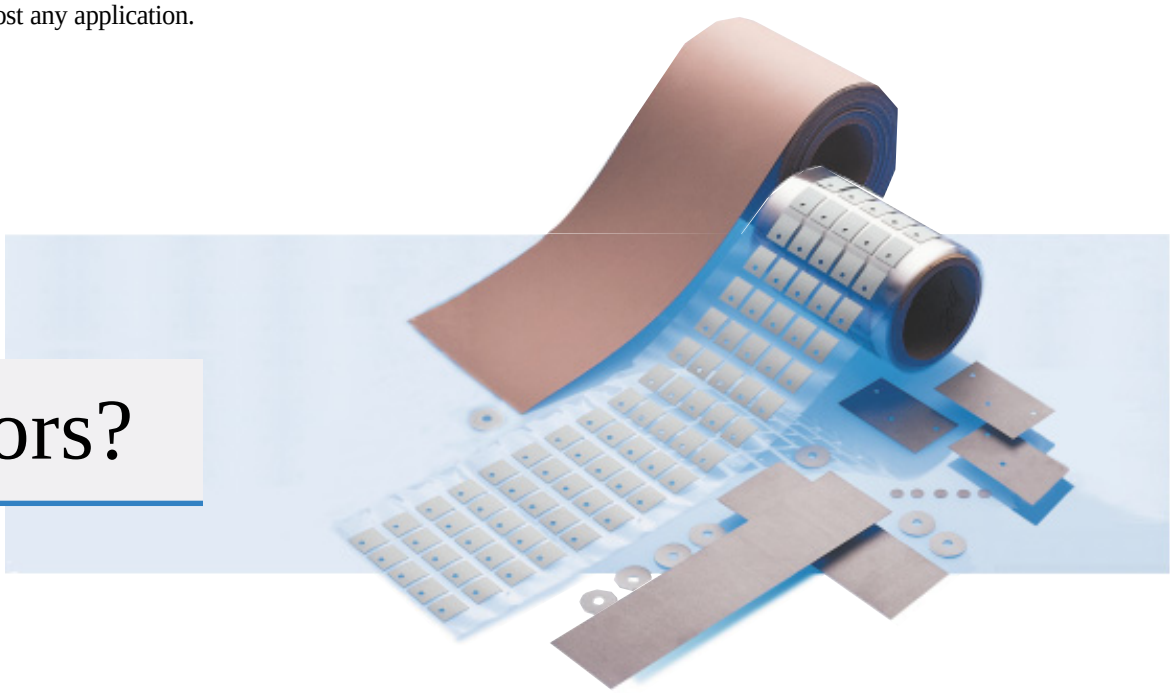
Sil-Pad® Materials

Sil-Pad Thermally Conductive Insulators are designed to be clean, grease-free and flexible. The combination of a tough carrier material such as fiberglass and silicone rubber which is conformable, provides the engineer with a more versatile material than mica or ceramics and grease. Sil-Pads minimize the thermal resistance from the case of a power semiconductor to the heat sink. Sil-Pads electrically isolate the semiconductor from the heat sink and have sufficient dielectric strength to withstand high voltage. They are also tough enough to resist puncture by the facing metal surface. With more than 30 different Sil-Pad materials available there is a Sil-Pad matched to almost any application.

Sil-Pad® Construction

Sil-Pads are constructed with a variety of different materials including fiberglass, silicone rubber, polyimide film, polyester film and fillers used to enhance performance. Sil-Pads are typically constructed with an elastomeric binder compounded with a thermally conductive filler coated on a carrier. The characteristics of your application often determine which Sil-Pad construction will produce the best performance.

ve Insulators?



Binders

Most Sil-Pad products use silicone rubber as the binder. Silicone rubber has a low dielectric constant, high dielectric strength, good chemical resistance and high thermal stability.

Silicone rubber also exhibits cold flow, which excludes air from the interface as it conforms to the mating surfaces. This flow eliminates the need for thermal grease. A rough surface textured insulator needs to flow more to exclude air than a smooth one. The smoother pads also need less pressure to wet out the surfaces and obtain optimum thermal contact.

Carriers

The carrier provides physical reinforcement and contributes to dielectric strength. High dielectric and physical strength is obtained by using a heavy, tight mesh, but thermal resistance will suffer. A light, open mesh reduces thermal resistance, dielectric strength and cut-through resistance. The carrier materials used in Sil-Pad materials include fiberglass, dielectric film and polyester film which is used in Poly-Pad® materials.

Fillers

The thermal conductivity of Sil-Pad products is improved by filling them with ingredients of high thermal conductivity. The fillers change the characteristics of the silicone rubber to enhance thermal and/or physical characteristics.

For instance, some fillers make the silicone rubber hard and tough while still retaining the ability to flow under pressure. A harder silicone helps the material resist cut-through. In other applications a filler is used to make the silicone rubber softer and more conformable to rough surfaces. While the range in thermal resistance of greased mica is quite large, the average is comparable to elastomeric insulators filled with a blend of the appropriate ingredients.

• Fiberglass based insulators (Sil-Pad® 400 and Sil-Pad® 1500) have a rough surface texture and will show a 15-20% decrease in thermal resistance over a 24 hour period. Film based Sil-Pads (Sil-Pad® K-4, Sil-Pad® K-6 and Sil-Pad® K-10) are smoother initially and show a 5% decrease over the same period of time.

Choosing the Right Sil-Pad Starts with the M

Mechanical Properties

Woven fiberglass and films are used in Sil-Pads to provide mechanical reinforcement. The most important mechanical property in Sil-Pad applications is resistance to cut-through to avoid electrical shorting from the device to the heat sink.

- Sil-Pad® K-4, Sil-Pad® K-6 and Sil-Pad® K-10 are very good at resisting cut-through from sharp burrs left on heat sinks after machining operations such as drilling and tapping
- Fiberglass is good at resisting the type of cut-through encountered when device mounting flanges are pulled into oversized mounting holes. This occurs when fasteners are torqued. (Sil-Pad® 400 and Sil-Pad® 2000)

Cut-through resistance is very dependent on the application and depends on several factors:

- A very sharp burr may cause cut-through with less than 100 pounds while a blunt burr may require several hundred pounds to cause cut-through
- When two flat parallel surfaces are brought together on a Sil-Pad, over 1000 pounds of force can be applied without damaging the insulator
- The Poly-Pad insulators are the most mechanically durable Sil-Pads overall. The polyester resin used has a higher modulus than silicone rubber. (Poly-Pad® 400, Poly-Pad® 1000, Poly-Pad® K-4 and Poly-Pad® K-10)

Mounting Techniques and Mounting Pressure

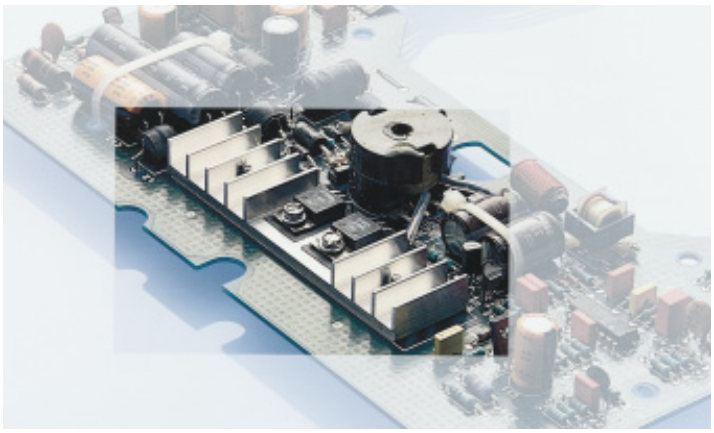
Typical mounting techniques include:

- A Spring clip, which exerts a centralized clamping force on the body of the transistor. The greater the mounting force of the spring, the lower the thermal resistance of the insulator
- A screw in the mounting tab. With a screw mounted TO-220, the force on the transistor is determined by the torque applied to the fastener

In extremely low pressure applications, an insulator with pressure sensitive adhesive on each side may give the lowest thermal resistance since the adhesive wets out the interface easier than the dry rubber. This decreases the interfacial thermal resistance.

Devices with larger surface areas need more pressure to get the insulator to conform to the interface than smaller devices. In most screw mount applications, the torque required to tighten the fastener is sufficient to generate the pressure needed for optimum thermal resistance. There are exceptions where the specified torque on the fastener does not yield the optimum thermal resistance for the insulator being used and either a different insulator or a different mounting scheme should be used.

Interfacial thermal resistance decreases as time under pressure increases. In applications where high clamping forces cannot be used, time can be substituted for pressure to achieve lower thermal resistance. *The only way to know precisely what the thermal resistance of an insulator will be in an application is to measure it in that application.*



Mechanical and Electrical Properties

Electrical Properties

If your application does not require electrical insulation, Q-Pad® II or Q-Pad® 3 are ideal grease replacement materials. These materials do not isolate but have excellent thermal properties. Hi-Flow phase change materials should also be considered for these applications. (Reference pages 20-30 of this guide.)

The most important electrical property in a typical assembly where a Sil-Pad insulator is used is dielectric strength. In many cases the dielectric strength of a Sil-Pad will be the determining factor in the design of the apparatus in which it is to be used.

Here are some general guidelines regarding electrical properties to consider when selecting a Sil-Pad material;

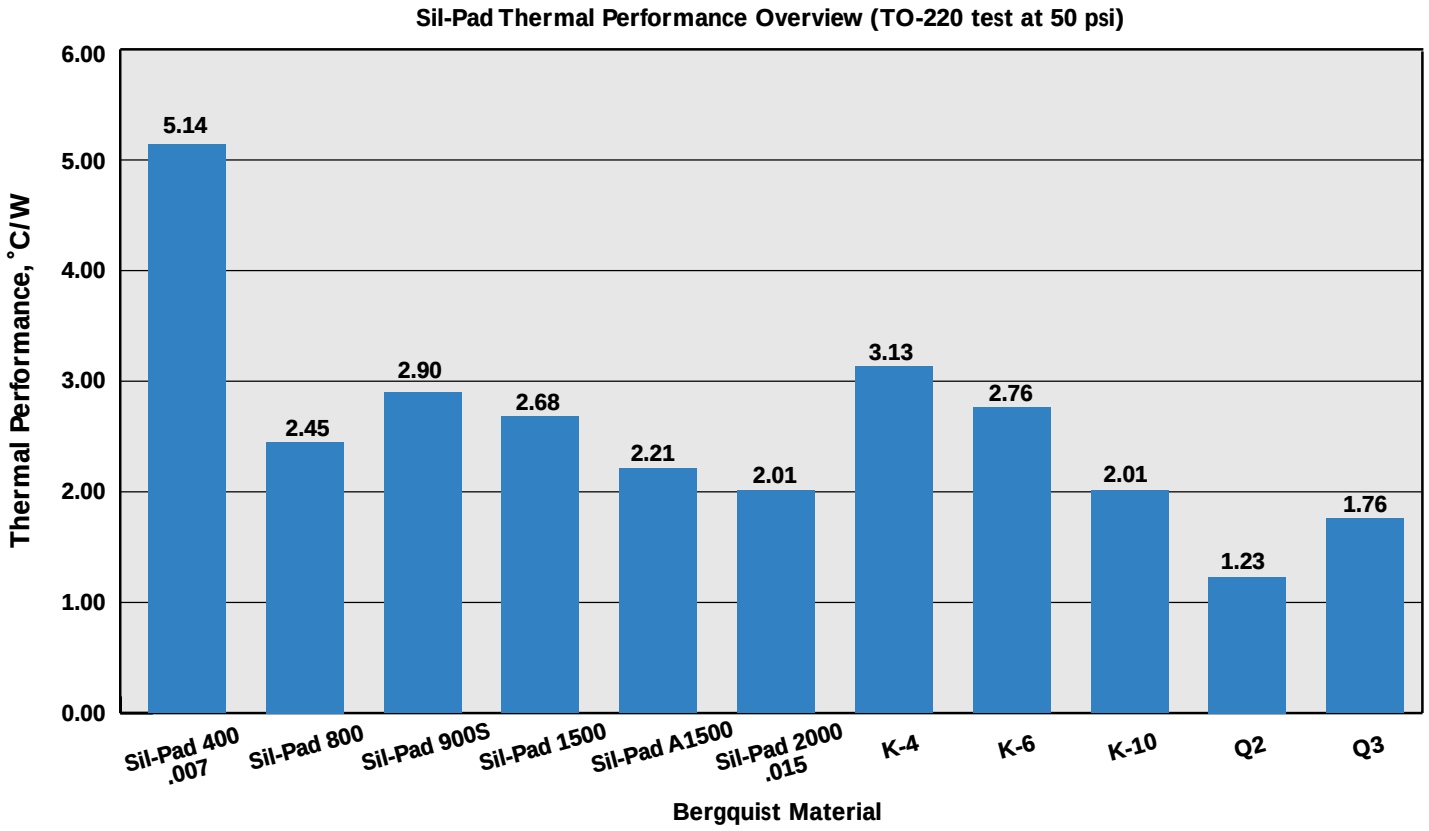
- Q-Pad II and Q-Pad 3 are used when electrical isolation is not required
- Dielectric breakdown voltage is the total voltage that a dielectric material can withstand. When insulating electrical components from each other and ground, it is desirable to use an insulator with a high breakdown voltage
- Breakdown voltage decreases as the area of the electrodes increases. This area effect is more pronounced as the thickness of the insulator decreases
- Breakdown voltage decreases as temperature increases
- Breakdown voltage decreases as humidity increases (Sil-Pad® 1750 is less sensitive to moisture)
- Breakdown voltage decreases in the presence of partial discharge
- Breakdown voltage decreases as the size of the voltage-source (kVA rating) increases
- Breakdown voltage can be decreased by excessive mechanical stress on the insulator

Dielectric strength, dielectric constant and volume resistivity should all be taken into consideration when selecting a Sil-Pad material. If your application requires special electrical performance please contact the factory for more detailed testing information.

Typical Electrical Properties of Sil-Pads®

Material	Breakdown Voltage (kV)	Dielectric Strength (Volts/mil)	Dielectric Strength (kV/mm)	Dielectric Constant	Volume Resistivity (Ohm-Metre)
Sil-Pad 400® -.007	5	700	18	5.5	10^{11}
Sil-Pad 400® -.009	7	800	20	5.5	10^{11}
Sil-Pad 1000®	7	700	18	4.5	10^{11}
Sil-Pad 2000®	12	800	20	4.0	10^{11}
Sil-Pad K-4®	7	1200	30	5.0	10^{12}
Sil-Pad K-6®	7	1200	30	4.0	10^{12}
Sil-Pad K-10®	7	1200	30	3.7	10^{12}
Test Method	ASTM D 149*	ASTM D 149*			ASTM D 150
					ASTM D 257

Sil-Pad® Thermal Properties



How Thermal Properties Affect Your Selection

The thermal properties of a Sil-Pad material and your requirements for thermal performance probably have more to do with your selection of a Sil-Pad than any other factor. Discrete Semiconductors, under normal operating conditions, dissipate waste power which raises the junction temperature of the device. Unless sufficient heat is conducted out of the device, its electrical performance and parameters are changed. *A 10° C rise in junction temperature can reduce the mean-time-to-failure of a device by a factor of two. Also, above 25°C, the semiconductor's total power handling capability will be reduced by a derating factor inherent to the device.*

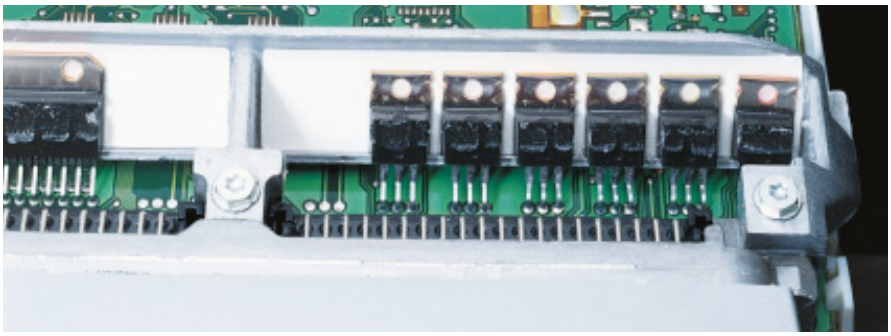
The thermal properties of Sil-Pad products are thermal impedance, thermal conductivity and thermal resistance. The thermal resistance and conductivity of Sil-Pad products are inherent to the material and do not change. Thermal resistance and thermal conductivity are measured per ASTM D5470 and do not include the interfacial thermal resistance effects. Thermal impedance applies to the thermal transfer in an application and includes the effects of interfacial thermal resistance. *As the material is applied in different ways the thermal impedance values will vary from application to application.*

- The original Sil-Pad material, Sil-Pad® 400 continues to be Bergquist's most popular material for many applications.
- Sil-Pad® 1500 is chosen when more thermal performance is required. Sil-Pad® A2000 is ideal for high performance, high reliability applications.

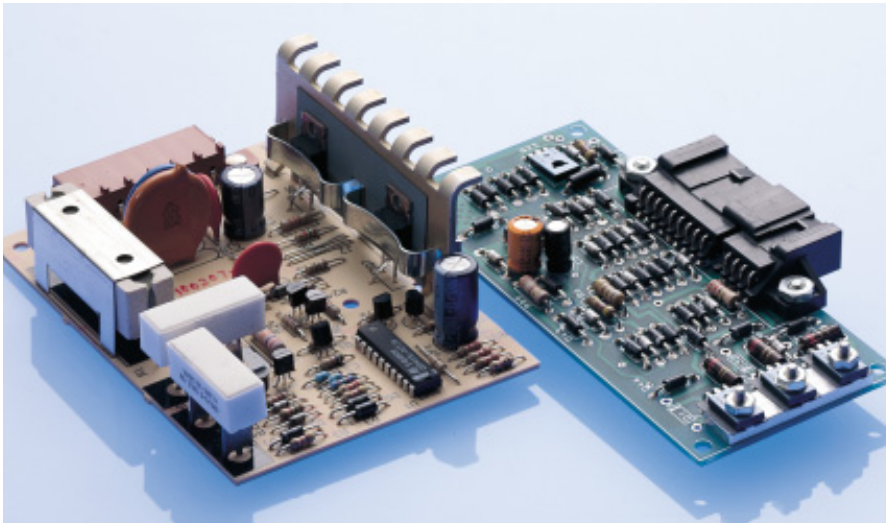
Beyond these standard materials many things can contribute to the selection of the correct material for a particular application. Questions regarding the amount of torque and clamping pressure are often asked when selecting a Sil-Pad material. Here are some guidelines:

- Interfacial thermal resistance decreases as clamping pressure increases.
- The clamping pressure required to minimize interfacial thermal resistance can vary with each type of insulator.
- Sil-Pads with smooth surface finishes (Sil-Pad® 1500, Sil-Pad® 2000, Sil-Pad® K-4, Sil-Pad® K-6 and Sil-Pad® K-10) are less sensitive to clamping pressure than Sil-Pads with rough surface finishes (Sil-Pad® 400).

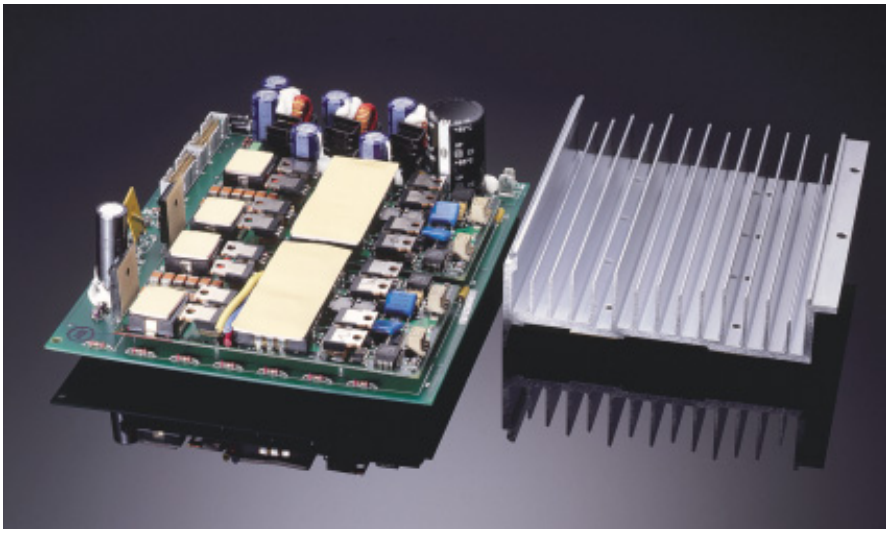
Sil-Pad® Applications



A common Sil-Pad application includes TO-220 transistors mounted in a row on a heat rail.



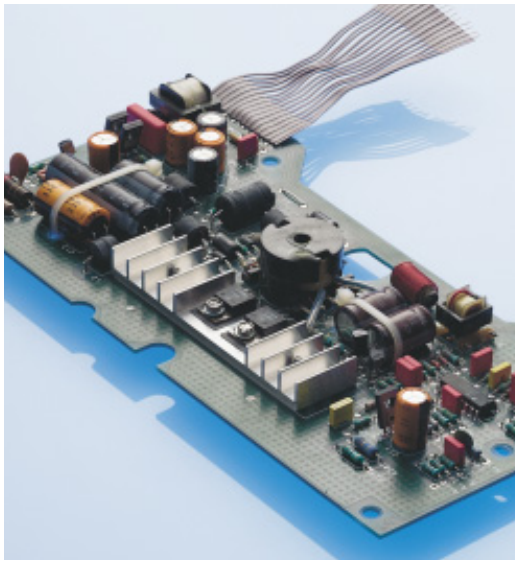
Two different Sil-Pad applications show clip mounting of transistors on the left and screw mounting of transistors to an aluminum bracket on the right.



Gap Pad is applied to the top surface of heat generating components in this assembly. A heat sink mounted over the board dissipates heat.

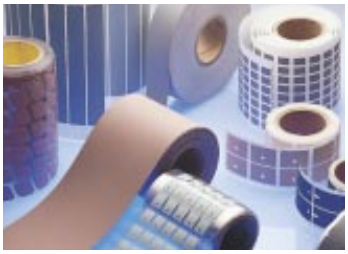
The application above uses punched parts to insulate the transistors from the mounting bracket and a sheet of Sil-Pad to isolate the mounting brackets from the frame of the assembly.

The circuit board below shows punched parts interfacing screw-mounted transistors to a finned heat sink.



Sil-Pad® Thermally Conducti

	Sil-Pad 400 .007 in	Sil-Pad 400 .009 in	Sil-Pad 800	Sil-Pad 900S	Sil-Pad A1500	Sil-Pad A2000	Sil-Pad K-4
Color	Gray	Gray	Gold	Pink	Green	White	Gray
Thickness Inches (mm)	.007 ± .001 (.18 ± .025)	.009 ± .001 (.23 ± .025)	.005 ± .001 (.13 ± .025)	.009 ± .001 (.23 ± .025)	.010 ± .001 (.25 ± .025)	.015 ± .001 (.38 ± .025)	.006± .001 (.15 ± .025)
Thermal Impedance TO-220 Test @ 50 psi ˚C/W	5.14	6.61	2.45	2.90	2.21	1.86	3.13
Thermal Conductivity W/m-K nominal	0.9	0.9	1.6	1.6	2.0	3.5	0.9
Voltage Breakdown Vac	3500	4500	1700	5500	6000	4000	6000
Continuous Use Temperature °C	-60 to 180	-60 to 180	-60 to 180	-60 to 180	N/A	N/A	-60 to 180
Construction	Silicone/ Fiberglass	Silicone/ Fiberglass	Silicone/ Fiberglass	Silicone/ Fiberglass	Silicone/ Fiberglass	Silicone/ Fiberglass	Silicone/ Film

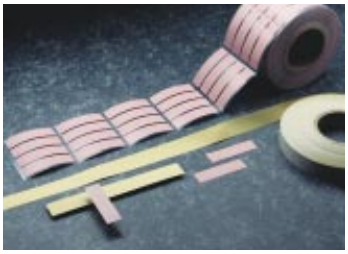


Sil-Pad® 400

- The original Sil-Pad material
- Durable silicone rubber and fiberglass construction for excellent mechanical / physical characteristics
- Fiberglass provides excellent cut-through resistance
- Thermal performance improves with age
- Non-toxic and resists damage from cleaning agents
- *Contact the factory for special thicknesses of Sil-Pad 400*

Sil-Pad® 800
Sil-Pad® 900-S

- Designed for low cost applications requiring high thermal performance
- These applications also typically have low mounting pressures for component clamping
- Sil-Pad 800-S material combines a smooth surface design with high thermal conductivity and electrical insulation
- Applications include discrete semiconductors (TO-220, TO-247 and TO-218) mounted with spring clips



Sil-Pad® A1500

- Sil-Pad A1500 is a fiberglass reinforced material with enhanced thermal properties
- Designed for high performance thermal applications while meeting specific cost considerations

Sil-Pad® A2000

- For high performance, high reliability military / aerospace and commercial applications
- Sil-Pad A2000 complies with military standards
- Special ingredients maximize thermal and dielectric performance

Sil-Pad® K-4

- Sil-Pad K-4 uses a physically tough, thermally conductive, dielectric film and well-known Sil-Pad rubber.

Sil-Pad® K-6

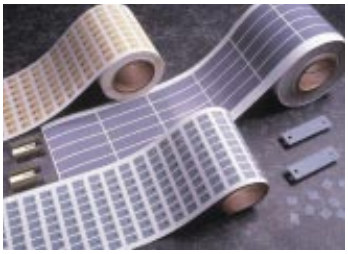
- Sil-Pad K-6 is a medium performance film based material
- Filled with special ingredients to improve thermal performance
- The film provides a continuous, physically tough dielectric barrier against “cut-through”

Sil-Pad® K-10

- Highest thermal performance of the film based insulators. Minimum thickness helps lower thermal resistance
- Designed to replace brittle, ceramic insulators: Beryllium Oxide, Boron Nitride and Alumina

ve Insulator Selection Guide

	Sil-Pad K-6	Sil-Pad K-10	Q-Pad II	Q-Pad 3	Poly-Pad 400	Poly-Pad 1000	Poly-Pad K-4	Poly-Pad K-10	Bond-Ply 100	Visual
	Bluegreen	Beige	Black	Black	Mauve	Yellow	Mauve	Yellow	White	ASTM D 374
	.006 ± .001 (.15 ± .025)	.006 ± .001 (.15 ± .025)	.006 ± .001 (.15 ± .025)	.005 (.15 mm) .0055 w/ac	.009 ± .001 (.23 ± .025)	.009 ± .001 (.23 ± .025)	.006 ± .001 (.15 ± .025)	.006 ± .001 (.15 ± .025)	.005 ± .001 (.13 ± .025)	ASTM D5470
	2.76	2.01	1.23	1.76	5.13	3.74	4.34	2.75	3.48	ASTM D 5470
	1.1	1.3	2.5	2.0	0.9	01.2	0.9	1.3	0.8	ASTM D 149
	6000	6000	N/A	N/A	4500	2500	6000	6000	3000	-
	-60 to 180	-60 to 180	-60 to 180	-60 to 180	-20 to 150	-20 to 150	-20 to 150	-30 to 120	-30 to 120	-
	Silicone/ Film	Silicone/ Film	Silicone/ Alum Foil	Silicone/ Fiberglass	Polyester/ Fiberglass	Polyester/ Fiberglass	Polyester/ Film	Polyester/ Film	Acrylic PSA/ Fiberglass	Test Method

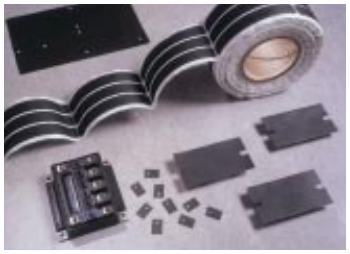


Q-Pad® II

- Grease replacement material used where electrical insulation is not required
- Q-Pad II is a composite of .0015 in. aluminum foil coated on both sides with a .00225 in. thermally conductive coating
- Q-Pad II eliminates problems associated with grease such as contamination of reflow solder or cleaning operations
- Q-Pad II can be installed prior to these operations. Q-Pad II also eliminates dust collection which can result in surface shorting or heat build-up

Q-Pad® 3

- Grease replacement material where electrical insulation is not required
- Q-Pad 3 consists of graphite imbedded in a polymer matrix
- When exposed to modest heat and pressure, the elastomer conforms to surface textures thereby creating an air free interface between surfaces
- Q-Pad 3 is fiberglass reinforced and withstands processing stresses without losing physical integrity



Poly-Pad® Materials

- Polyester based Poly-Pad® 400, Poly-Pad® 1000, Poly-Pad® K-4 and Poly-Pad® K-10
- Designed for silicone sensitive applications
- Ideally suited for applications requiring conformal coatings or applications where silicone contamination is a concern (telecommunications and aerospace applications)

Bond-Ply® 100

- Bergquist Bond-Ply is a thermally conductive, acrylic based PSA bonding material used to permanently mount a heat sink on top of a central processing unit
- The material will adhere to the heat sink or integrated circuit with moderate heat and pressure, forming a bond between components

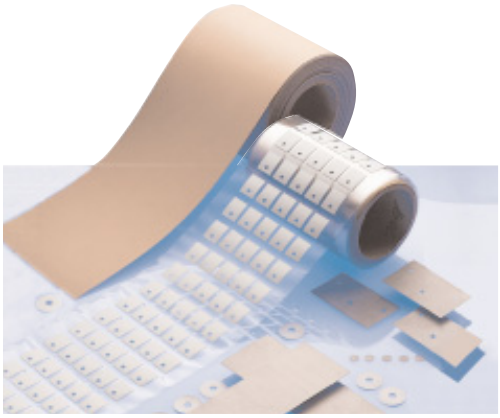
Sil-Pad® Shield

- Bergquist Sil-Pad Shield is a bonded laminate of thermally conductive, electrically isolating Sil-Pad 400 or Sil-Pad 1000 pads with a copper shield between the layers. It is supplied with a pretinned solder point for easy grounding

Sil-Pad® 400

The Original Sil-Pad Material

Sil-Pad 400 is the original Sil-Pad material. Sil-Pad 400 is a composite of silicone rubber and fiberglass. It is flame retardant and is specially formulated for use as a thermally conductive insulator. Primary use is to electrically isolate power sources from heat sinks.



Sil-Pad 400 has excellent mechanical and physical characteristics. Surfaces are pliable and allow complete surface contact with excellent heat dissipation. Sil-Pad 400 actually improves its thermal resistance with age. The reinforcing fiberglass gives excellent cut-through resistance and Sil-Pad 400 is non-toxic and resists damage from cleaning agents.

MIL SPEC. MIL-M-38527/8A
MIL-M-38527C
MIL-I-49456
MIL-M-87111
U.L. FILE NUMBER E59150
FSCM NUMBER 55285

Typical Properties of Sil-Pad 400

Property	Typical Value		Test Method
Color	Gray	Gray	Visual
Thickness	0.007"	0.009"	ASTM D374
Specific Gravity	2.0 - 2.1	2.0 - 2.1	ASTM D792
Hardness (Shore Type A)	85	85	ASTM D2240
Breaking Strength	100 lbs./inch	100 lbs./inch	ASTM D1458
Elongation	40%	40%	ASTM D412
Tensile Strength	3 kPsi	3 kPsi	ASTM D412
Continuous Use Temp.	-60°C to 180°C		
Electrical			
Breakdown Voltage, minimum	3500	4500	ASTM D149
Dielectric Constant	5.5	5.5	ASTM D150
Volume Resistivity, Ohm-meter	10^{11}	10^{11}	ASTM D257

Thermal Impedance vs. Pressure		Pressure (psi)				
		10	25	50	100	200
TO-220 Thermal Performance, °C/W @ Standard Thickness, inch	0.007	6.62	5.93	5.14	4.38	3.61
	0.009	8.51	7.62	6.61	5.63	4.64
Thermal Impedance, °C-in² / W (1) @ Standard Thickness, inch	0.007	1.82	1.42	1.13	0.82	0.54
	0.009	2.34	1.83	1.45	1.05	0.69

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES

0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS

Q-Pad II is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES

We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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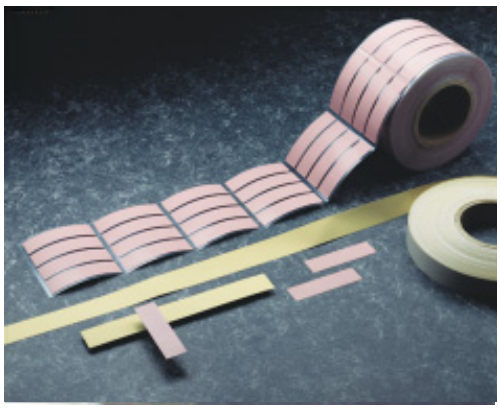
Sil-Pad® 800

High Performance Insulator for Low Pressure Applications

The Sil-Pad 800 family of thermally conductive insulation materials is designed for applications requiring high thermal performance and electrical isolation. These applications also typically have low mounting pressures for component clamping.



Sil-Pad 800 material combines a smooth and highly compliant surface characteristic with high thermal conductivity. These features optimize the thermal resistance properties at low pressure.

Applications requiring low component clamping forces include discrete semiconductors (TO-220, TO-247 and TO-218) mounted with spring clips. Spring clips assist with quick assembly but apply a limited amount of force to the semiconductor. The smooth surface texture of Sil-Pad 800 minimizes interfacial thermal resistance and maximizes thermal performance.

Typical Properties of Sil-Pad 800

Property	Typical Value	Test Method
Color	Gold	Visual
Thickness	0.005"	ASTM D374
Elongation, %45° to warp & fill	20	ASTM D412
Tensile Strength	12 MPa	ASTM D412
Electrical		
Dielectric Breakdown Voltage		
Type 1 Electrodes	1.7 kVa-c	ASTM D149
Type 3 Electrodes	3.0 kVa-c	ASTM D149
Dielectric Constant	6	ASTM D150
Volume Resistivity, Ohm-meter	10^{10}	ASTM D257
Thermal		
Thermal Conductivity	1.6 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.56	3.01	2.45	2.05	1.74
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.92	0.60	0.45	0.36	0.29

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad 800 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

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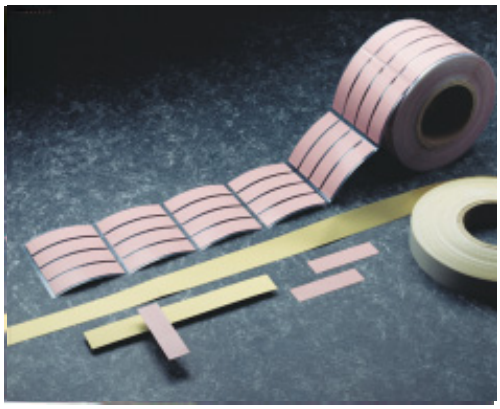
Sil-Pad® 900S

High Performance Insulator for Low Pressure Applications

The Sil-Pad 900S family of thermally conductive insulation materials is designed for applications requiring high thermal performance and electrical isolation. These applications also typically have low mounting pressures for component clamping.



Sil-Pad 900S material combines a smooth and highly compliant surface characteristic with high thermal conductivity. These features optimize the thermal resistance properties at low pressure.

Applications requiring low component clamping forces include discrete semiconductors (TO-220, TO-247 and TO-218) mounted with spring clips. Spring clips assist with quick assembly but apply a limited amount of force to the semiconductor. The smooth surface texture of Sil-Pad 900S minimizes interfacial thermal resistance and maximizes thermal performance.

Typical Properties of Sil-Pad 900S

Property	Typical Value	Test Method
Color	Mauve	Visual
Thickness	0.009"	ASTM D374
Elongation, %45° to warp & fill	20	ASTM D412
Tensile Strength	9 MPa	ASTM D412
Electrical		
Dielectric Breakdown Voltage		
Type 1 Electrodes	5.5 kVa-c	ASTM D149
Type 3 Electrodes	8.3 kVa-c	ASTM D149
Dielectric Constant	6	ASTM D150
Volume Resistivity, Ohm-meter	10^{10}	ASTM D257
Thermal		
Thermal Conductivity	1.6 W/m-k	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.96	3.41	2.90	2.53	2.32
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.95	0.75	0.61	0.47	0.41

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad 900S is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
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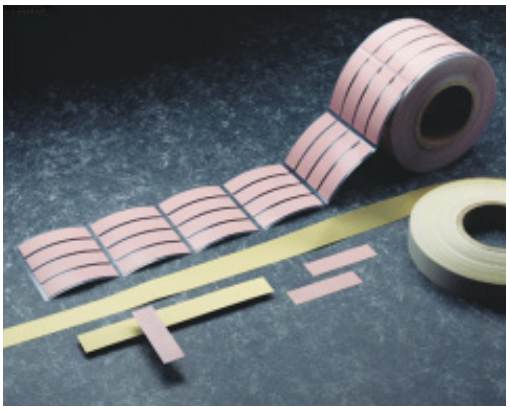
Sil-Pad® 950

The Sil-Pad 900 family of thermally conductive insulation materials are designed for applications requiring high thermal performance.



Sil-Pad 950 material uses a heavy fiberglass carrier to increase the mechanical strength and durability of the material. The smooth surface texture of Sil-Pad 950 minimizes interfacial thermal resistance and maximizes thermal performance as well.

Typical Properties of Sil-Pad 950

Property	Typical Value	Test Method
Color	Mauve	Visual
Thickness	0.009"	ASTM D374
Specific Gravity	2.5 g/cm^3	ASTM D792
Tensile Strength 45˚ to Warp & Fill	1.6 kpsi	ASTM D412
Breaking Strength Warp & Fill	70x20 Lbs./inch	ASTM D1458
Tensile Elongation 45˚ to Warp & Fill	20%	ASTM D412
Electrical		
Dielectric Breakdown Voltage		ASTM D149
Type 1 Electrodes	4.5 kVa-c	
Type 3 Electrodes	6.0 kVa-c	
Dielectric Constant, 1 kHz	6	ASTM D150
Volume Resistivity, Ohm-meter	1 x 10^{10}	ASTM D257
Thermal		
Thermal Conductivity	1.4 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, ºC/W	3.94	3.50	3.05	2.66	2.42
Thermal Impedance Per ASTM D5470, ºC-in^2 / W (1)	1.09	.84	.67	.50	.36

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad 950 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

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Sil-Pad® 980

High Cut-Through Resistant, Electrically Insulative, Thermally Conductive Material

Bergquist Sil Pad 980 is a specially formulated material with high crush resistance to prevent cut through. Sil Pad 980 interface material provides thermal conductivity and electrical insulation.

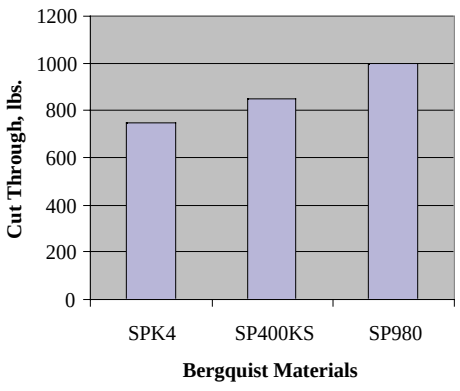
Use Sil Pad 980 material in screw mounted application with cut through problems. The Sil Pad 980 is Bergquist's best material for cut through resistance.

The **cut through resistance** of Sil-Pad 980, K4, SP400KS have been measured using a combination cut-through/voltage breakdown test. A 1"x1" test sample was placed on 2"x2" base plate mounted in an Instron Universal Test Machine.

A force probe was installed in a 1000 lbs. load cell in the Instron crosshead. A high potential DC current supply was used to apply 500 Vdc to the test sample. The probe was applied to the test sample with a crosshead speed of 0.05 in/min until breakdown voltage occurred. The applied load at breakdown was read from the chart recorder.

Probe Design:

Round metal probe machined to a 0.060-inch radius and electrically insulated with phenolic resin core material. Contact length is 0.5 inch.



Typical Properties of Sil-Pad 980

Property	Typical Value	Test Method
Color	Mauve	Visual
Thickness	0.009"	ASTM D374
Breaking Strength	140 lbs./inch	ASTM D1458
Elongation	10%	ASTM D412
Cut Through	750 lbs	ASTM D412
Continuous Use Temp.	-40°C to 150°C	
Electrical		
Dielectric Breakdown Voltage	4000 VAC	ASTM D149
Dielectric Constant	3.5	ASTM D150
Volume Resistivity, Ohm-meter	$>10^{10}$	ASTM D257
Thermal		
Thermal Conductivity	1.2 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	5.48	5.07	4.52	4.04	3.56
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	1.51	1.22	1.07	.89	.53

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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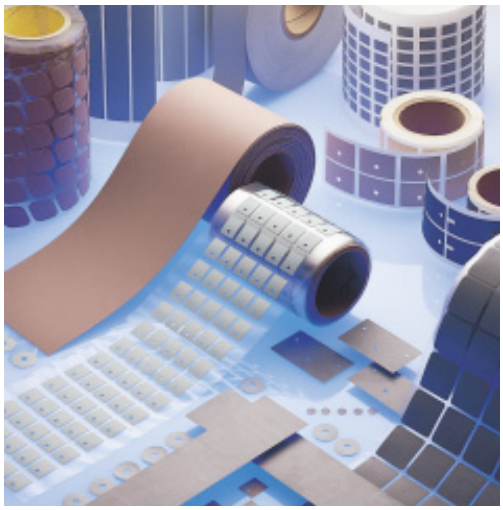
Sil-Pad® 1500

Electrically Insulating, Thermally Conductive Elastomeric Material

Sil-Pad 1500 is a silicone elastomer formulated to maximize the thermal and dielectric performance of the filler/binder matrix. The result is a grease-free, conformable material, capable of meeting or exceeding the thermal and electrical requirements of high reliability electronic packaging applications.



Typical Properties of Sil-Pad 1500

Property	Typical Value	Test Method
Color	Green	Visual
Thickness	0.010"	ASTM D374
Hardness (Shore Type A)	80	ASTM D2240
Breaking Strength	65 lbs./inch	ASTM D1458
Elongation	20%	ASTM D412
Tensile Strength	1000 psi	ASTM D412
Continuous Use Temp.	-60°C to 200°C	
Electrical		
Dielectric Breakdown Voltage	4000 VAC	ASTM D149
Dielectric Constant	4	ASTM D150
Volume Resistivity, Ohm-meter	10^{11}	ASTM D257
Thermal		
Thermal Conductivity	2 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.54	3.18	2.68	2.40	2.22
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.72	0.57	0.46	0.38	0.32

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad 1500 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

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Sil-Pad® A1500

Electrically Insulating, Thermally Conductive Elastomeric Material

Bergquist Sil-Pad A1500 (SPA 1500) is a silicone based thermally conductive and electrically insulating material. It consists of a cured silicone elastomeric compound coated on both sides of a fiberglass reinforcement layer.

SPA 1500 has been designed as an effective alternative to the SP 1500 product filler technologies.

SPA 1500 is a product of similar performance to the SP 1500 manufactured with a more environmentally friendly, solvent-free process.

Typical Properties of Sil-Pad A1500

Property	Typical Value	Test Method
Color	Green	Visual
Thickness	0.010"	ASTM D374
Specific Gravity	2.9 g/cc	ASTM D792
Hardness (Shore Type A)	80	ASTM D2240
Breaking Strength	65 lbs./inch	ASTM D1458
Elongation	40%	ASTM D412
Continuous Use Temp.	-60°C to 200°C	
Electrical		
Dielectric Breakdown Voltage	6000 VAC	ASTM D149
Dielectric Constant	7	ASTM D150
Volume Resistivity, Ohm-meter	10^{11}	ASTM D257
Flame Rating	94V-0	U.L.
Thermal		
Thermal Conductivity	2 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.03	2.62	2.21	1.92	1.78
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	0.59	0.50	0.42	0.34	0.31

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad A1500 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 4" x 4", 6" x 6", 8" x 8", and 10" x 10" are available. The maximum recommended roll width is 10 inches.

SPECIAL SHAPES
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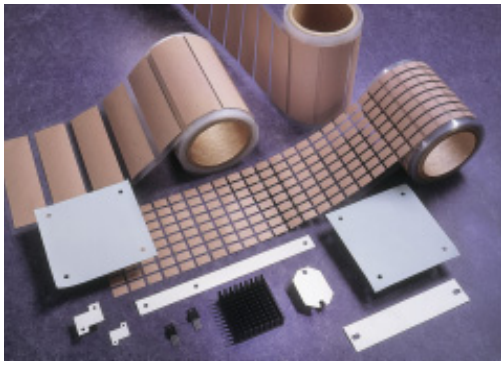
Sil-Pad® 1750

Sil-Pad for High Humidity, High Dielectric (U.L. 1950, IEC 950) Requirements

The combination of high thermal conductivity and excellent dielectric strength retention after humidity exposure is formulated into the Sil-Pad 1750 elastomeric pad.



Sil-Pad 1750 relies on processes that minimize the effect of high humidity on the electrical properties of finished material. Therefore, exposure to humid environments during assembly, or over long term operating conditions, will not severely affect the ability of the material to perform.

Typical Properties of Sil-Pad 1750

Property	Typical Value	Test Method
Color	Green	Visual
Thickness, inches (mm)	0.012± .001 (.30)	ASTM D374
Breaking Strength, Lbs./inch (kN/m)	65 (12)	ASTM D1458
Hardness (Shore Type A)	85	ASTM D2240
Electrical		
Dielectric Breakdown Voltage VAC, min.	6000	ASTM D149
Volume Resistivity, Ohm-meter		ASTM D257
As Manufactured	1.0×10^{12}	
After 48hrs at 90% rh & 35°C	3.0×10^{11}	
After 4hrs at 150°C	2.0×10^{14}	
Thermal		
Thermal Conductivity, W/m-K	2.2	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.11	2.87	2.42	2.08	1.90
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	.86	.68	.53	.39	.28

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
SP 1750 may be purchased as sheets or punched parts. SP 1750 is available with either a Silicone or Acrylic adhesive. SP 1750 is not available in rolls. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
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Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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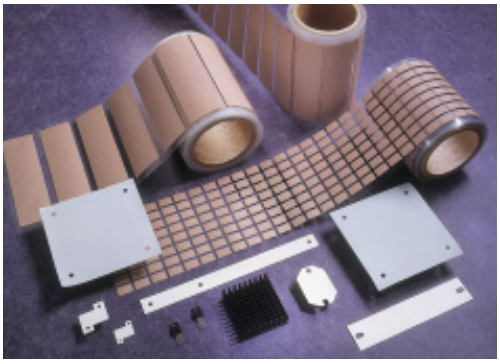
Sil-Pad® 2000

The High Performance, High Reliability Insulator

Sil-Pad 2000 is a high performance thermally conductive insulator. Sil-Pad 2000 material is designed for demanding military / aerospace and commercial applications. In these applications, Sil-Pad 2000 complies with military standards.



Sil-Pad 2000 is a silicone elastomer formulated to maximize the thermal and dielectric performance of the filler/binder matrix. The result is a grease-free, conformable material, capable of meeting or exceeding the thermal and electrical requirements of high reliability electronic packaging applications.

Typical Properties of Sil-Pad 2000

Property	Typical Value	Test Method
Color	White	Visual
Thickness	0.015" ± 0.002	ASTM D374
Hardness (Shore Type A)	90	ASTM D2240
Continuous Use Temp.	-60°C to 200°C	
Electrical		
Dielectric Breakdown Voltage	4000 AC-minimum	ASTM D149
Dielectric Constant	4	ASTM D150
Volume Resistivity, Ohm-meter	10^{11}	ASTM D257
Thermal		
Thermal Conductivity	3.5 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure		Pressure (psi)				
		10	25	50	100	200
TO-220 Thermal Performance, °C/W @ Standard Thickness, inch	0.010	2.61	2.32	2.02	1.65	1.37
	0.015	2.76	2.34	2.01	1.71	1.56
	0.020	2.78	2.48	2.21	1.99	1.86
Thermal Impedance, °C-in² / W (1) @ Standard Thickness, inch	0.010	0.57	0.43	0.33	0.25	0.20
	0.015	0.63	0.48	0.37	0.30	0.24
	0.020	0.76	0.63	0.55	0.45	0.35

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

OUTGASSING DATA FOR SPACECRAFT MATERIALS

Post Cure Conditions	% TML (1.0% Maximum Acceptable)	%CVLM (0.1% Maximum Acceptable)
24 hrs. @ 175°C	0.07	0.03
No Post Cure	0.26	0.10

MIL SPEC. MIL-M-38527/8A
MIL-M-38527C
MIL-I-49456
UL FILE NUMBER E59150
FSCM NUMBER 55285

SPECIAL THICKNESS
SP 2000 is available in a variety of thickness gages to meet customer requirements. Preferred thickness includes 10, 15, and 20 mil. Please contact Inside Sales for additional thickness information.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
SP 2000 is available in sheet or die-cut form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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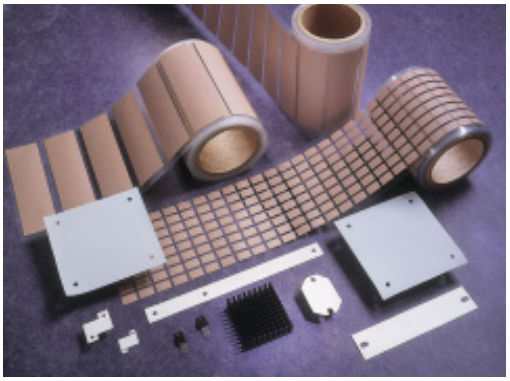
Sil-Pad® A2000

High Performance, High Reliability Thermally Conductive Interface Material

Sil-Pad A2000 (SPA-2000) is a conformable elastomer with very high thermal conductivity that acts as a thermal interface between electrical components and heat sinks. SPA-2000 is for applications where optimal heat transfer is a requirement.



This thermally conductive silicone elastomer is formulated to maximize the thermal and dielectric performance of the filler/binder matrix. The result is a "grease-free", conformable material capable of meeting or exceeding the thermal and electrical requirements of high reliability electronic packaging applications.

Typical Applications

- Motor Drive Controls
- Avionics
- High Voltage Power Supplies
- Power Transistor / Heat Sink Interface

Area where heat needs to be transferred to a frame, chassis, or other type of heat spreader.

Typical Properties of Sil-Pad A2000

Property	Typical Value	Test Method
Color	White	Visual
Thickness	.011", .015", .020"	ASTM D374
Specific Gravity	3.2 g/cc	ASTM D792
Hardness (Shore Type A)	90	ASTM D2240
Heat Capacity	1.0 J/g-K	ASTM C351
Continuous Use Temp.	-60°C to 200°C	
Electrical		
Dielectric Breakdown Voltage	4000 AC-minimum	ASTM D149
Dielectric Constant	7	ASTM D150
Volume Resistivity, Ohm-meter	10^{11}	ASTM D257
Flame Rating	94V-0 (pending)	U.L.
Thermal		
Thermal Conductivity	3.5 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure		Pressure (psi)				
		10	25	50	100	200
TO-220 Thermal Performance, °C/W @ Standard Thickness, inch	0.011	2.06	1.93	1.82	1.77	1.71
	0.015	2.05	1.94	1.86	1.79	1.72
	0.020	2.51	2.46	2.41	2.34	2.24
Thermal Impedance, °C-in^2 / W (1) @ Standard Thickness, inch	0.011	0.46	0.36	0.32	0.28	0.25
	0.015	0.53	0.40	0.32	0.28	0.26
	0.020	0.62	0.52	0.51	0.44	0.41

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

SPECIAL THICKNESS
SP A2000 is available in a variety of thickness gages to meet customer requirements. Preferred thickness includes 11, 15, and 20 mil. Please contact Inside Sales for additional thickness information.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad A2000 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 4" x 4", 6" x 6", 8" x 8", and 10" x 10" are available. Maximum roll width is 10inches.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

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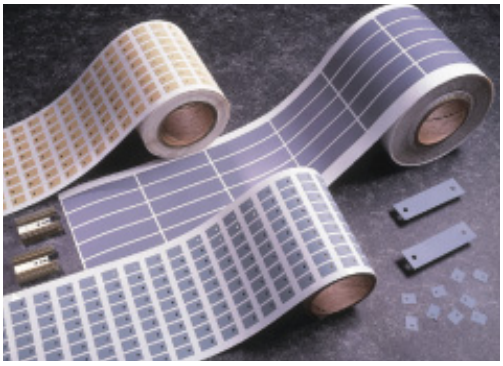
Sil-Pad® K-4

The Original Kapton® Based Insulator

Sil-Pad K-4 (SP K-4) uses a specially developed film which has high thermal conductivity, high dielectric strength and is very durable. SP K-4 combines the thermal transfer properties of well-known Sil-Pad rubber with the physical properties of a film.



SP K-4 is a durable insulator that withstands high voltages and requires no thermal grease to transfer heat. SP K-4 is available in customized shapes and sizes.

Typical Properties of Sil-Pad K-4

Property	Typical Value	Test Method
Color	Gray	Visual
Thickness	0.006	ASTM D374
Hardness (Shore Type A)	90	ASTM D2240
Breaking Strength	30 lbs/in 5 kN/m	ASTM D1458
Elongation, %45° to warp & fill	40	ASTM D882A
Tensile Strength	5 kPsi	ASTM D412
Construction	Silicone / Kapton	
Continuous Use Temp.	-60°C to 180°C	
Electrical		
Dielectric Breakdown Voltage	6000 AC-minimum	ASTM D149
Dielectric Constant	5	ASTM D150
Volume Resistivity, Ohm-meter	10^{12}	ASTM D257
Thermal		
Thermal Conductivity	0.9 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.66	3.43	3.13	2.74	2.42
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	1.07	0.68	0.48	0.42	0.38

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad K-4 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available with and without pressure sensitive adhesive.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

MIL SPEC. MIL-M-38527/8A
MIL-M-38527C
MIL-I-49456
MIL-M-87111
UL FILE NUMBER E59150
FSCM NUMBER 55285

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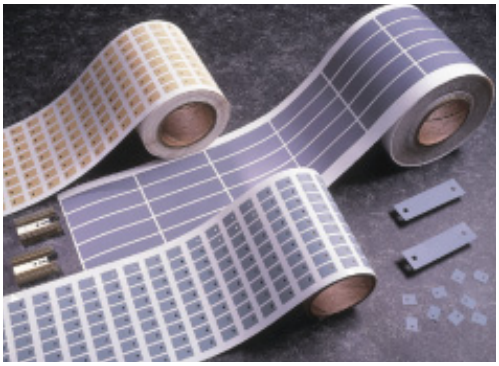
Sil-Pad® K-6

The Medium Performance Kapton® Based Insulator

Sil-Pad K-6 is a medium performance film based thermally conductive insulator. The film is coated with a silicone elastomer to deliver high performance and provides a continuous physically tough dielectric barrier against "cut-through" and resultant assembly failures.



Typical Properties of Sil-Pad K-6

Property	Typical Value		Test Method
Color	Bluegreen		Visual
Thickness	0.006		ASTM D374
Hardness (Shore Type A)	90		ASTM D2240
Breaking Strength	30 lbs/in	5 kN/m	ASTM D1458
Elongation, %45° to warp & fill	40		ASTM D882A
Tensile Strength	5 kPsi		ASTM D412
Construction	Silicone / Kapton		
Continuous Use Temp.	-60°C to 180°C		
Electrical			
Dielectric Breakdown Voltage	6000 AC-minimum		ASTM D149
Dielectric Constant	4		ASTM D150
Volume Resistivity, Ohm-meter	10^{12}		ASTM D257
Thermal			
Thermal Conductivity	1.1 W/m-K		ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.24	3.03	2.76	2.45	2.24
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.82	0.62	0.49	0.41	0.36

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad K-6 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available with and without pressure sensitive adhesive.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

MIL SPEC. MIL-M-38527/8A
MIL-M-38527C
MIL-I-49456
MIL-M-87111
UL FILE NUMBER E59150
FSCM NUMBER 55285

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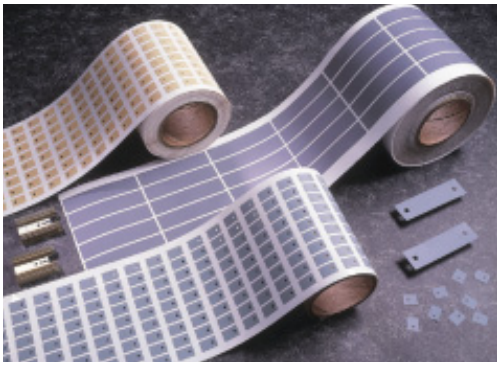
Sil-Pad® K-10

The High Performance Kapton® Based Insulator

Sil-Pad K-10 (SP K-10) is a high performance insulator. It combines special film with a filled silicone rubber. The result is a product with good cut-through properties and excellent thermal performance.



SP K-10 is designed to replace ceramic insulators such as Beryllium Oxide, Boron Nitride, and Alumina. These insulators are expensive and they break easily. SP K-10 eliminates breakage and costs much less than ceramics.

Typical Properties of Sil-Pad K-10

Property	Typical Value	Test Method
Color	Beige	Visual
Thickness	0.006	ASTM D374
Hardness (Shore Type A)	90	ASTM D2240
Breaking Strength	30 lbs/in | 5 kN/m	ASTM D1458
Elongation, %45° to warp & fill	40	ASTM D882A
Tensile Strength	5 kPsi	ASTM D412
Construction	Silicone / Kapton	
Continuous Use Temp.	-60°C to 180°C	
Electrical		
Dielectric Breakdown Voltage	6000 AC-minimum	ASTM D149
Dielectric Constant	3.7	ASTM D150
Volume Resistivity, Ohm-meter	10^{12}	ASTM D257
Thermal		
Thermal Conductivity	1.3 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	2.35	2.19	2.01	1.87	1.76
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.86	0.56	0.41	0.29	0.24

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad K-10 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available with and without pressure sensitive adhesive.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

MIL SPEC. MIL-M-38527/8A
MIL-M-38527C
MIL-I-49456
MIL-M-87111
UL FILE NUMBER E59150
FSCM NUMBER 55285

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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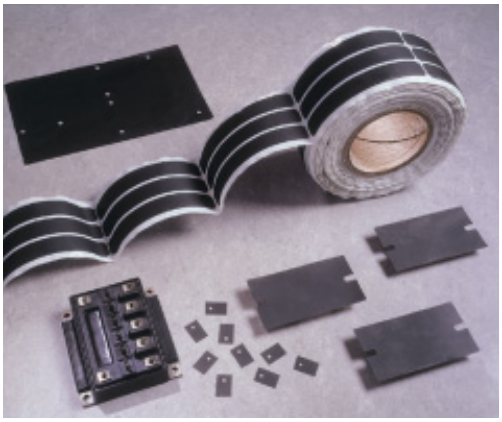
Q-Pad® II Thermally Conductive Pad

The Grease Replacement Material for Maximum Heat Transfer

Q-Pad II Eliminates Grease

Q-Pad II is a composite of .0015" aluminum foil coated both sides with .0025" thermally/electrically conductive Sil-Pad rubber. It is designed for those applications where maximum heat transfer is needed and electrical isolation is not required. Q-Pad II is the ideal thermal interface material to replace messy thermal grease compounds.



Q-Pad II eliminates problems associated with grease such as contamination of reflow solder or cleaning operations. Q-Pad II can be used prior to these operations unlike grease. Q-Pad II also eliminates dust collection which can cause possible surface shorting or heat buildup.

Some applications where Q-Pad II is typically used include:

- Between a transistor and a heat sink.
- Between two large surfaces such as an L-bracket and the chassis of an assembly.
- Between a heat sink and a chassis.
- Under electrically isolated power modules or devices such as resistors, transformers and solid state relays.

Properties of Q-Pad II

Property	Typical Value	Test Method
Color	Black	Visual
Thickness	0.006 ± 0.001 w/ac 0.0065 ± 0.001	ASTM D374
Continuous Use Temp.	180 ˚ C w/ac 150˚ C	
Electrical		
Volume Resistivity, Ohm-meter	1.0 x 10^2 w/ac1.0 x 10^3	ASTM D257
Thermal		
Thermal Conductivity	2.5 W/m-K w/ac 1.3 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	2.44	1.73	1.23	1.05	0.92
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	0.52	0.30	0.22	0.15	0.12

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES

0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS

Q-Pad II is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES

We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

U.L. File Number E59150

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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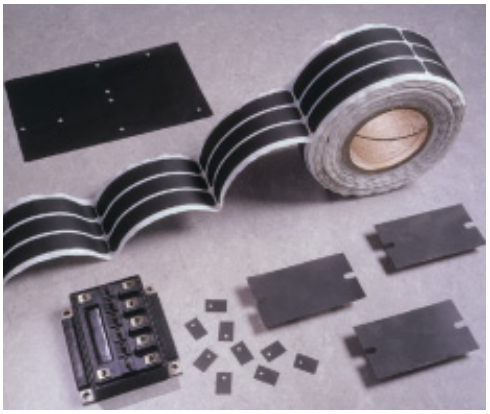
Q-Pad® 3 Thermally Conductive Pad

Easy to Handle, Greaseless Thermal Interface

Bergquist Q-Pad 3 eliminates problems associated with thermal grease such as contamination of electronic assemblies and reflow solder baths. Q-Pad 3 may be installed prior to soldering and cleaning, without worry. When clamped between two surfaces, the elastomer conforms to surface textures thereby creating and air free interface between heat generating components and heat sinks.



Fiberglass reinforcement enables Q-Pad 3 to withstand processing stresses without losing physical integrity.

Some applications where Q-Pad 3 is typically used include:

- Between a transistor and a heat sink.
- Between two large surfaces such as an L-bracket and the chassis of an assembly.
- Between a heat sink and a chassis.
- Under electrically isolated power modules or devices such as resistors, transformers and solid state relays.

Properties of Q-Pad 3

Property	Typical Value	Test Method
Color	Black	Visual
Thickness	0.005 ± 0.001 w/ac 0.0055 ± 0.001	ASTM D374
Continuous Use Temp.	180 ˚ C w/ac 150˚ C	
Electrical		
Volume Resistivity, Ohm-meter	1.0 x 10^{-1} w/ac1.0 x 10^{1}	ASTM D4496
Thermal		
Thermal Conductivity	2.0 W/m-K w/ac 1.6 W/m-K	ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	2.26	1.99	1.76	1.53	1.30
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	0.65	0.48	0.35	0.24	0.16

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES

0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS

Q-Pad 3 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES

We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

U.L. File Number E59150

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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Softface®

Automated, Greaseless Thermal Interface

Bergquist Softface eliminates problems associated with thermal grease such as contamination of electronic assemblies and reflow solder baths. Softface may be installed prior to soldering and cleaning, without worry.

Softface is supplied on a polyester film. The material is transferred to a heat sink or device using commercial hot-stamping equipment.

With Softface applied to a component or other surface you have a built-in thermal interface. Rapid assembly of the material eliminates labor and Softface has the same thermal resistance as grease.

Softface can be supplied already applied to a heat sink or other surface in the assembly. The heat sink or other part can be sent to the factory and Bergquist will apply Softface before shipping to the customer for pre-production quantities.

If rework is required, the heat sink or component can be removed and then reused without replacing Softface.

Typical Properties of Softface

Property	Insulating Value	Non-Insulating Value	Test Method
Color	White	Black	Visual
Thickness, inches	.005 & .008	.003, .005 & .008	ASTM D374
Electrical			
Dielectric Strength, V/mil	500	NA	ASTM D149
Dielectric Constant, @ 1 KHz	4	Non-Insulating	ASTM D150
Volume Resistivity, Ohm-Cm	10^{10} ----------	---------- 10^{1}	ASTM D257 ASTM D4496
Thermal			
Thermal Conductivity, W/mK	3.5	3.5	ASTM D5470
Thermal Resistance, C-in^2/W	.06 / .09	.06 / .09	ASTM D5470
Manufacturing Requirements			
Storage Life, @ 25°C	1 year (min)	1 year (min)	---
Cleanability, Alcohol (IPA)	Water &/or Isopropyl Alcohol	Water &/or Isopropyl Alcohol	---

OPTIONS:
Softface material is available in roll form only. Hot-stamp equipment will accommodate many different roll sizes. For more information on hot-stamping equipment and techniques, please contact a Bergquist Sales Representative.

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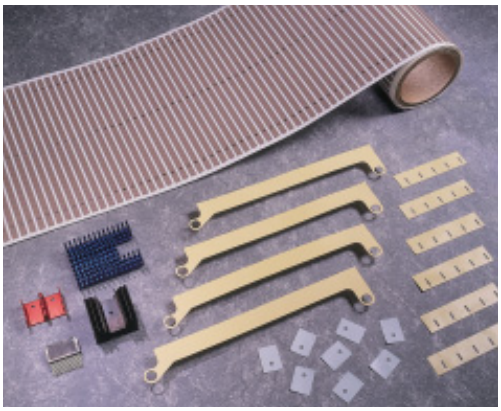
Poly-Pad®

The Poly-Pad Family of Polyester-Based Thermally Conductive Insulation Materials

Poly-Pads… For Silicone Sensitive Applications

Polyester based, thermally conductive insulators from Bergquist provide a complete family of material for silicone-sensitive applications. Poly-Pads are ideally suited for applications requiring conformal coatings or applications where silicone contamination is a concern (telecomm & certain aerospace applications). Poly-Pads are constructed with ceramic filled polyester resins coating either side of a fiberglass carrier or a film carrier. The Poly-Pad family offers a complete range of performance characteristics to match individual applications.



Poly-Pad 400

Poly-Pad 400 is a fiberglass-based insulator coated with a filled polyester resin. Poly-Pad 400 is economical and designed for most standard applications.

Poly-Pad 1000

Poly-Pad 1000 is also a fiberglass-based insulator coated with a filled polyester resin. Poly-Pad 1000 offers superior thermal resistance for high performance applications.

Poly-Pad K-4

Poly-Pad K-4 is a composite of film coated with a polyester resin. PPK-4 is an economical insulator and the film carrier provides excellent dielectric and physical strength.

Poly-Pad K-10

Poly-Pad K-10 is a composite of film coated with a polyester resin. PPK-10 offers superior thermal performance for your most critical applications with thermal resistance of 0.2 °C-in²/Watt as well as excellent dielectric strength.

Typical Poly-Pad Properties	PP 400	PP 1000	PP K-4	PP K-10	Test Method
Color	Mauve	Yellow	Mauve	Yellow	Visual
Thickness	0.009"	0.009"	0.006"	0.006"	ASTM D374
Elongation, %45° to warp and fill	10	10	40	40	ASTM D412
Hardness, Shore A ± 5	90	90	90	90	ASTM D2240
Breaking Strength, Lbs./inch	100	100	30	30	ASTM D1458
Tensile Strength, kPsi %45° to warp and fill	7	7	5	5	ASTM D412
Specific Gravity	2.0	1.5	1.8	1.3	ASTM D792
Continuous Use Temp.	-20°C to 150°C	-20°C to 150°C	-20°C to 150°C	-20°C to 150°C	---
Dielectric Breakdown Voltage, Volts a-c Min	4500	2500	6000	6000	ASTM D149
Dielectric Constant, 1000 Cps	5.5	4.5	5.0	3.7	ASTM D150
Volume Resistivity, Ohm-meter	1.0×10^{11}	1.0×10^{11}	1.0×10^{12}	1.0×10^{12}	ASTM D257
Thermal Conductivity, W/mK	0.9	1.2	0.9	1.3	ASTM D5470

Thermal Impedance vs. Pressure – PP 400					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	5.85	5.61	5.13	4.59	4.12
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	1.62	1.35	1.13	.86	.61

Thermal Impedance vs. Pressure – PP 1000					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	4.7	4.25	3.74	3.27	2.89
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	1.30	1.02	.82	.61	.43

Thermal Impedance vs. Pressure – PP K-4					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	5.64	5.04	4.34	3.69	3.12
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	1.55	1.21	.95	.70	.46

Thermal Impedance vs. Pressure – PP K-10					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	3.76	3.35	2.75	2.3	2.03
Thermal Impedance Per ASTM D5470, °C-in² / W (1)	1.04	.80	.60	.43	.30

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

TOLERANCES
0.015 inch tolerances are held on width, length, hole diameters and hole locations. Please contact your sales representative if tighter tolerances are required.

OPTIONS
Sil-Pad 950 is available in sheet, die-cut, or roll form, with and without pressure sensitive adhesive. Standard sheet sizes of 6" x 6", 6" x 12", 8" x 8", 10" x 10", and 12" x 12" are available.

SPECIAL SHAPES
We produce thousands of specials. Tooling charges vary depending on tolerances and complexity of the part.

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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Bond-Ply® 100

Thermally Conductive, Pressure Sensitive Adhesive Tape

Bergquist Bond-Ply 100 is a thermally conductive, double-sided pressure sensitive adhesive tape. The tape consists of a high performance, thermally conductive acrylic adhesive coated with a fiberglass reinforced interweave. Bond-Ply 100 is designed to attain high bond strength to a variety of surfaces and maintain high bond strength with long term exposure to moderate heat and high humidity.

Use Bond-Ply 100 for:

- Mount heat sink onto BGA graphic processor
- Mount heat sink to computer processor
- Mount heat sink onto drive processor
- Mount heat spreader onto power converter PCB
- Mount heat spreader onto motor control PCB

Use Bond-Ply 100 instead of:

- Heat Cure Adhesive
- Screw Mounting
- Clip Mounting

Bond-Ply 100 is made in standard thickness of 5, 8 and 11 mil. In the case that these thickness will not work for your application, Bergquist will coat custom thickness of 4 to 12 mils.

Bond-Ply 100 is available in sheets, rolls and punch part form. Standard sheet size is 10" by 10". Standard Roll size is 10" by 300'. Punch parts can be supplied on rolls and individual parts.

Typical Properties of Bond-Ply 100

Property	Typical Value	Test Method
Color	White	Visual
Short Term Temperature Resistance, 30Sec	200 °C	
Continuous Use Temperature	-30°C to +120°C	
Elongation, 45° Warp	70%	ASTM D412
Tape Tensile Strength	0.9Kpsi	ASTM D412
CTE	325 ppm	TMA
Glass Transition	-30 °C	DSC
Lap shear at RT	100 psi	ASTM D1002
Lap shear After 5 hr @ 100 °C	200 psi	ASTM D1002
Lap shear After 2 minutes @ 200 °C	200 psi	ASTM D1002
Static Dead Weight Shear	150 °C	PSTC#7
Thermal Conductivity	0.8 W/m-K	ASTM D5470

Property @ (inch)	0.005	0.008	0.011	Test Method
Breakdown Voltage, KVAC	3	6.5	8.5	ASTM D149
Surface Flatness, inch/inch	0.001	0.002	0.0025	
Application	Processors	Processors	PCB	

Thermal Impedance vs. Pressure		Pressure (psi)				
		10	25	50	100	200
TO-220 Thermal Performance, °C/W @ Standard Thickness, inch	0.005	4.39	4.02	3.48	3.15	3.05
	0.008	5.11	4.69	4.53	4.45	4.38
	0.011	6.26	5.92	5.73	5.63	5.53
Thermal Impedance, °C-in^2 / W (1) @ Standard Thickness, inch	0.005	0.78	0.61	0.58	0.55	0.54
	0.008	1.28	0.94	0.90	0.86	0.84
	0.011	2.47	1.22	1.19	1.14	1.11

* Single layer test that includes interfacial thermal resistance

Shelf Life: The double-sided pressure sensitive adhesive (PSA) inherent with Bond-Ply products require the use of dual liners to protect the surfaces from environmental contamination and accidental contact. The adhesive bond strength between the PSA and the protective liner will typically increase while in storage conditions. Thus, the worst-case shelf life for Bond-Ply products is limited not by the material characteristics of Bond-Ply, but by the adhesion of the Bond-Ply PSA to the protective liner. Bergquist recommends a 6 month shelf life at a maximum continuous storage temperature of 35°C, or 3 month shelf life at a maximum continuous storage temperature of 45°C, for maintenance of controlled adhesion to the liner. The shelf life of the Bond-Ply material, without consideration of liner adhesion (which is often not critical for manual assembly processing), is recommended at 12 months from date of manufacture at a maximum continuous storage temperature of 60°C.

Bond-Ply®: U.S. Patent 5,090,484 and others.

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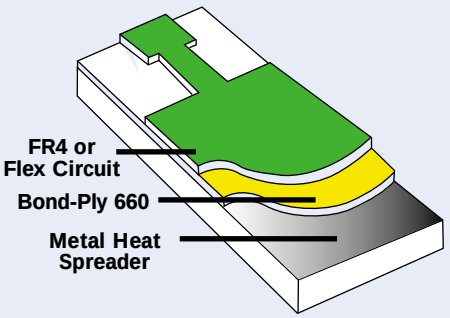
Bond-Ply® 660

Thermally Conductive, Electrically Insulating, Pressure Sensitive Adhesive Tape

Bond-Ply 660 is a thermally conductive, electrically insulating double-sided pressure sensitive adhesive tape. The tape consists of a high performance, thermally conductive acrylic adhesive coated on both sides of Bergquist T-600 film. Use Bond-Ply 660 in applications to replace mechanical fasteners or screws. Bond-Ply 660 is designed specifically for applications that require electrical isolation.



Bond-Ply 660 is available in roll form with kiss-cut or die-cut parts. The material as delivered will include a continuous base liner with differential release properties to allow simplicity in roll form pakaging and application assembly.

The Bergquist T-600 film has UL746B electrical mechanical RTI rating of 150°C. Bergquist File Number is E59150.

Typical Properties of Bond-Ply 660

Physical Property	Typical Value		Test Method
Color	White		Visual
Thickness	0.14 mm	0.0055 in	ASTM D374
Tensile Strength	210 MPa	30 kpsi	ASTM D882A
Elongation	40%		ASTM D882A
TCE	250 ppm		TMA
Glass Transition	-30 ° C		DSC
Adhesion			
Lap shear at RT	0.7 MPa	100 psi	ASTM D1002
Lap shear After 5 hr @ 100 °C	1.4 MPa	200 psi	ASTM D1002
Lap shear 2 minutes @ 200 °C	1.4 MPa	200 psi	ASTM D1002
Static Dead Weight Shear	150 °C		PSTC#7
Electrical			
Breakdown Voltage as received	7 KVac		ASTM D-149
Continuous Use Temperature	-30 to 120°C		
Short Term Temp.Resistance,10min.	200 °C		
Thermal			
Thermal Conductivity	0.4 W/m-K		ASTM D5470

Thermal Impedance vs. Pressure					
Pressure (psi)	10	25	50	100	200
TO-220 Thermal Performance, °C/W	5.30	4.94	4.38	4.02	3.88
Thermal Impedance Per ASTM D5470, °C-in^2 / W (1)	1.15	0.79	0.74	0.72	0.70

1). The ASTM D5470 (Bergquist Corrected) test fixture was used. The recorded value includes interfacial thermal resistance. These values are given to the customer for reference only. Actual application performance is directly related to the surface roughness, flatness and pressure applied.

Shelf Life: The double-sided pressure sensitive adhesive (PSA) inherent with Bond-Ply products require the use of dual liners to protect the surfaces from environmental contamination and accidental contact. The adhesive bond strength between the PSA and the protective liner will typically increase while in storage conditions. Thus, the worst-case shelf life for Bond-Ply products is limited not by the material characteristics of Bond-Ply, but by the adhesion of the Bond-Ply PSA to the protective liner. Bergquist recommends a 6 month shelf life at a maximum continuous storage temperature of 35°C, or 3 month shelf life at a maximum continuous storage temperature of 45°C, for maintenance of controlled adhesion to the liner. The shelf life of the Bond-Ply material, without consideration of liner adhesion (which is often not critical for manual assembly processing), is recommended at 12 months from date of manufacture at a maximum continuous storage temperature of 60°C.

Bond-Ply®: U.S. Patent 5,090,484 and others.

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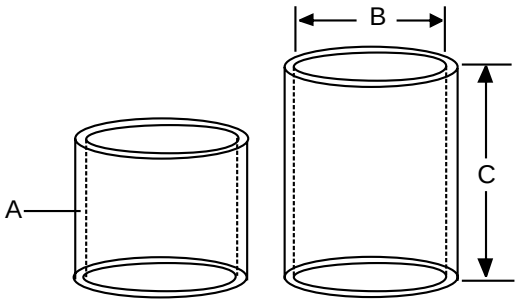
Sil-Pad® Tubes

SPT 400 and SPT 1000

SPT 400 and SPT 1000 ("Sil-Pad Tubes") provide thermally conductive insulation for clip mounted plastic power packages. Sil-Pad Tubes are made of silicone rubber with high thermal conductivity. Sil-Pad Tube 1000 is best suited for higher thermal performance and Sil-Pad Tube 400 is ideal for applications requiring average thermal performance and economy.

Sil-Pad Tube standard configurations are available for TO-220, TO-218, TO-247 and TO-3P plastic power packages. Special thicknesses and diameters can also be ordered. SPT 400 and SPT 1000 are designed to meet VDE, UL and TUV agency requirements. Typical properties of Sil-Pad Tube are shown in the table below.

	SPT 400	SPT 1000	Test Method
Color	Gray/Green	Brown	Visual
Thermal Resistance C-in²/Watt	0.6	0.4	ASTM D5470
Thermal Conductivity, W/m-k	0.9	1.2	ASTM D5470
Breakdown Voltage, minimum	5000	5000	ASTM D149
Dielectric Constant, 1000 (Hz)	5.5	4.5	ASTM D150
Continuous Use Temp. °C	-60 to + 180	-60 to + 200	—
Hardness, Shore A	80	80	ASTM D2240
Thickness/Wall (Inches) (mm)	.012 (.30)	.012 (.30)	ASTM D374
Breaking Strength lbs./in. (kN/m)	6 (1)	6 (1)	ASTM D1458
Volume Resistivity, Ohm Meter	1.0 x 10^{11}	1.0 x 10^{11}	ASTM D257



Standard Dimensions

A = Wall Thickness: .30 mm (.012") + .10 mm/-0.0 mm (+.004"/-0.0")
B = Inner Diameter: 11 mm (.433") and 13.5 mm (.532") ±1.0 mm (±.039")
C = Length 25 mm (.985") and 30 mm (1.18") +3.18 mm/-0.0 mm (+.125"/-0.0")

Special lengths are available. For more information contact the factory.

Ordering Procedure:

Sample: SPT400 ___ ___ ___
"A" -"B" -"C"

Sil-Pad®: U.S. Patents 4,574,879; 4,602,125; 4,602,678; 4,685,987; 4,842,911 and others.

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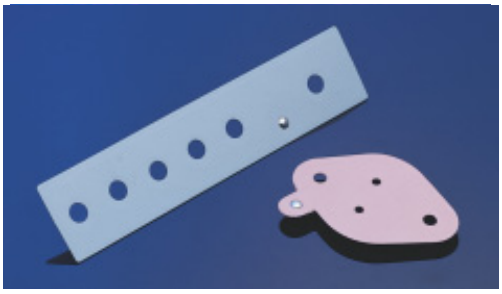
Sil-Pad® Shield

Bonded Laminate of Sil-Pad with a Copper Shield

Sil-Pad Shield

Bergquist Sil-Pad Shield is a bonded laminate of thermally conductive, electrically isolating Sil-Pad 400 or Sil-Pad 1000 pads with a copper shield between the layers. It is supplied with a pre-tinned solder point for easy grounding.



RFI Produced by Heat Sink Current

The Capacitance between a TO-3 encapsulated transistor and its heat sink is typically 100pf when a mica or other insulating washer is used. A power supply constructed with a standard insulator and a grounded heat sink can be expected to produce about 10 times more interference than is permitted.

A solution to the problem can be accomplished by:

1. The use of chokes, filters and LC networks which have to be designed into the circuitry.

OR

2. Constructing a shield between the transistor and its heat sink by replacing the mica insulator with a Sil-Pad Shield. (See illustration)

Typical Properties of Sil-Pad Shield

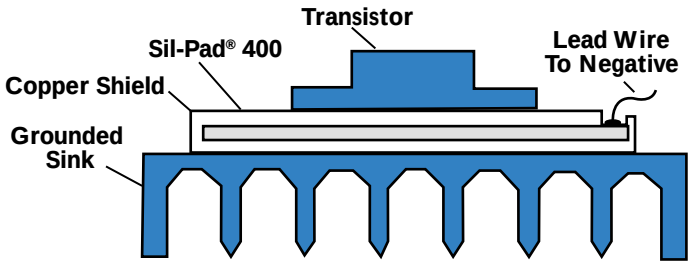
Property	Typical Value	Test Method
Thickness (total) inches	0.019± 0.004	--
Shield Thickness, inches Copper Thickness	0.0015	--
Approx. Thermal Resistance (TO-3)	.85° to 1.0°C/W	--
Min. Breakdown Voltage Between Device and Copper	4500 Volts	ASTM D149
Capacitance at 1000 Hz and 5 Volts	50 pico F	--
Dissipation Factor at 1000 Hz and 5 Volts (TO-3) Power Factor	0.0155	ASTM D150
Dielectric Constant at 1000 Hz and 5 Volts	5.5	ASTM D150
Continuous Use Temp. °C	-60 to +180	--
Recommended Torque (TO-3)	6-8 inch Lbs.	--

Sil-Pad Shield is a laminate of copper with Sil-Pad thermally conductive insulators. Sil-Pad Shield provides:

- Shielding effectiveness of 50dB or higher.
- Electrical isolation of 500 volts minimum.
- Good thermal transfer.
- Reduced labor costs due to the elimination of having to apply thermal grease.

SPECIAL SHAPES

Sil-Pad Shield is available in many custom configurations to meet special requirements. Tooling charges vary depending on tolerances and complexity of the part.



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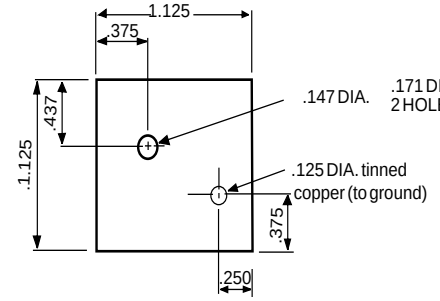
Sil-Pad® Shield

Sil-Pad Shield Standard Configurations



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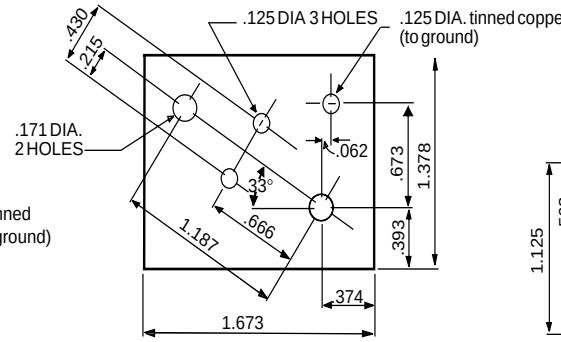

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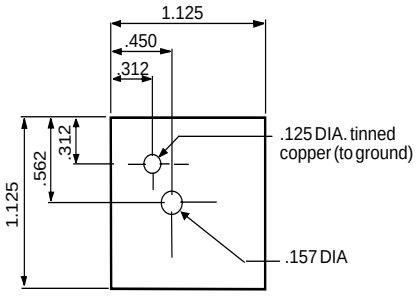

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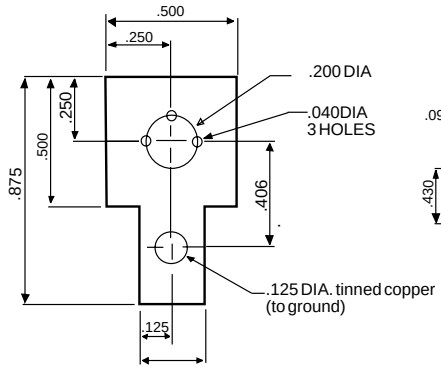

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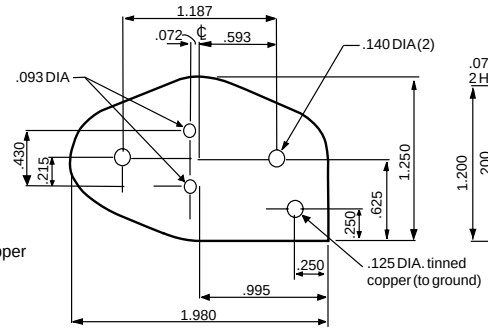

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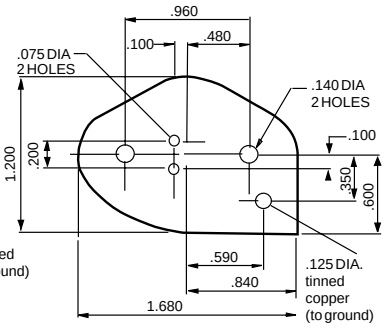

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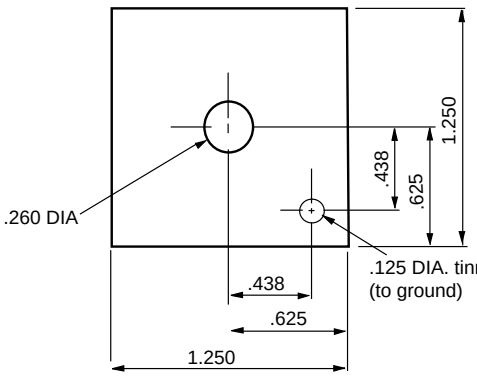

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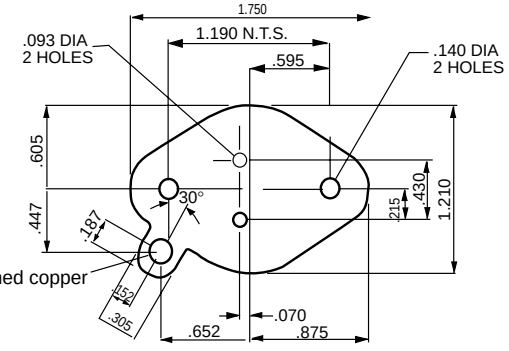

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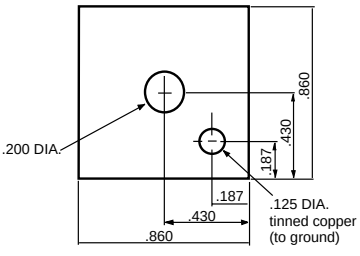

P/N 09SPS01-019 (DO-4)

Contact the factory for other configurations.

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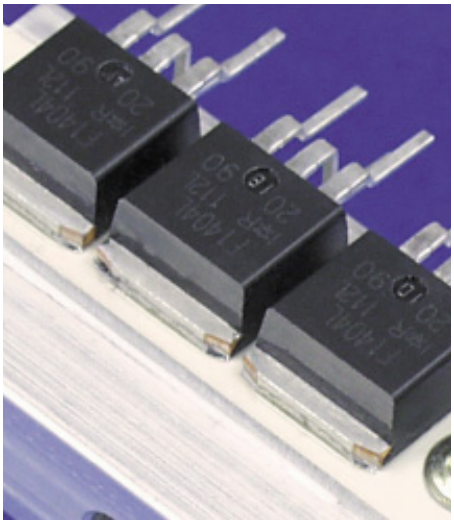
Bergquist Solutions for Surface Mount Applications

This guide covers Sil-Pad products specifically, but Bergquist offers a wide array of thermal solutions for any surface mount application. Reasons for selecting one material over another are varied, but typically the decision is power density driven.

Maximum Power	100 Watts plus per square inch	Hi-Flow and Heat Spreader with or without Thermal Clad
High Power	40 to 100 Watts per square inch	Bergquist Thermal Clad (CML, MP, LTI and HT)
Medium Power	10 to 50 Watts per square inch	Bergquist Sil-Pad or Bond-Ply with Heat Spreader
Low Power	1 to 15 Watts per square inch	Bergquist Gap Pad with or without Heat Spreader



HI-FLOW®

The Hi-Flow family of Phase Change Materials (PCM) offers an easy to apply thermal interface for many surface mount packages. At the phase change temperature, Hi-Flow materials change from a solid and flow with minimal applied pressure. This characteristic optimizes heat transfer by maximizing wet-out of the interface. Hi-Flow is commonly used to replace messy thermal grease.

Bergquist PCMs are specially compounded to prevent pump out of the interface area, which is often associated with thermal grease.

High Power Application
Hi-Flow with Thermal Clad

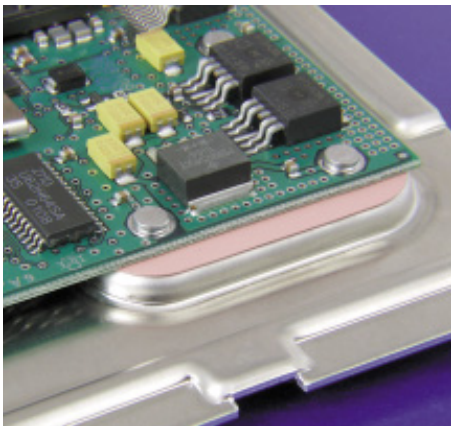
High Power Application
Hi-Flow without Thermal Clad

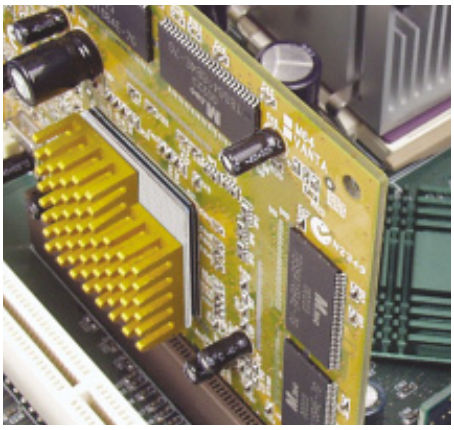
Typical applications include:

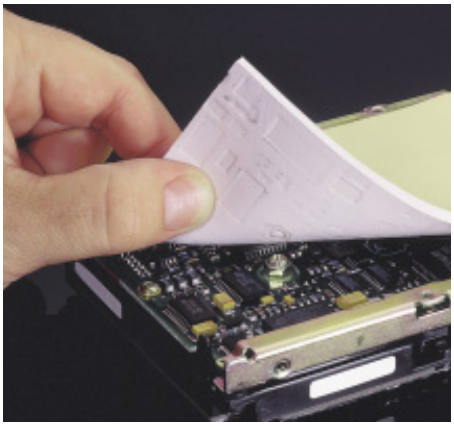
- Pentium®, Athlon®, and other high performance CPUs
- DC/DC Converters
- Power modules

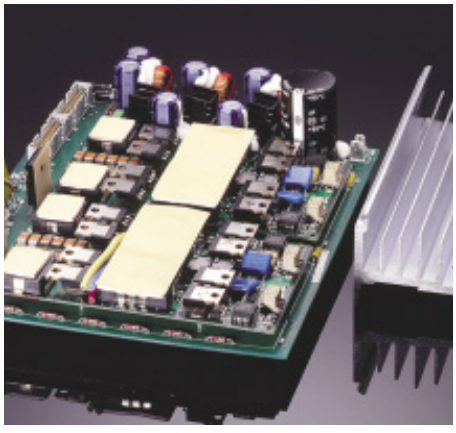
Hi-Flow materials are manufactured with or without film or foil carriers. Custom shapes and sizes for non-standard applications are also available.

Where Thermal Solutions All Come Together







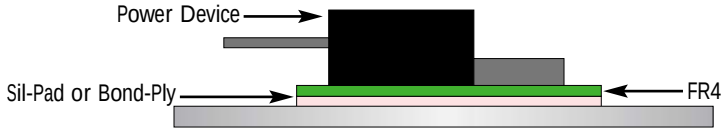


Sil-Pad®

Sil-Pad is the benchmark in thermal interface materials. The Sil-Pad family of materials are thermally conductive and electrically insulating. Sil-Pad materials come in a variety of different thicknesses and are frequently used in SMT applications such as:

- Interface between thermal via's in a PCB, and a heatsink or casting
- Heat sink interface to many surface mount packages

Sil-Pad is available in custom shapes, sheets, and rolls.



Mid Power Application with Sil-Pad or Bond-Ply

Bond-Ply®

The Bond-Ply family of materials are thermally conductive and electrically isolating. Bond-Ply is available in a PSA or laminating format, is reinforced with fiberglass or film and comes in a variety of different thicknesses. Bond-Ply provides for the mechanical decoupling of bonded materials with mismatched thermal coefficients of expansion. Typical applications include:

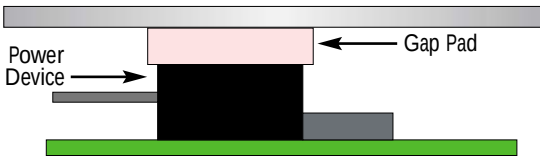
- Bonding bus bars in a variety of electronic modules and sub assemblies
- Attaching a metal-based component to a heatsink
- Bonding a heat sink to a variety of ASIC, graphic chip, and CPU packages
- Bonding flexible circuits to a rigid heat spreader or thermal plane
- Assembly tapes for BGA heat spreader

Gap Pad®

The Gap Pad product family offers a line of thermally conductive materials which are highly conformable. Varying degrees of thermal conductivities and compression deflection characteristics are available. Typical applications include:

- On top of a semiconductor package such as a QFP or BGA (Often times, several packages with varying heights can use a common heatsink when utilizing Gap Pad)
- Between a PCB or substrate and a chassis, frame, or other heat spreader
- Areas where heat needs to be transferred to any type of heat spreader

Gap Pads are available in thickness of 0.010" to 0.200", and in custom shapes, with or without adhesive.



Lower Power Application with Gap Pad

Top Efficiency In Thermal Materials For Today's Changing Technology.

Contact Bergquist for additional information regarding our Thermal Solutions. We are constantly innovating to offer you the greatest selection of options and flexibility to meet today's changing technology.

Ordering Procedure, PSA Characteristics, Mil-Spec

Ordering Procedure:

The last 2 or 3 digits define the part number selected. The "foot print" and dimensions are shown on pages 70-76. Each material has a prefix as shown on page 69.

Special Shapes:

For applications requiring non standard or custom Sil-Pad configurations contact the factory.

We produce thousands of specials. Engineering charges are about $200 for simple parts. Increased complexity or tighter tolerances increase engineering charges.

Tolerances:

Typical converting tolerances are held on length (L), width (W), hole diameter and hole location for most materials as noted below:

Sil-Pads

Part Dimension	Length & Width	Hole Location & Diameter
< 6"	± .010"	± .005"
6" - 12"	± .015"	± .010"
> 12"	± .020"	TBD

Gap Pads

Material Thickness	Tolerance
10 mil	± .015"
15 mil	± .015"
20 mil	± .020"
30 mil	± .030"
40 mil	± .035"
50 mil	± .040"
60 mil	± .050"
80 mil	± .050"
100 mil	± .060"
125 mil	± .075"
140 mil	± .100"
160 mil	± .100"
200 mil	± .125"
225 mil	± .160"
250 mil	± .160"

Note: Dependent upon material and application requirements, tighter tolerances may be feasible and available. Please contact Bergquist Sales for these requests and additional information regarding tolerances.

Sheets:

Standard sheet size for most materials is 12" x 12", with or without adhesive as specified on the individual data sheet. When ordering sheets, please specify material type, thickness and include all dimensions. Contact Bergquist Sales if other sizes are required.

Note: Sil-Pad A2000 maximum sheet size is 10" x 12". Gap Pad standard sheet size is 8" x 16".

Rolls:

Sil-Pad materials are available in roll form, with or without adhesive, with the exception of Sil-Pad 1750, Sil-Pad 2000 and Sil-Pad A2000. Hi-Flow materials are available in roll form. Certain Gap Pad materials are available in roll form. Please contact Bergquist Sales for more information.

Adhesives:

Bergquist offers two primary types of adhesives for all materials.

SILICONE: (AC) - Unloaded
(TAC) - Loaded (Thermally Enhanced)
ACRYLIC: (AAC) - Unloaded
(TAAC) - Thermally Loaded
(EAAC) - Thermally Enhanced

THICKNESS: .0005-.001,(12-25µm) (Adhesive only)

PEEL STRENGTH: See data below.
POL = Peel Off Liner (force per lineal strength of the liner to the adhesive).
QS = Quick Stick (Simulated force per lineal strength of the adhesive to the heat sink).
g/in = Grams per inch.

ADHESIVE	POL	QS
Silicone AC	50-150 g/in	50-150 g/in
Silicone TAC	50-150 g/in	50-150 g/in
Acrylic AAC	5-70 g/in	100-800 g/in
Acrylic TAAC	5-70 g/in	100-400 g/in
Acrylic EAAC	5-60 g/in	100-200 g/in

Note: These values are typical after the material has aged for 2-3 weeks and are significantly different immediately after coating. Upon completion of coating, QS is 250-500 g/in and POL is 3-20 g/in for all silicone adhesives.

Shelf Life:

Silicone Adhesives: Six (6) months from DOM (date of manufacture) when stored in original packaging at 70°F (21°C) and 50% relative humidity.

Acrylic Adhesives: One (1) year from DOM (date of manufacture) when stored in original packaging at 70°F (21°C) and 50% relative humidity.

Peel adhesion data is available upon request. Please contact Bergquist Sales for more information.

PSA Characteristics:

Standard pressure sensitive adhesive (AC) coated on one side of a Sil-Pad will increase the thermal resistance (per ASTM D5470) by 0.2 C/in^2/W. Standard PSA on 2 sides increases the thermal impedance by 0.4 C/in^2/W.

Thermally conductive PSA (TAC) on one side increases the thermal resistance by 0.05 C/in^2/W and on two sides by 0.1 C/in^2/W.

The effect of AC and TAC on the thermal impedance in an application will vary. In low pressure applications, the pressure sensitive adhesive will wet out the interface easier and eliminate the interfacial thermal resistance.

Note: Bergquist adhesives are designed for ease of application during assembly. If an automated dispensing method is preferred, Bergquist will recommend manufacturers of automated dispensing equipment upon request. Please contact Bergquist Sales for more information on this subject.

Note: Bergquist cannot be responsible for dispensing equipment selection and/or performance of specific materials on said equipment. It is the customer's responsibility to determine the suitability and compatibility of the specific Bergquist material with the selected equipment.

Material Specifications:

Bergquist will supply a Thermal Insulation Material Cross Reference Listing for all pertinent military part numbers included in the following Mil-Specs:

MIL M-38527 / 08	MIL I-49456A
MIL I-49466 / 02	NAS 4117
MIL H-87111	NAS 4118

Each Bergquist part number specifies a Bergquist grade of thermal insulation material and a transistor case configuration. Details of different Bergquist thermal insulation materials as well as details on different thermal insulator configurations are found on previous pages of the Sil-Pad Selection Guide.

MIL-I-49456A specifies a fiberglass reinforced elastomeric sheet material showing type and class. MIL-I-49466-02, MIL M-38527 / 08 and MIL-H-87111 specify thermal insulator configurations.

MIL I-49466 / 02 supersedes the part numbers covered under MIL M-38527 / 08. M49466 / 02 is the most complete listing of military part numbers. Each of the military part numbers in M49466 / 02 is cross referenced to specific Bergquist part numbers. Please use MIL-I-49466 whenever possible. Please contact The Bergquist Company for the complete MIL Spec Reference Guide.

FSCM NUMBER 55285

U.L.® Recognition:

For information regarding the UL (Underwriters Laboratories, Inc.) recognition status of Bergquist Sil-Pad, Gap Pad and Hi-Flow materials, the UL web site provides the most current information.

Using the address: http://www.ul.com, select "Online Certification Directory." You may then enter one of the following file numbers for the applicable Bergquist file:

QMFZ2.E59150: Plastics – Component. This category includes all Sil-Pad, Gap Pad and Hi-Flow materials.

QOQW2.E81718: Polymeric Adhesive Systems, Electrical Equipment – Component. This category includes Bond-Ply Adhesive only.

In each group there is a "Guide Information" section which gives a detailed description of the categories listed and all recognized materials will be listed with supporting data.

Building a Part Number

Material Thickness:

Sil-Pad® 400
☐ .007" ☐ .009"
☐ .015"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® 800
☐ .005" DRY
☐ .005" ADHESIVE

Sil-Pad® 900S
☐ .009" DRY
☐ .009" ADHESIVE

Sil-Pad® 950
☐ .009"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® 980
☐ .009"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® 1500 & A1500
☐ .010"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® 1750
☐ .012" DRY
☐ .012" ADHESIVE

Sil-Pad® 2000 & A2000
☐ .010" ☐ .015" ☐ .020" ☐ .030"
☐ .040" ☐ .050" ☐ .060" ☐ .080"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® K-4
☐ .006"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® K-6
☐ .006"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Sil-Pad® K-10
☐ .006"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Q-Pad® II
☐ .006"
☐ ADHESIVE 1 SIDE

Q-Pad® 3
☐ .005"
☐ ADHESIVE 1 SIDE

SOFTFACE®
(INSULATING) (NON-INSULATING)
☐ .003" ☐ .005"
☐ .005" ☐ .008"
☐ .008"

Poly-Pad® 400
☐ .009"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Poly-Pad® 1000
☐ .009"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Poly-Pad® K-4
☐ .006"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Poly-Pad® K-10
☐ .006"
☐ ADHESIVE 1 SIDE
☐ ADHESIVE 2 SIDES

Bond-Ply® 100
☐ .005"
☐ .008"
☐ .011"

Bond-Ply® 660
☐ .0055"

Sil-Pad® Shield
☐ SP400 ☐ SP1000

Gap Pad® VO & VO Ultra Soft
☐ .020" ☐ .080" ☐ .160"
☐ .040" ☐ .100" ☐ .200"
☐ .060" ☐ .125" ☐ .250"
☐ ADHESIVE 1 SIDE

Gap Pad® VO Soft
☐ .020" ☐ .100"
☐ .040" ☐ .125"
☐ .060" ☐ .160"
☐ .080"
☐ ADHESIVE 1 SIDE

Gap Pad® 1500
☐ .020" ☐ .100"
☐ .040" ☐ .125"
☐ .060" ☐ .160"
☐ .080" ☐ .200"

Gap Pad® 1500R
☐ .010" ☐ .020"
☐ .015"

Gap Pad® A2000
☐ .010" ☐ .020"
☐ .015" ☐ .040"

Gap Pad® A3000
☐ .010" ☐ .015" ☐ .020"

Gap Pad® HC 1000
☐ .010" ☐ .015" ☐ .020"

Gap Pad® HC 1100
☐ .015" ☐ .020"

Hi-Flow® 105
(THICKNESS WITH SUBSTRATE)
☐ .0055"

Hi-Flow® 115-AC
☐ .0055"

Hi-Flow® 200G
☐ .0055"

Hi-Flow® 225F-AC
☐ .004"

Hi-Flow® 225U
☐ .0015"

Hi-Flow® 225UT
☐ .003"

Hi-Flow® 625
☐ .005"

Hi-Flow® 818
☐ .0055"

NOTE: The following Gap Pad™ materials are available with adhesive:

Gap Pad® VO – all thicknesses
Gap Pad® VO Soft – all thicknesses
Gap Pad® VO Ultra Soft – all thicknesses

Adhesive is applied to **one side only** of the material. The other surface has a natural inherent tack. All Gap Pads® that are not offered with adhesive have this natural tack (with the exception of HC 1100).

Call 1-800-347-4572 to order free samples.

Building a Part Number (2)

Part Number Coding:

Complete the part number with a 2 or 3 digit part number suffix from standard configurations as listed on the following pages.

Sil-Pad® 400

7 mil - dry	3223-07FR-_____
9 mil - dry	7403-09FR-_____
7 mil - adhesive	3223-07AC-_____
9 mil - adhesive	7403-09AC-_____

Sil-Pad® 800

5 mil - dry	SP800S-_____
5 mil - adhesive	SP800SAC-_____

Sil-Pad® 900S

9 mil - dry	SP900-_____
9 mil - adhesive	SP900AC-_____

Sil-Pad® 950

9 mil - dry	SP950-_____
9 mil - adhesive	SP950AC-_____

Sil-Pad® 980

9 mil - dry	SP980-_____
9 mil - adhesive	SP980AC-_____

Sil-Pad® 1500

10 mil - dry	1510-_____
10 mil - adhesive	1510AC-_____

Sil-Pad® A1500

10 mil - dry	A1510-_____
10 mil - adhesive	A1510AC-_____

Sil-Pad® 1750

12 mil - dry	1750-_____
12 mil - adhesive	1750AC-_____

Sil-Pad® 2000

15 mil - dry	2015-_____
15 mil - adhesive	2015AC-_____

Sil-Pad® A2000

15 mil - dry	A2015-_____
15 mil - adhesive	A2015AC-_____

Sil-Pad® K-4

6 mil - dry	K4-_____
6 mil - adhesive	K4AC-_____

Sil-Pad® K-6

6 mil - dry	K6-_____
6 mil - adhesive	K6AC-_____

Sil-Pad® K-10

6 mil - dry	K10-_____
6 mil - adhesive	K10AC-_____

Q-Pad® II

6 mil - dry	Q2-_____
6 mil - adhesive	Q2AC-_____

Q-Pad® 3

5 mil - dry	Q3-_____
5 mil - adhesive	Q3AC-_____

Poly-Pad® 400

9 mil - dry	PP400-_____
9 mil - adhesive	PP400AC-_____

Poly-Pad® 1000

9 mil - dry	PP1000-_____
9 mil - adhesive	PP1000AC-_____

Poly-Pad® K-10

6 mil - dry	PPK10-_____
6 mil - adhesive	PPK10AC-_____

Bond-Ply® 100

5 mil - adhesive	BP105-_____
8 mil - adhesive	BP108-_____
11 mil - adhesive	BP111-_____

(double-sided adhesive only)

Bond-Ply® 660

.0055”	BP660-_____

(double-sided adhesive only)

Sil-Pad® Shield 400

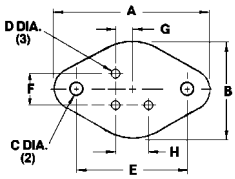
09SPS01-_____

Sil-Pad® Shield 1000

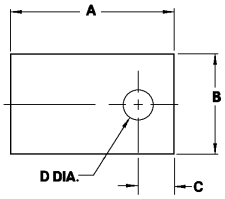
01SPS01-_____

Call 1-800-347-4572 to order free samples.

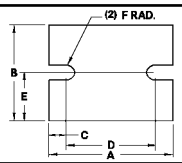
Sil-Pad® Configurations



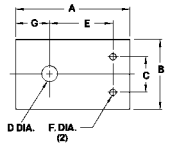
4 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-84	1.312	.762	.140	.062	.960	.200	.100



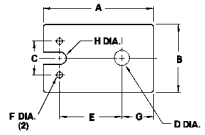
Plastic Power	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"
Various	-35	.710	.500	.160	.141	Various	-104	1.000	.750	.300	.140
TO-220 (Clip Mount)	-43	.750	.500			Various	-107	.810	.910	.170	.147
TO-126	-50	.437	.312	.140	093	Various	-110	.984	.787		
Various	-51	.687	.562	.218	.125	Various	-114	.827	.945	.197	.150
Various	-52	.855	.630	.230	.093	Various	-116	.855	.630	.228	.122
TO-220	-54	.750	.500	.187	.147	Various	-117	.827	.709	.256	.126
TO-202	-55	.610	.560	.245	.125	Various	-118	.748	.551	.217	.126
Various	-56	.855	.562	.218	.125	Various	-119	.437	.311	.142	.110
TO-220	-58	.750	.500	.187	.125	Various	-120	.728	.472	.157	.098
TO-126	-60	.437	.312	.140	.122	TO-3P	-122	1.140	.810	.355	.147
Various	-61	.750	.410	.225	.156	Various	-126	.945	.748	.256	.162
TO-220	-62	.750	.600	.240	.150	Various	-128	.984	1.654	.315	.157
Various	-63	.750	.600	.240	.115	Various	-131	.709	.512	.177	.122
Various	-64	.500	.385	.170	.120	Various	-132	.472	.315	.157	.126
TO-218	-68	1.125	.625	.200	.145	Various	-133	.866	.709	.256	.126
Various	-70	1.410	.810	.355	.147	Various	-134	.945	.709	.228	.126
Various	-90	.860	.740	.200	.160	Various	-136	1.250	1.000		
Various	-102	.866	.650	.217	.142	Various	-137	1.250	1.000	.258	.127
Various	-103	.750	.800	.150	.160	Various	-138	1.250	1.000	.258	.148



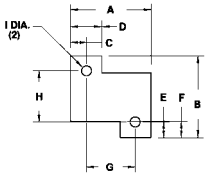
Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-67	1.500	.900	.150	1.200	.450	.075
	-101	2.500	2.000	.344	1.812	1.000	.156



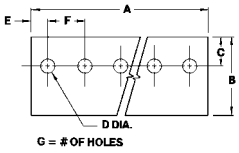
Plastic Power	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-57	.910	.500	.200	.125	.580	.046	.265
	-89	.983	.750	.432	.156	.665	.101	.217



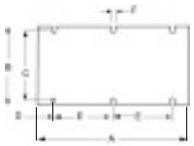
Plastic Power	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-66	1.000	.500	.200	.141	.626	.046	.219	.032



Power Resistors	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"
RH-25	-94	1.187	1.205	.234	.469	.212	.156	.719	.781	.140
RH-50	-95	2.093	1.265	.265	.530	.210	.255	1.563	.845	.140
RH-5	-96	.725	.771	.140	.280	.140	.156	.445	.491	.093
RH-10	-97	.805	.890	.127	.250	.130	.190	.551	.630	.121
RH-25	-98	1.150	1.180	.231	.425	.190	.270	.688	.800	.147
RH-50	-99	1.965	1.236	.198	.404	.132	.263	1.569	.972	.130

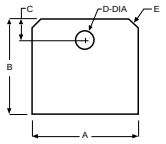


TO-220 Multiples	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	# Of Holes
2 Parts	-34	1.000	.750	.187	.125	.250	.500	2
3 Parts	-36	1.500	.750	.187	.125	.250	.500	3
	-37	2.000	.750	.187	.125	.250	.500	4
	-38	2.500	.750	.187	.125	.250	.500	5
	-39	3.000	.750	.187	.125	.250	.500	6
	-40	3.500	.750	.187	.125	.250	.500	7
	-41	4.000	.750	.187	.125	.250	.500	8

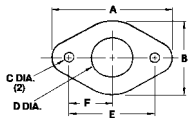


Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-108	4.600	2.400	2.125	.500	1.800	.125
	-140	4.598	2.402	2.098	0.500	1.799	0.150
	-141	2.279	2.402	2.102	0.488	0.650	0.150
	-142	2.280	1.450	1.270	0.490	0.650	0.130

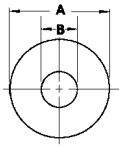
Sil-Pad® Configurations



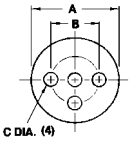
Multiwatt	Part Number Suffix	"A"	"B"	"C"	"D"	"E"
	-124	.872	.790	.160	.148	.118 x 45°
	-125	.866	.787	.157	.154	.079 x 45°



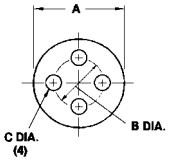
Multi-Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-93	1.350	.800	.140	.400	.960	.480



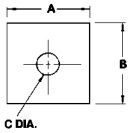
Diode Washer	Part Number Suffix	Dimensions "A"	"B"		Part Number Suffix	Dimensions "A"	"B"
Various	-19	.510	.140	Various	-75	.360	.260
DO-4	-20	.510	.200	Various	-76	.750	.125
DO-5	-21	.800	.260	Various	-77	.800	.190
DO-4 (oversized)	-22	.625	.200	DO-8	-78	.875	.313
DO-5 (oversized)	-25	1.000	.260	Various	-79	1.180	.515
Various	-26	.812	.145	Various	-80	1.250	.380
Various	-27	.812	.115	Various	-81	1.500	.200
Various	-28	1.000	.140	Various	-82	.512	.161
Various	-32	1.500	.500	Various	-111	.591	.217



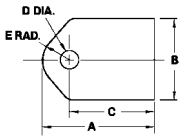
TO-36	Part Number Suffix	Dimensions "A"	"B"	"C"
	-08	1.063	.690	.190



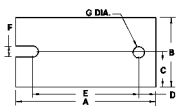
Small Power Devices	Part Number Suffix	"A"	"B"	"C"
TO-5, 3 Holes	-09	.360	.200	.040
TO-18, 3 Holes	-12	.250	.100	.036
TO-18, 4 Holes	-13	.250	.100	.036
TO-5, 4 Holes	-33	.360	.200	.040
TO-5, 3 Holes	-44	.390	.200	.040
TO-5, 4 Holes	-45	.390	.200	.040



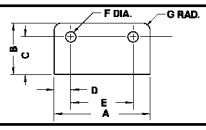
Rectifier	Part Number Suffix	Dimensions "A"	"B"	"C"
	-46	1.250	1.250	.200
	-47	1.125	1.125	.140
	-48	1.000	1.000	.187



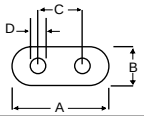
TIP Packages	Part Number Suffix	"A"	"B"	"C"	"D"	"E"
Clip Mount	-42	.984	.787			.205
TIP-36 Plastic Tip	-53	.865	.650	.650	.140	.205
TO-3P	-65	1.260	.787	.984	.142	.205
Plastic Clip	-73	.984	.787	.708	.142	.205



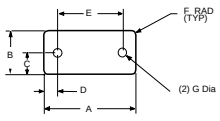
Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-100	2.510	1.260	.630	.305	1.900	.205	.205
	-123	1.614	1.102	.551	.157	1.220	.118	.118



SIP Package	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-105	1.450	.838	.612	.245	.960	.170	.120

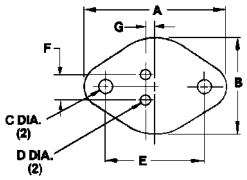


Quarz	Part Number Suffix	"A"	"B"	"C"	"D"
	-115	.472	.197	.193	.031

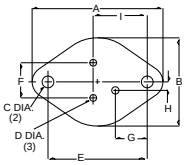


Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-109	1.350	.642	.321	.195	.960	.060	.125

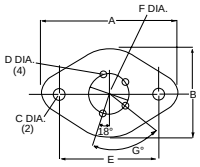
Sil-Pad® Configurations



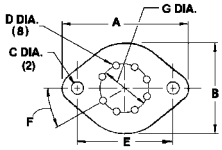
TO-3 & TO-66 Style	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	"E"	"F"	"G"
	-02	1.780	1.250	.140	.093	1.187	.430	.072
	-03	1.563	1.050	.140	.080	1.187	.430	.072
	-04	1.650	1.140	.122	.062	1.187	.430	.072
	-05	1.650	1.140	.140	.093	1.187	.430	.072
	-06	1.650	1.140	.165	.062	1.187	.430	.072
	-07	1.780	1.250	.165	.094	1.187	.430	.072
	-10	1.440	1.000	.140	.075	.960	.200	.100
	-11	1.312	.762	.140	.062	.960	.200	.100
	-15	1.780	1.250	.140	.046	1.187	.430	.072
	-16	2.070	1.560	.122	.062	1.187	.430	.072
	-17	1.650	1.140	.140	.046	1.187	.430	.072
	-18	1.563	1.050	.140	.140	1.187	.430	.072
	-23	1.593	1.100	.156	.062	1.187	.430	.072
	-24	1.700	1.187	.156	.062	1.187	.430	.072
	-29	1.650	1.065	.140	.046	1.187	.430	.072
	-30	1.250	.700	.140	.062	.960	.200	.100
	-31	1.375	.825	.140	.062	.960	.200	.100
	-59 Leadless	1.650	1.140	.165		1.187		
	-112	1.780	1.248	.165	.063	1.185	.429	.073
	-113	1.563	1.051	.165	.079	1.185	.429	.073
	-127	1.307	.819	.165	.063	.909	.236	.061
	-129	1.654	1.063	.138	.059	1.181	.433	.071
	-135	1.650	1.142	.165	.142	1.187	.429	..072



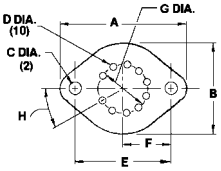
3 Lead TO-3	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"
	-92	1.650	1.140	.140	.093	1.187	.430	.400	.155	.718



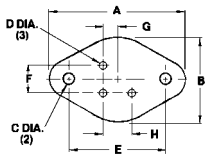
4 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-86	1.560	1.050	.156	.080	1.170	.470	72°
	-87	1.563	1.050	.156	.063	1.187	.470	72°



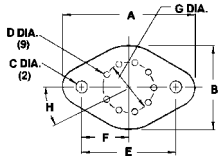
8 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-88	1.655	1.187	.156	.060	1.187	40°	.500



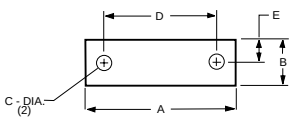
10 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-91	1.650	1.140	.165	.040	1.187	.593	.500	32.7°



3 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-85	1.275	.750	.156	.100	.960	.200	.100	.200



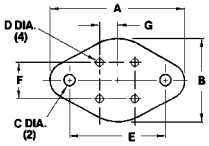
9 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-83	1.440	1.000	.140	.055	.960	.480	.325	36°



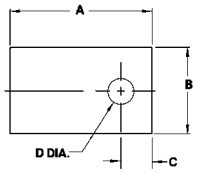
Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"
	-130	1.600	.480	.165	1.197	.240

ORDERING

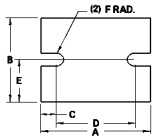
Sil-Pad® Configurations (SI Measurements)



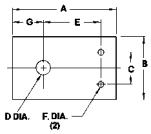
4 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-84	33.32	19.35	3.56	1.57	24.38	5.08	2.54



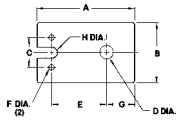
Plastic Power	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"
Various	-35	18.03	12.70	4.06	3.58	Various	-104	25.40	19.05	7.62	3.56
(Clip Mount)	-43	19.05	12.70			Various	-107	20.57	23.11	4.32	3.73
TO-220 TO-126	-50	11.10	7.92	3.56	2.36	Various	-110	24.99	19.99		
Various	-51	17.45	14.27	5.54	3.18	Various	-114	21.01	24.00	5.00	3.81
Various	-52	21.72	16.00	5.84	2.36	Various	-116	21.72	16.00	5.79	3.10
TO-220	-54	19.05	12.70	4.75	3.73	Various	-117	21.01	18.01	6.50	3.20
TO-202	-55	15.49	14.22	6.22	3.18	Various	-118	19.00	14.00	5.51	3.20
Various	-56	21.72	14.27	5.54	3.18	Various	-119	11.10	7.90	3.61	2.79
TO-220	-58	19.05	12.70	4.75	3.18	Various	-120	18.49	11.99	3.99	2.49
TO-126	-60	11.10	7.92	3.56	3.10	TO-3P	-122	28.96	20.57	9.02	3.73
Various	-61	19.05	10.41	5.72	3.96	Various	-126	24.00	19.00	6.50	4.11
TO-220	-62	19.05	15.24	6.10	3.81	Various	-128	24.99	42.01	8.00	3.99
Various	-63	19.05	15.24	6.10	2.92	Various	-131	18.01	13.00	4.50	3.10
Various	-64	12.70	9.78	4.32	3.05	Various	-132	11.99	8.00	3.99	3.20
TO-218	-68	28.58	15.88	5.08	3.68	Various	-133	22.00	18.01	6.50	3.20
Various	-70	35.81	20.57	9.02	3.73	Various	-134	24.00	18.01	5.79	3.20
Various	-90	21.84	18.80	5.08	4.06	Various	-136	31.75	25.40		
Various	-102	22.00	16.51	5.51	3.61	Various	-137	31.75	25.40	6.55	3.23
Various	-103	19.05	20.32	3.81	4.06	Various	-138	31.75	25.40	6.55	3.76



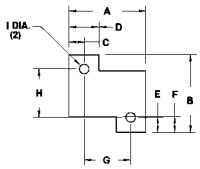
Power Module	Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-67	38.10	22.86	3.81	30.48	11.43	1.90
	-101	63.50	50.80	8.74	46.02	25.40	3.96



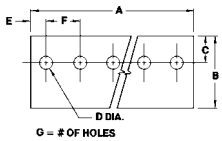
Plastic Power	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-57	23.11	12.70	5.08	3.18	14.73	1.17	6.73
	-89	24.97	19.05	10.97	3.96	16.89	2.57	5.51



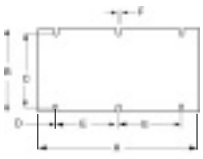
Plastic Power	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-66	25.40	12.70	5.08	3.58	15.90	1.17	5.56	0.81



Power Resistors	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"
RH-25	-94	30.15	30.61	5.94	11.91	5.38	3.96	18.26	19.84	3.56
RH-50	-95	53.16	32.13	6.73	13.46	5.33	6.48	39.70	21.46	3.56
RH-5	-96	18.42	19.58	3.56	7.11	3.56	3.96	11.30	12.47	2.36
RH-10	-97	20.45	22.61	3.23	6.35	3.30	4.83	14.00	16.00	3.07
RH-25	-98	29.21	29.97	5.87	10.80	4.83	6.86	17.48	20.32	3.73
RH-50	-99	49.91	31.39	5.03	10.26	3.35	6.68	39.85	24.69	3.30

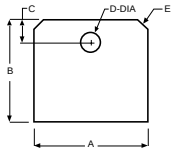


TO-220 Multiples	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	# Of Holes
2 Parts	-34	25.40	19.05	4.75	3.18	6.35	12.70	2
3 Parts	-36	38.10	19.05	4.75	3.18	6.35	12.70	3
	-37	50.80	19.05	4.75	3.18	6.35	12.70	4
	-38	63.50	19.05	4.75	3.18	6.35	12.70	5
	-39	76.20	19.05	4.75	3.18	6.35	12.70	6
	-40	88.90	19.05	4.75	3.18	6.35	12.70	7
	-41	101.60	19.05	4.75	3.18	6.35	12.70	8

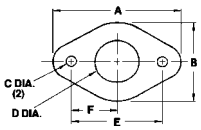


Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-108	116.84	60.96	53.97	12.70	45.72	3.18
	-140	116.8	61.00	53.30	12.70	45.70	3.80
	-141	57.90	61.00	53.40	12.40	16.50	3.80
	-142	57.91	36.83	32.26	12.45	16.50	3.30

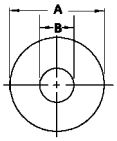
Sil-Pad® Configurations (SI Measurements)



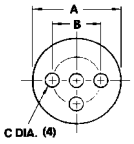
Multiwatt	Part Number Suffix	"A"	"B"	"C"	"D"	" E"
	-124	22.15	20.07	4.06	3.76	3.0 x 45°
	-125	22.00	19.99	3.99	3.91	2.0 x 45°



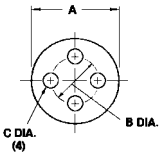
Multi-Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"
	-93	34.29	20.32	3.56	10.16	24.38	12.19



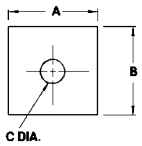
Diode Washer	Part Number Suffix	Dimensions "A"	"B"		Part Number Suffix	Dimensions "A"	"B"
Various	-19	12.95	3.56	Various	-75	9.14	6.60
DO-4	-20	12.95	5.08	Various	-76	19.05	3.18
DO-5	-21	20.32	6.60	Various	-77	20.32	4.83
DO-4 (oversized)	-22	15.88	5.08	DO-8	-78	22.23	7.95
DO-5 (oversized)	-25	25.40	6.60	Various	-79	29.97	13.08
Various	-26	20.62	3.68	Various	-80	31.75	9.65
Various	-27	20.62	2.92	Various	-81	38.10	5.08
Various	-28	25.40	3.56	Various	-82	13.00	4.09
Various	-32	38.10	12.70		-111	15.01	5.51



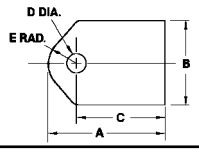
TO-36	Part Number Suffix	"A"	Dimensions "B"	"C"
	-08	27.00	17.53	4.83



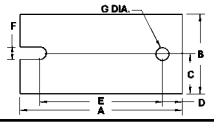
Small Power Devices	Part Number Suffix	"A"	"B"	"C"
TO-5, 3 Holes	-09	9.14	5.08	1.02
TO-18, 3 Holes	-12	6.35	2.54	0.91
TO-18, 4 Holes	-13	6.35	2.54	0.91
TO-5, 4 Holes	-33	9.14	5.08	1.02
TO-5, 3 Holes	-44	9.91	5.08	1.02
TO-5, 4 Holes	-45	9.91	5.08	1.02



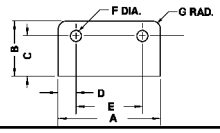
Part Number Rectifier	Suffix	Dimensions "A"	"B"	"C"
	-46	31.75	31.75	5.08
	-47	28.58	28.58	3.56
	-48	25.40	25.40	4.75



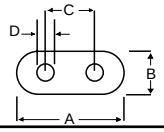
TIP Packages	Part Number Suffix	"A"	"B"	"C"	"D"	"E"
Clip Mount	-42	24.99	19.99			5.21
TIP-36 Plastic Tip	-53	21.97	16.51	16.51	3.56	5.21
TO-3P	-65	32.00	19.99	24.99	3.61	5.21
Plastic Clip	-73	24.99	19.99	17.98	3.61	5.21



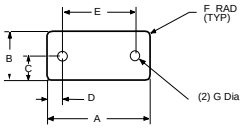
Power Module	Part Number Suffix	"A"	"B"	Dimensions "C"	"D"	"E"	"F"	"G"
	-100	63.75	32.00	16.00	7.75	48.26	5.21	5.21
	-123	41.00	27.99	14.00	3.99	30.99	3.00	3.00



SIP Package	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-105	36.83	21.29	15.54	6.22	24.38	4.32	3.05

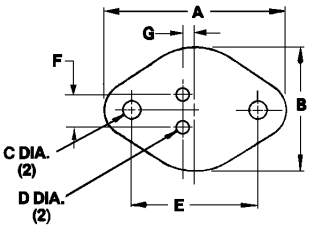


Power Module	Part Number Suffix	"A"	"B"	"C"	"D"
	-115	11.99	5.00	4.90	0.79

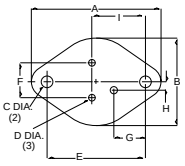


Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-109	34.29	16.31	8.15	4.95	24.38	1.52	3.18

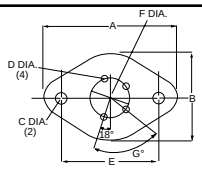
Sil-Pad® Configurations (SI Measurements)



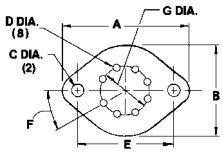
TO-3 Style	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	"E"	"F"	"G"
	-02	45.21	31.75	3.56	2.36	30.15	10.92	1.83
	-03	39.70	26.67	3.56	2.03	30.15	10.92	1.83
	-04	41.91	28.96	3.10	1.57	30.15	10.92	1.83
	-05	41.91	28.96	3.56	2.36	30.15	10.92	1.83
	-06	41.91	28.96	4.19	1.57	30.15	10.92	1.83
	-07	45.21	31.75	4.19	2.39	30.15	10.92	1.83
	-10	36.58	25.40	3.56	1.90	24.38	5.08	2.54
	-11	33.32	19.35	3.56	1.57	24.38	5.08	2.54
	-15	45.21	31.75	3.56	1.17	30.15	10.92	1.83
	-16	52.58	39.62	3.10	1.57	30.15	10.92	1.83
	-17	41.91	28.96	3.56	1.17	30.15	10.92	1.83
	-18	39.70	26.67	3.56	3.56	30.15	10.92	1.83
	-23	40.46	27.94	3.96	1.57	30.15	10.92	1.83
	-24	43.18	30.15	3.96	1.57	30.15	10.92	1.83
	-29	41.91	27.05	3.56	1.17	30.15	10.92	1.83
	-30	31.75	17.78	3.56	1.57	24.38	5.08	2.54
	-31	34.92	20.96	3.56	1.57	24.38	5.08	2.54
	-59 Leadless	41.91	28.96	4.19		30.15		
	-112	45.21	31.70	4.19	1.60	30.10	10.90	1.85
	-113	39.70	26.70	4.19	2.01	30.10	10.90	1.85
	-127	33.20	20.80	4.19	1.60	23.09	5.99	1.55
	-129	42.01	27.00	3.51	1.50	30.00	11.00	1.80
	-135	41.91	29.01	4.19	3.61	30.15	10.90	1.83



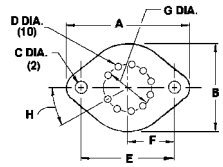
3 Lead TO-3	Part Number Suffix	Dimensions "A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"
	-92	41.91	28.96	3.56	2.36	30.15	10.92	10.16	3.94	18.24



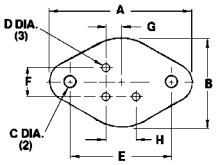
4 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-86	39.62	26.67	3.96	2.03	29.72	11.94	72°
	-87	39.70	26.67	3.96	1.60	30.15	11.94	72°



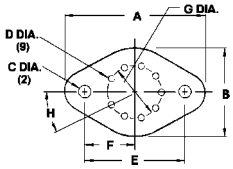
8 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"
	-88	42.04	30.15	3.96	1.52	30.15	40°	12.70



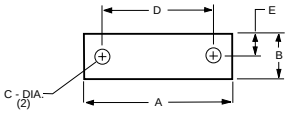
10 Lead TO-3	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-91	41.91	28.96	4.19	1.02	30.15	15.06	12.70	32.7°



3 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
	-85	32.38	19.05	3.96	2.54	24.38	5.08	2.54	5.08



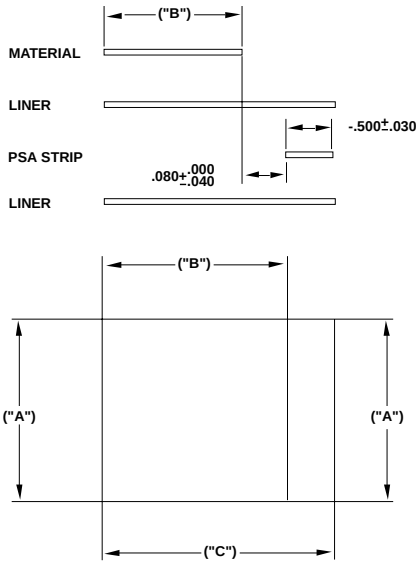
9 Lead TO-66	Part Number Suffix	"A"	"B"	"C"	"D"	"E"	"F"	"G""H"
	-83	36.58	25.40	3.56	1.40	24.38	12.19	8.26	36°



Power Module	Part Number Suffix	"A"	"B"	"C"	"D"	"E"
	-130	40.64	12.19	4.19	30.40	6.10

Hi-Flow® Configurations

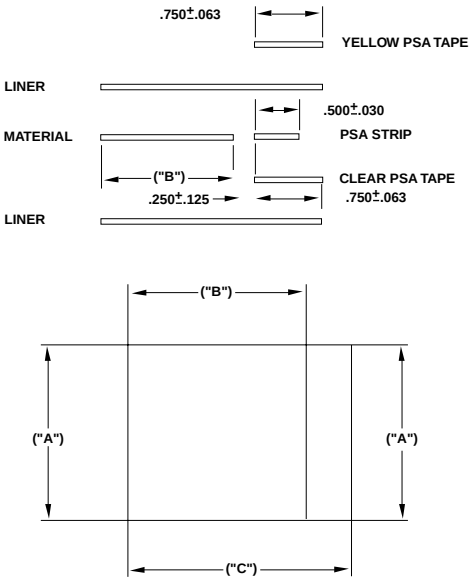
Hi-Flow 225U



Configurations

Part Number	"A" +/-.015	"B" +/-.015	"C" +/-.015	MIN. PCS/ROLL
BG409490	1.500	1.500	2.500	5000
BG410344	1.378	1.378	2.378	5000
BG411198	1.250	1.250	2.250	5000
BG410345	1.000	1.000	2.000	7500
BG410346	.700	.700	1.700	10000
BG410347	.500	.500	1.500	15000
BG411444	.300	1.000	2.000	22500

Hi-Flow 225UT



Configurations

Part Number	"A" +/-.015	"B" +/-.015	"C" +/-.015	MIN. PCS/ROLL
BG411595	1.650	1.650	2.650	3000
BG411594	1.500	1.500	2.500	5000
BG411550	1.375	1.375	2.375	5000
BG411549	1.250	1.250	2.250	5000
BG411548	1.000	1.000	2.000	7500
BG411547	.700	.700	1.700	10000
BG411546	.500	.500	1.500	15000

Hi-Flow 225F-AC

HF 225F-AC Die Size Minimum, 0.7 x 0.7 inches.

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