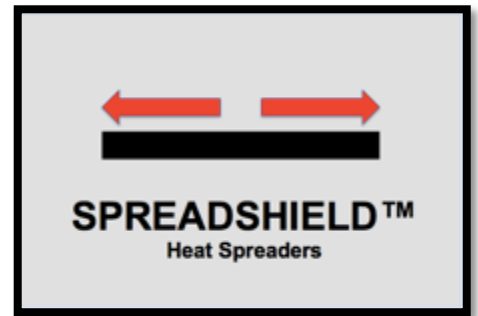
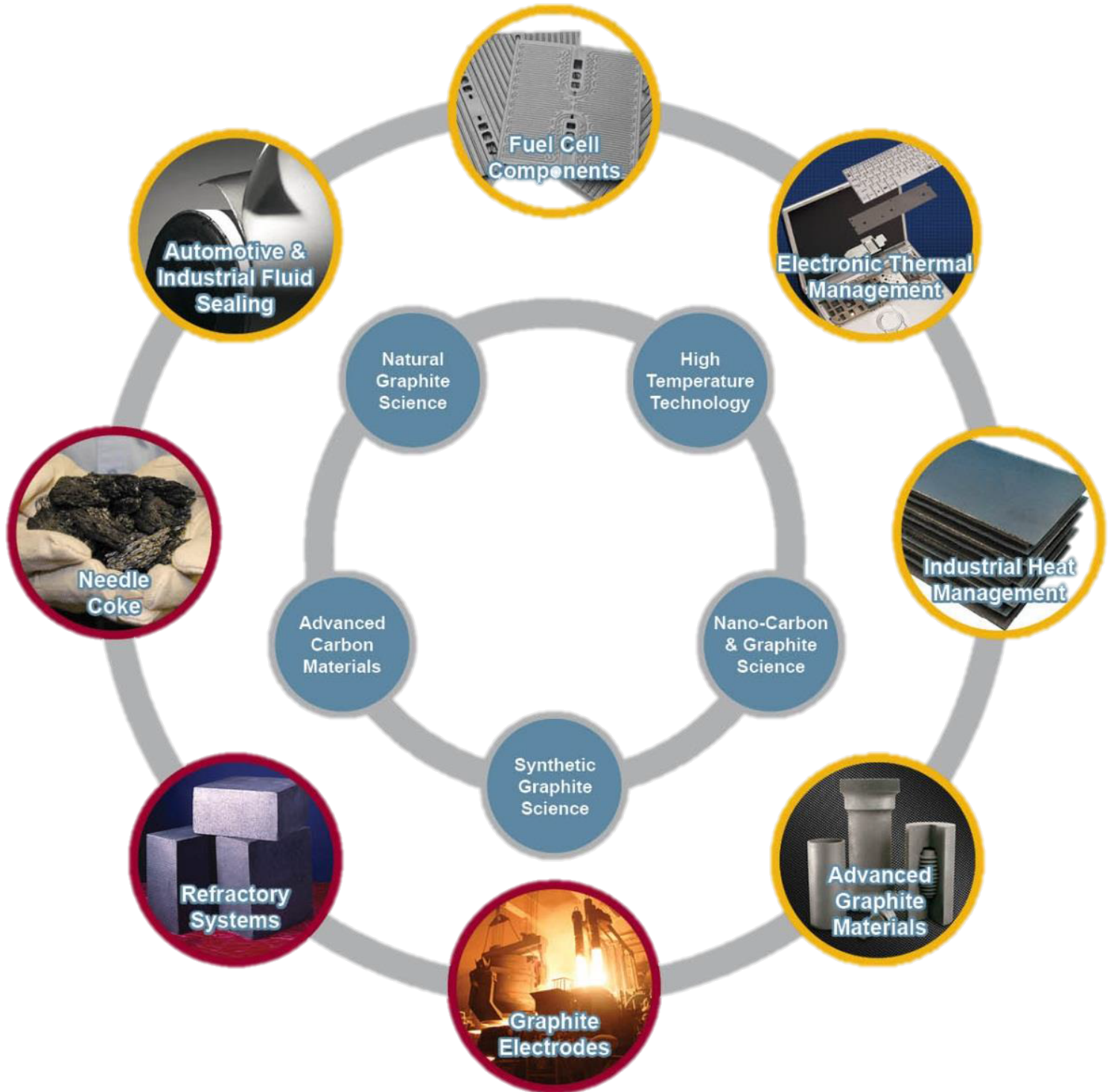


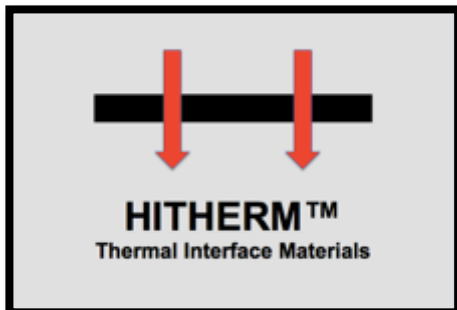
eGRAF® Flexible Graphite



Redefining Limits



Revolutionary Thermal Management Solutions



eGRAF® HITHERM™ HT-1200 series & HT2500 series thermal interface materials are designed for use in applications requiring low contact resistance and high thermal conductivity. The flexible graphite materials can be die-cut and/or laminated with electrically & thermally conductive silicone rubber, polyurethane sponge, plastics and adhesives.

Other innovative integration designs using eGRAF® are made possible at Everjoy Industrial Supplies Pte. Ltd. Contact

technical_support@everjoy.com.sg or salesmgnt@everjoy.com.sg

Characteristic	Unit	Pure Graphite	Polymer Enhanced
		HT-1200 Series	HT-2500 Series
Thermal Impedance @ 200 kPa	K-cm ² /W	HT-1205 = 0.59 HT-1210 = 0.66	HT-2505 = 0.41 HT-2510 = 0.58
Thermal Impedance @ 700 kPa	K-cm ² /W	HT-1205 = 0.30 HT-1210 = 0.40	HT-2505 = 0.24 HT-2510 = 0.41
Typical Thermal Conductivity ^[2] @ 700 kPa Through-Plane • In-Plane	W/m-K	10 • 150	16 • 120
Typical Thickness with Tolerance 0.127 mm (0.005") ± 10% 0.25 mm (0.010") ± 5% 0.51 mm (0.020") ± 5%	-	HT-1205 HT-1210 HT-1220*	HT-2505 HT-2510 -
Electrical Resistivity ^[3] In-Plane • Through Thickness	μΩm	60 • 1230	80 • 1550
Hardness (Shore A)		85	
Coefficient of Thermal Expansion (CTE) In Plane • Through-Plane	ppm/°C	-0.4 • 27.0	
Flammability Rating	UL	94V-0	
Operating Temperature	°C	-40 to +400	-25 to +125
Specific Heat @ 25°C	J/g-°C	0.77	
RoHS Compliant	-	Yes	
Lead / Halogen Free	-	Yes	

HITHERM™ Thermal Interface Materials - Adhesive Coating Option

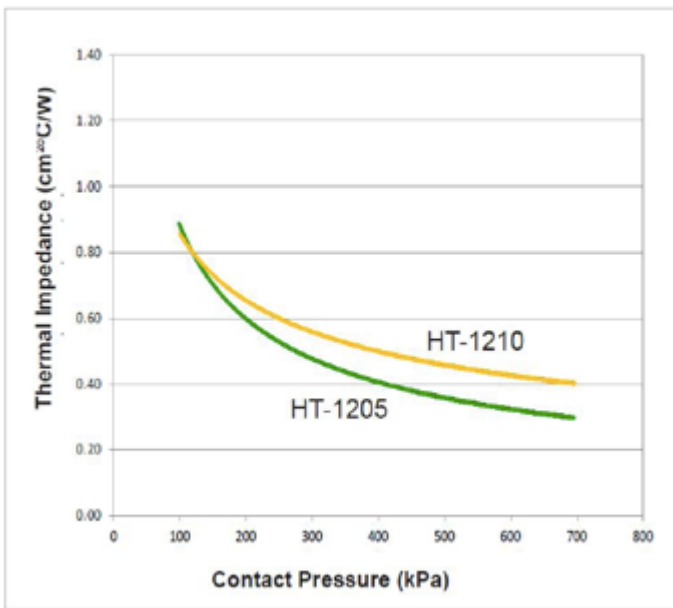
Characteristic	Adhesive "A" Coating*
Nominal Thickness (mm • inches)	0.008 • 0.0003
Operating Temperature (°C)	-40 to +150
Thermal Impedance ^[4] per Side (cm ² °C/W @ 110 kPa)	0.16
Thermal Conductivity (W/m-K)	-
Dielectric Strength (V)	-
Adhesive Strength ^[5] (g/cm ²)	700 Typical 450 Minimum

Notes:

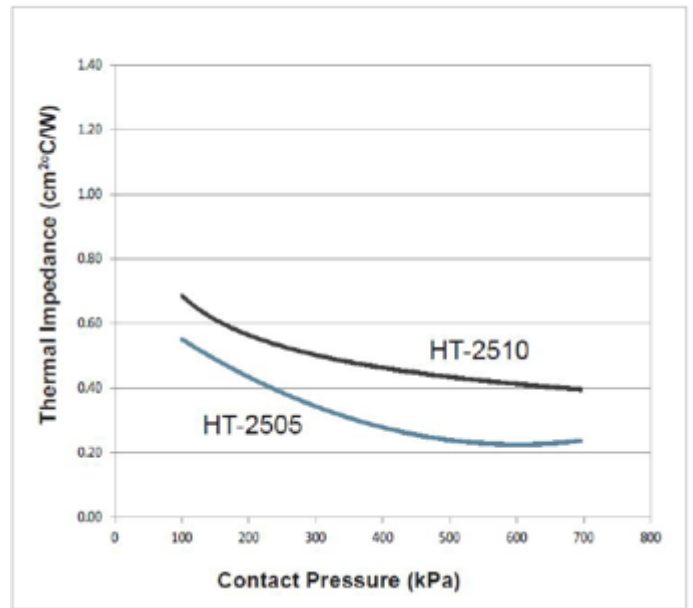
- Properties listed are typical and should not be used to write specifications. Users are to test product suitable for their application.
- In-Plane conductivity at ambient temperature is determined using Angstrom's Method.
- Through-Plane conductivity is determined using ASTM D5470 Modified Method.
- ASTM C611.4 Point Resistivity Test.
- ASTM D5470 Modified (at 110kPa/16psi/1.1bar). Total thermal impedance = thermal impedance of graphite + thermal impedance of coating.
- Adhesive strength is based on a lap shear test (ASTM D3163) with material adhering to a glass plate.

Thermal Impedance vs. Interface Pressure

HITHERM™ 1200 Series



HITHERM™ 2500 Series



eGRAF® HITHERM™ HT-C3200 thermal interface materials are designed for use in applications requiring large surface, high contact pressure, high performance, low contact resistance and high thermal conductivity. This flexible graphite materials can be die-cut to ensure exact fit while the compressibility of the material improves surface contact for high in-plane thermal conductivity and compensates for up to 100µ of flatness (no thickness recovery after compression.)

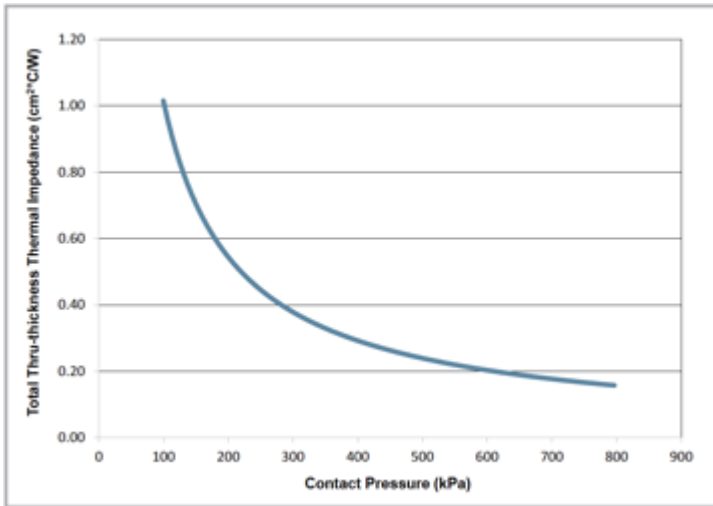
Applications

Power modules such as IGBT, RF devices used in:

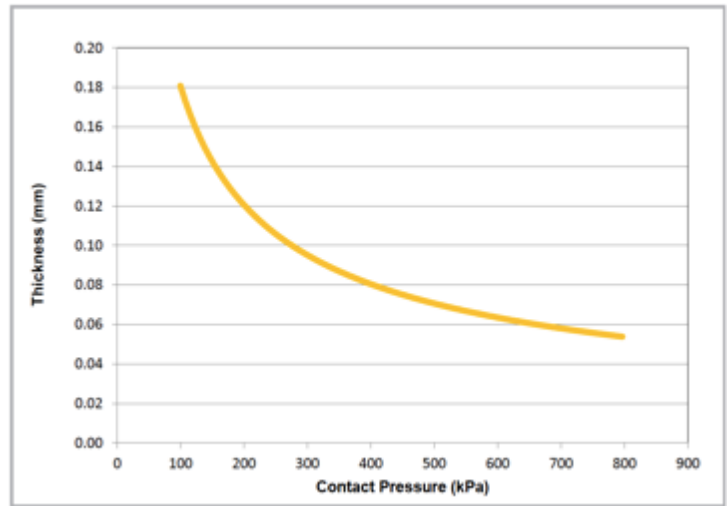
- UPS and inverters
- Motor drives
- Base stations
- Power supply modules, rectifiers and chargers

Characteristic	Unit	Typical Value
Thermal Impedance @ 200 kPa (K-cm²/W)	K-cm²/W	0.49
Thermal Impedance @ 700 kPa (K-cm²/W)	K-cm²/W	0.18
Typical Thermal Conductivity ^[2] @ 700 kPa Through-Thickness • In-Plane	W/mK	7 • 800
Typical Starting Thickness	µm inches	200 ± 20 0.008 ± 0.001
Coefficient of Thermal Expansion Through-Thickness • In-Plane	ppm/°C	27 • -0.4
Electrical Conductivity Through-Thickness • In-Plane	S/cm	5 • 19,000
Flammability Rating (UL)	-	Compliant
Operating Temperature	°C	-40 to +400
Specific Heat @ 25°C	J/g-°C	0.80
RoHS Compliant	-	Yes
Halogen Free	-	Yes

Thermal Impedance Vs. Pressure HT C3200



Thickness Under Pressure HT C3200



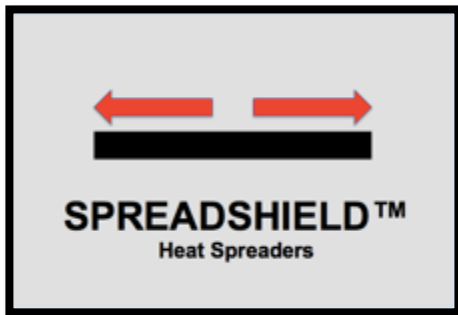
HITHERM™ HT C3200 Applied IGBT Modules

Manufacturer	Module*	GrafTech Part Number
Fuji Electric	62mm	G10118
	Dual XT	G10020
	PrimePACK™ 2	G10019
	PrimePACK™ 3	G10018
Infineon	62mm	G10118
	EconoDUAL™ 3	G10020
	EconoPACK™ 4	G10121
	PrimePACK 2	G10019
	PrimePACK 3	G10018
Semikron	SEMIPACK®	G10118
	SEMITRANS® 3	G10118
	SEMITRANS® 4	G10118
	SEMITRANS® 5	G10118
	SEMiX® 3p/3s	G10020
	SEMiX® 5	G10121
Various	SOT-227	Coming Soon

* Modules listed above are for reference only. Please contact salesmgnt@everjoy.com.sg regarding modules not listed above.

EconoPACK™+ and PrimePACK™ are registered trademarks of Infineon Technology AG, Germany.

SEMiX, SEMITRANS, and SEMIPACK are registered trademarks of Semikron Elektronik GmbH & Co. Kg.



eGRAF® SPREADERSHIELD™ flexible graphite products function as both a passive heat spreader and heat shield. These products offer a variety of in-plane thermal conductivity solutions. The flexible graphite materials can be die-cut, press-formed, or laminated with all polymers, plastics and/or adhesives.

SPREADSHIELD™ flexible graphite are available with a choice of Natural or Synthetic series.

SPREADSHIELD™ Natural Graphite Series

Characteristic	SS300	SS350	SS400	SS500	SS600
Typical Thermal Conductivity ^[3] In-Plane • Through-Plane (W/m-K)	300 • 4.5	350 • 4.1	400 • 3.7	500 • 2.8	600 • 3.5
Thickness Capability Range ^[2] (mm)	0.94 ↕ 0.51	0.94 ↕ 0.127	0.94 ↕ 0.040	0.76 ↕ 0.076	0.127 0.102
Typical Roll Thickness ^[2] (mm) • Typical Roll Width (mm) <i>Width of graphite material only, finished roll width will slightly decrease with coating and adhesive options</i>	0.94 • 610 0.51 • 1000	0.94 • 610 0.48 • 610 0.20 • 610	0.94 • 610 0.51 • 584 0.25 • 584 0.20 • 610 0.127 • 610 0.076 • 559 0.051 • 355 0.040 • 355	0.76 • 305 0.40 • 508 0.20 • 457 0.127 • 440 0.076 • 400	0.127 • 182 0.102 • 182
Thermal Contact Impedance Per Side (°C cm²/W) @ specified thickness (mm)	0.30 @ 0.51	0.34 @ 0.51	0.38 @ 0.51	0.90 @ 0.102	0.44 @ 0.102
Tensile Strength (MPa)	-	-	9.7	7.7	9.7
Electrical Resistivity In-Plane (μΩm)	6.5	5.8	5.2	4.2	3.4
Electrical Conductivity In-Plane • Through-Plane (S/cm)	1,600 • 28	1750 • 23	1,900 • 18	2,400 • 15	2,900 • 10
Coefficient of Thermal Expansion (ppm/°C) In-Plane • Through-Plane	-0.4 • 27.0				
Specific Heat ^[4] (J/g°C) @ 50°C	0.81				
Operating Temperature (°C)	-40 to +400				
UL Flammability Rating	94V-0				
RoHS Compliant	Yes				
Lead / Halogen Free	Yes				

Die-Cut Edge Options	{Blank}	EN
Description	Flush Edge Cut	Envelope Seal
Diagram		

SPREADSHIELD™ Synthetic Graphite Series

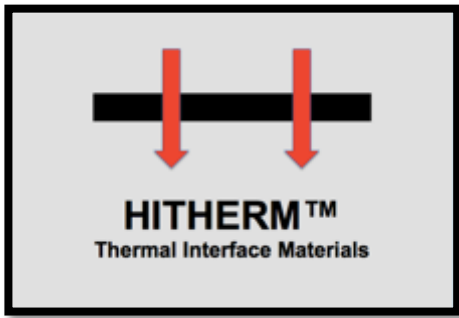
Characteristic		TG-826ACR	TG-827CR	TG-828CR	TG-829CR	TG-818
Thickness (mm)		0.017 ±0.003	0.025 ±0.005	0.032 ±0.005	0.040 ±0.005	0.050 ±0.010
Typical Roll Dimensions	Width (mm)	200	200 240	200 240	200	248mm x 390mm Sheets 650 pcs/roll
	Length (m)	100	100 200	100 200	100	
Typical Thermal Conductivity ^[3] (W/m-K) In-Plane • Through-Plane		1600 • 3.4	1500 • 3.4	1400 • 3.4	1350 • 3.4	1400 • 3.4
Tensile Strength (MPa) Machine Direction • Cross-Machine Direction		25 • 20				
Electrical Conductivity (S/cm) In-Plane • Through-Plane @0.025mm		19,000 • 5				
Coefficient of Thermal Expansion (ppm/°C) In-Plane • Through-Plane		-0.4 • 27				
Operating Temperature (°C)		-40 to +400				
UL Flammability Rating		94V-0				
RoHS Compliant		Yes				
Lead / Halogen Free		Yes				

SPREADSHIELD™ Design Options

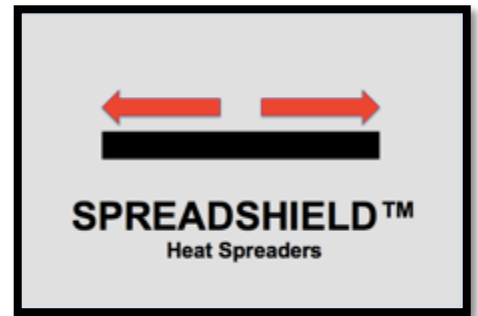
Description	Coating Options				Adhesive Options			
	P1	P22	P0	P7	A1	P1A1	P8A8	P0A0
Coating Thickness ^[4] (mm)	PET Film Coating	PET Film Coating	PET Film Coating ^[1]	Temporary Liner ^[2]	Acrylic Adhesive ^[3]	PET Film Adhesive ^[3]	PET Film Adhesive ^[3]	PET Film Adhesive ^[3]
Coating Thickness ^[4] (mm)	0.025	0.010	0.005 - 0.008	N/A	0.013	0.030 - 0.038	0.010 - 0.012	0.005 - 0.006
Release Liner Thickness (mm) Type	N/A	N/A	N/A	0.05 PET	0.08 Paper	0.08 Paper	0.05 PET	0.05 PET
Dielectric Strength ^[5] (V)	2,800	600	300	N/A	-	2,800	900	300
Operating Temperature (°C)	-40 to +150	-40 to +150	-40 to +100	-40 to +150	-40 to +150	-40 to +150	-40 to +100	-40 to +100
Thermal Contact Impedance ^[6] (°C•cm ² /W) per side	1.6	0.95	< 0.5	N/A	0.16	-	0.42	< 0.5
Thermal Conductivity Through-Thickness (W/m-K)	0.16	0.16	0.16	N/A	-	0.16	0.16	0.16

Notes:

- P0 is most often offered in black matte finished.
- P7 is a temporary liner used exclusively to package sheet of SS1500 into continuous roll and must be defined as the bottom coating type (GP7") for SS1500 if no other coating is specified.
- Adhesive of "A1" and "P1A1" are 700 g/cm² and 1100 g/cm² respectively based upon lap shear test ASTM D3163 on a glass plate. Adhesive strength of "P8A8 = 2.64 N/cm per 90° based upon peel adhesion test ASTM D3330 on a glass plate. P0A0 adhesive is best represented by a typical 180° peel strength of 5 N/25mm.
- Coating thickness specified includes adhesive thickness used to bond coatings to graphite.
- ASTM D149-09 Method A.
- ASTM D5470 Modified (at 110kPa/16psi/1.1bar). Total thermal impedance = impedance of graphite + impedance of coating.
- Overlay seal (-OV) is no longer an available sealing option.
- Availability and specified thickness "d" will vary depending upon graphite thickness and coating selected.



eGRAF®
Flexible Graphite

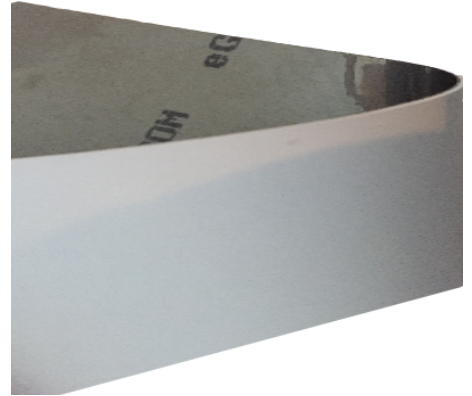


Redefining Limits

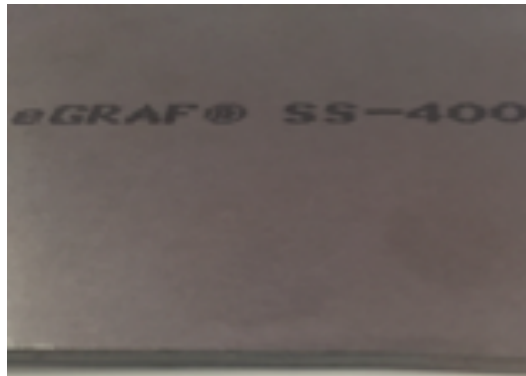
Revolutionary Thermal Management Design Capabilities



400W/m-K Heat Spreader On
Thermally Conductive Silicone Sponge Rubber



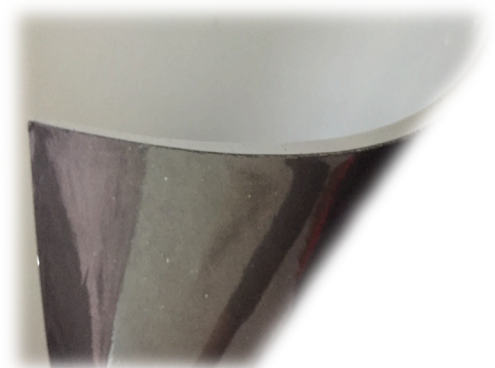
400W/m-K Heat Spreader On
Thermally Conductive Solid Silicone Rubber



400W/m-K Heat Spreader On
Thermally Conductive Silicone Free Rubber

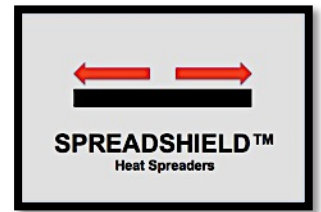
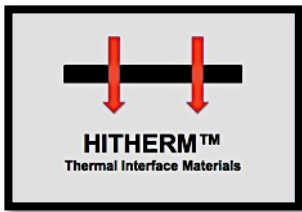


400W/m-K Heat Spreader On Non Conductive
Closed Cell Silicone Sponge Rubber



400W/m-K Heat Spreader On Non Conductive
Tear Resistant Solid Silicone Rubber

Other Composite Designs Available



Market Applications

Consumer Electronics



Scientific Camera



OLED • LED Display



Projector



SSD Module



Mobile Devices

Automotive



Infotainment Controls



LED Head Lights & Signal Lights



Bright Edge Lit LED Display



Engine Control Unit

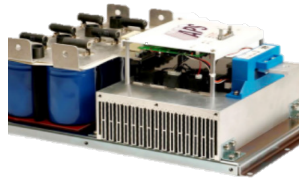


Heated Car Seat

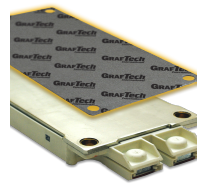
Power Electronics



Outdoor LED Power Supplies



Motor Drives • Power Inverters



IGBT



High Power Ballast

Telecommunications



CPU GPU Thermal Interface



Base Station



Solar Power



Fuel Cell



Wind Power

New Energy

LED



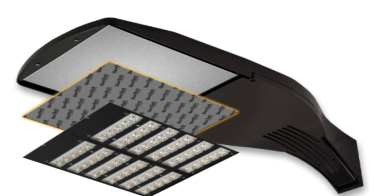
Custom Light Engines



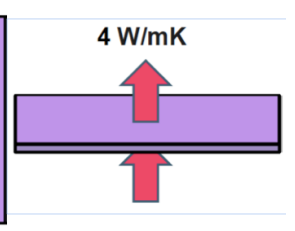
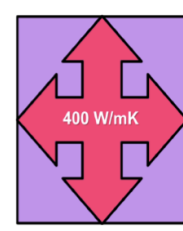
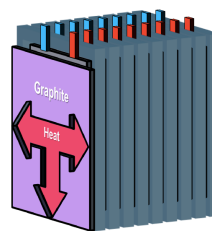
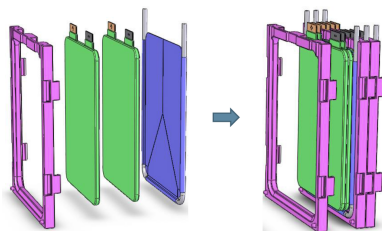
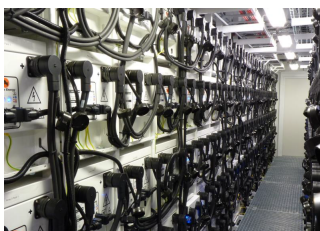
COB High Power Light Arrays



LED Light Pucks



Indoor • Outdoor Light Engine Boards

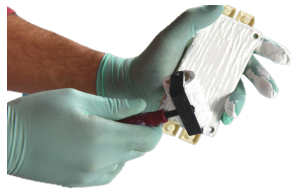


Physical Analysis

Property	No TIM "Dry Joint"	Grease	Silicon Pad	HITHERM™ TIM
Material Price	\$ Surface Finishing	\$	\$ \$ \$	\$ \$
Initial Thermal Performance	Worst	Best	Worst	Good
Long Term Thermal Performance	Worst	Good	Worst	Best
No Upfront Capital Cost (i.e. Dispensing Equipment)	✓	✗	✓	✓
Performance Consistency (Part to part variation)	✗	✗	✓	✓
Reworkable/Field Replaceable	✓	✗	✓	✓
Over 15 year rated life	✗	✗	✗	✓
NASA Outgassing Certified	✗	✗	✗	✓



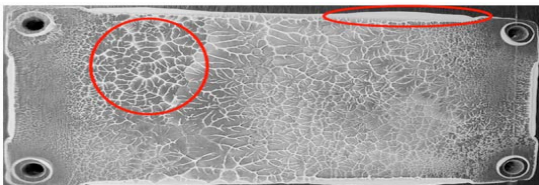
Avoid Expensive Dispensing Equipment and Messy Rollers



Eliminate Dry-Out and Pump-Out Failures



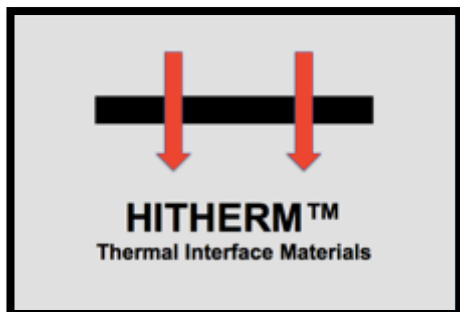
Resolve Your No Fan Issues



Thermal Grease and Phase Change degradation results in thermal failures and maintenance events



IGBT application subjected to temperature cycle testing
Material passed at over 75,000 temperature cycles
No residue or signs of change at teardown



Outlast Your Devices

