P-THERM®

Selection Guide

Thermal Management Materials for
Electronic Device Cooling

POLYMER
SCIENCE, INC.

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ISO 9001:2015

Table of Contents

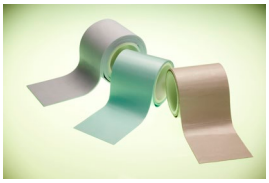
Material Selection Guide

PRODUCT OVERVIEW				PRODUCT PROPERTIES				
Product Type		Part Number	Description	Conductivity (W/m K)	Thickness Range (mm)	Durometer (Shore 00)	Dielectric Breakdown Strength (kV/mm)	Heat Capacity (J/g K)
GAP FILLERS	Pads	PS-1511	1.0 W/m K hyper-soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	1	0.5 - 5.0	<0	8.66	1.43
		PS-1513	3.0 W/m K hyper-soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	3	0.5 - 5.0	14	9.88	0.84
		PS-1541	1.0 W/m K ultra-soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	1	0.5 - 5.0	9	9.36	1.27
		PS-1543	3.0 W/m K ultra-soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	3	0.5 - 5.0	47	6.80	0.83
		PS-1593	3.0 W/m K, 0.25mm ultra-soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	3	0.25	47	8.30	0.80
		PS-2505	5.0 W/m K soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	5	0.5 - 5.0	54	18.00	0.84
		PS-2543	3.0 W/m K soft silicone gap filler with 25 micron PU carrier	3	0.5 - 5.0	47	9.92	0.90
		PS-2563	3.0 W/m K soft silicone gap filler with 25 micron PET carrier and single coated high adhesion acrylic adhesive	3	0.5 - 5.0	47	9.99	0.76
		PS-2622	1.8 W/m K soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	1.8	0.5 - 5.0	29	17.00	0.78
		PS-2641	1.0 W/m K soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	1	0.5 - 5.0	22	12.00	0.97
		PS-2642	2.0 W/m K soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	2	0.5 - 5.0	47	20.00	1.08
		PS-2643	3.0 W/m K soft silicone gap filler with embedded fiberglass support and 125 micron removable PET carrier	3	0.5 - 5.0	41	13.00	0.66
	Dispensables	PS-1931	1.0 W/m K ultra-soft thermally conductive silicone putty supplied as a two-component liquid dispensable	1	--	--	9.36	1.27
		PS-1933	3.0 W/m K ultra-soft thermally conductive silicone putty supplied as a two-component liquid dispensable	3	--	--	6.80	0.83
		PS-1935	5.0 W/m K ultra-soft thermally conductive silicone putty supplied as a two-component liquid dispensable	5	--	--	11.00	1.10
PHASE CHANGE		PS-1595	4.0 W/m K non-silicone, thermally conductive tacky phase change material with siliconized paper release liner	4	0.25	--	15.03	1.09
HEAT SPREADERS		PS-1672	1300 W/m K, 0.15mm copper foil and synthetic graphite heat trilaminate coated with clear acrylic adhesive and black acrylic adhesive	1300	0.15	--	--	--
		PS-1681	400 W/m K, 0.08mm electrically conductive acrylic adhesive multi-laminate with a copper foil carrier and black nano-thermal diffusion coating	400	0.08	--	--	--
		PS-1692	100 W/m K, 0.06mm single coated, conductive acrylic adhesive with a copper foil carrier	100	0.06	--	--	--
		PS-1693	100 W/m K, 0.15mm single coated conductive adhesive with aluminum foil carrier	200	0.15	--	--	--
		PS-1996	1200 W/m K, 0.05mm single coated condutive adhesive with synthetic graphite film carrier	1200	0.05	--	--	--
TAPES AND ADHESIVES		PS-0266	0.55 W/m K, 0.05mm single coated, thermally conductive acrylic transfer adhesive with 54# dense kraft paper release liner	0.55	0.05	--	3.59	1.35
		PS-1651	0558 W/m K, 0.15mm double coated, thermally conductive acrylic adhesive with aluminum foil carrier and siliconized paper release liner	0.55	0.15	--	--	--
		PS-1652	0.55 W/m K, 0.25mm double coated, thermally conductive acrylic adhesive with fiberglass carrier and siliconized paper release liner	0.55	0.25	--	--	--
		PS-1656	0.8 W/m K, 0.13mm double coated, thermally conductive acrylic adhesive with a PET carrier and siliconized paper release liner	0.8	0.13	--	--	--
		PS-1659	0.8 W/m K, 0.25mm double coated, thermally conductive acrylic adhesive with fiberglass carrier and siliconized paper release liners	0.8	0.25	--	--	--

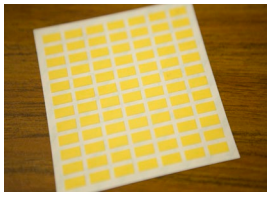
Thermal Management Solutions

Polymer Science is committed to developing high quality sub-components for the electronic device industry. P-THERM® thermal management materials are designed to efficiently and effectively aid in the conduction of heat to meet the growing thermal management requirements of today's advanced electronic designs.

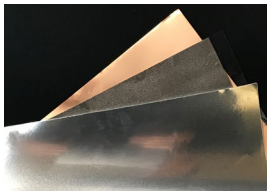
Polymer Science serves multiple industries including consumer electronics, lighting, automotive, marine, electric vehicle, telecommunications and more. Our diverse team of highly skilled engineers and technical staff, in conjunction with our state-of-the-art equipment, provide you with a quality product that is consistent with your application requirements. Our design team works quickly to provide the solutions you need, allowing your project to expeditiously move from conception to commercialization giving you the edge to ensure your next project is a success.



P-THERM® gap filler materials have been designed to achieve desired heat management properties to keep components at optimized operating temperatures in today's advanced electronics designs.

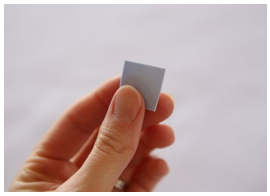


P-THERM® thermally conductive phase change materials perform like thermal grease with the convenience of a thermal pad.



Proper heat dissipation is critical in today's compact electronic devices. P-THERM® heat spreaders allow for quick dissipation of heat in the x-y direction.

All P-THERM® tapes and adhesives offer reliable adhesion and conductive properties across a wide temperature range.



P-THERM® ECIs offer good dielectric and thermally conductive properties without the worry of flow from wax-based products or mess associated with thermal grease.

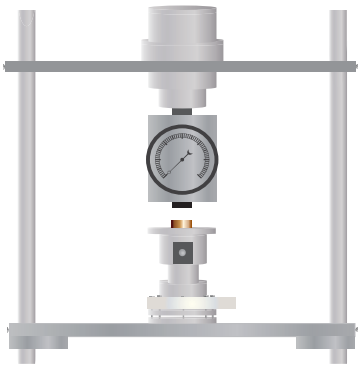
Custom Solutions

***** Specific tests should be performed by the end user to determine the product's suitability for the particular application.**

Thermal Properties and Test Methods

Durometer Testing

Durometer, like many other hardness tests, measures the depth of an indentation in the material created by a given force on a standardized indentor point. This depth is dependent on the hardness of the material, its viscoelastic properties, the shape of the presser foot, and the duration of the test. ASTM D2240 durometers allow for a measurement of the initial hardness or the indentation hardness after a given period of time. The basic test requires applying the force in a consistent manner, perpendicular to the surface being tested without shock, and measuring the hardness (depth of the indentation). If a timed hardness is desired, force is applied for the required time and then read.

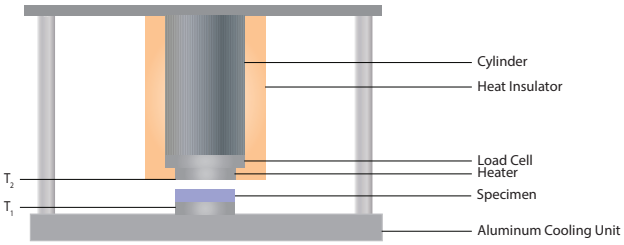


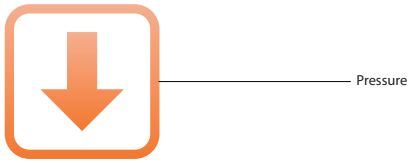
Thermal Resistance - Standard

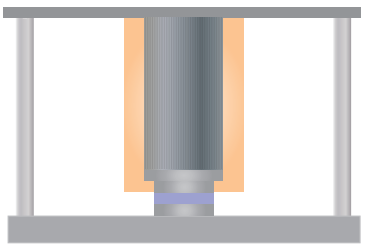
Thermal resistance by definition is a heat property or a measurement of a temperature difference by which an object or material resists a heat flow. Thermal resistance is the reciprocal of thermal conductance.

$$Rt = \frac{T_2 - T_1}{Q} \cdot A = \frac{L}{k}$$

Rt = Thermal Resistance (K m^2/W)
T_1 = Cooling Plate Temperature (K)
T_2 = Heater Temperature(K)
Q = Heat Flow (W)
A = Area of the Compressed Specimen (m^2)
L = Thickness of Specimen (m)
k = Thermal Conductivity (W/m K)







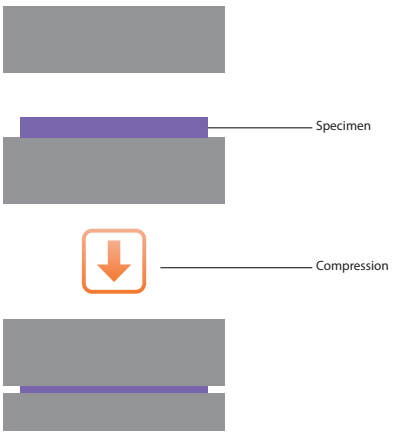
*The measurement by the load

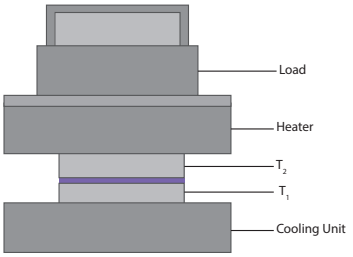
Thermal Conductivity - Modified

Thermal Conductivity - ASTM D5470

$$k = \frac{t_2 - t_1}{R_{t2} - R_{t1}}$$

k = Thermal Conductivity (W/m K)
t_1 = Thickness of Specimen 1 (m)
t_2 = Thickness of Specimen 2 (m)
($t_2 > t_1$)
R_{t1} = Thermal Resistance of Specimen 1 (K m^2/W)
R_{t2} = Thermal Resistance of Specimen 2 (K m^2/W)

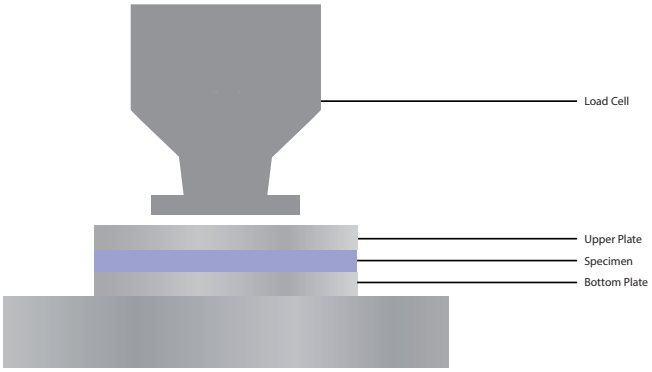




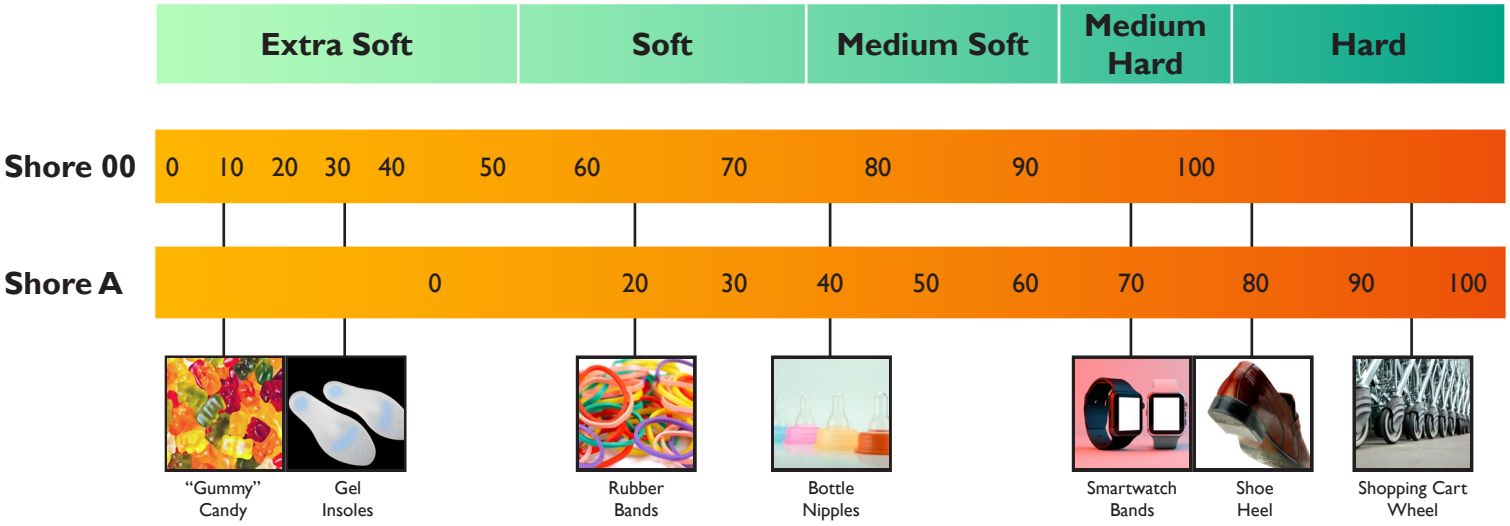
*The measurement by the quantity of compression

Compression Force

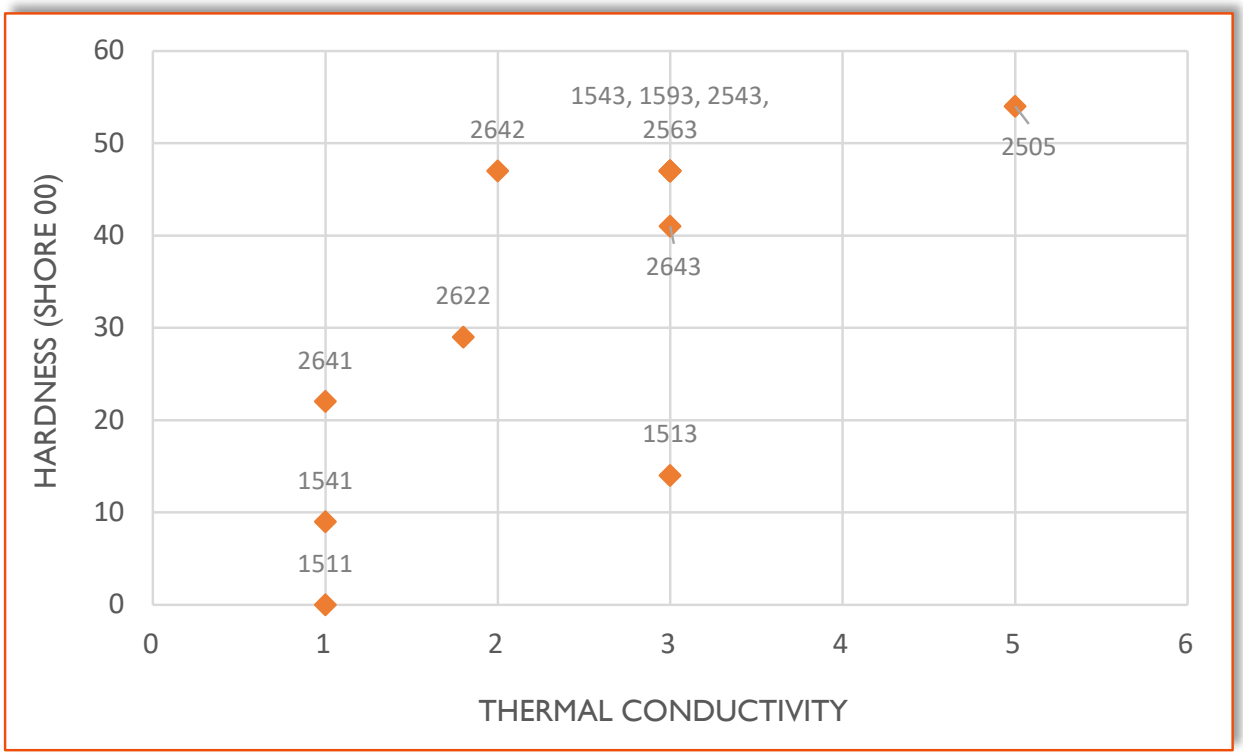
ASTM D575 test method A is a procedure for determining the compression-deflection of rubber compounds (except hard rubber and sponge rubber). ASTM D575 test method A is a compression test in which the force required to cause a specified deflection is determined. Deflection can be described as the change in thickness of the specimen upon application of a compressive force.



Shore Hardness Comparison Chart



Thermal Conductivity vs Hardness



PS-1511

Product Description:

P-THERM® PS-1511 is a hyper-soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

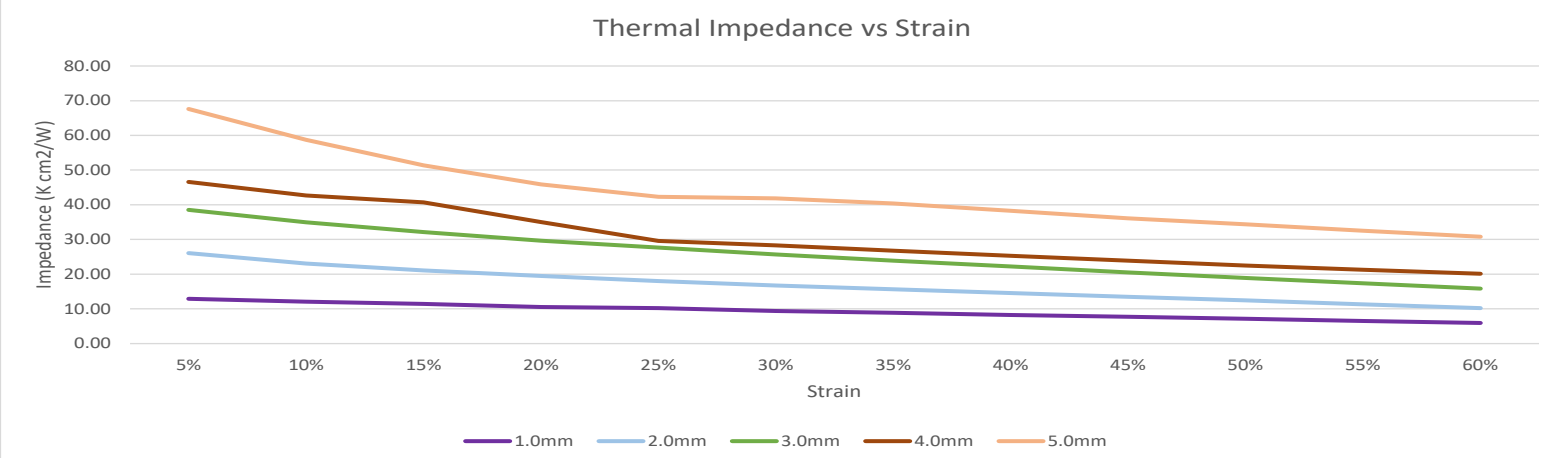
Construction / Properties:

	Property	Value	Test Method
General	Color	Gray	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	1.21	ASTM D792
	Heat Capacity (J/g K) @ 50 C	1.43	ASTM E1269
	Hardness (Shore 00)	<0	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.19%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	8.66	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+18	ASTM D257

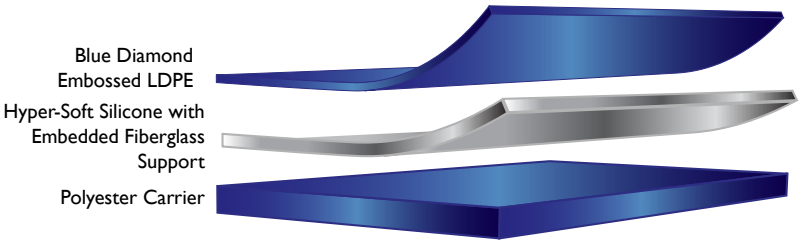
	Property	Value			Test Method
Thermal	Thermal Conductivity	1 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 1mm	12.08	10.56	9.41	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



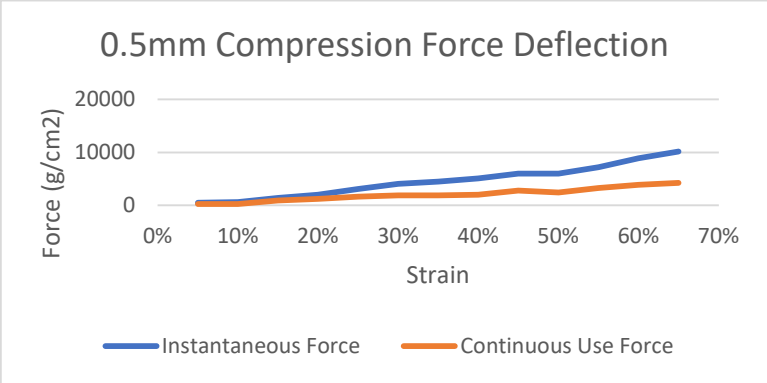
Features:

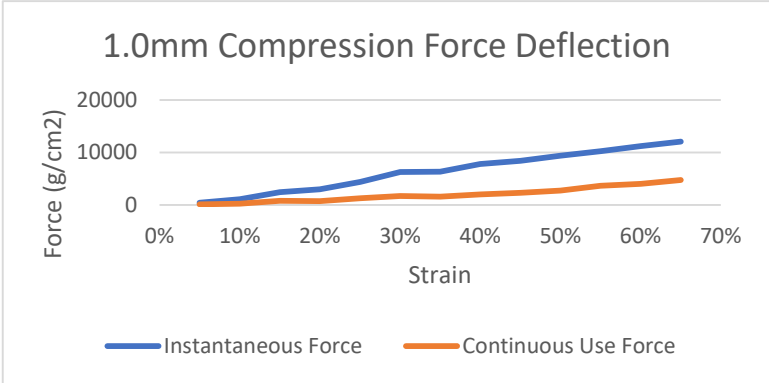
- Good Thermal Conductivity
- Excellent Compression Characteristics
- Excellent Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

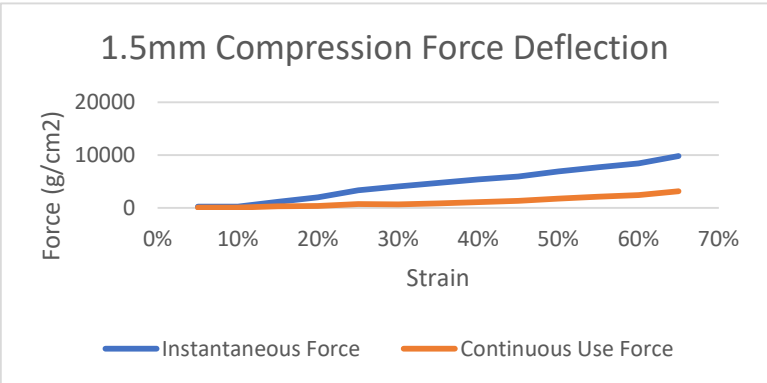


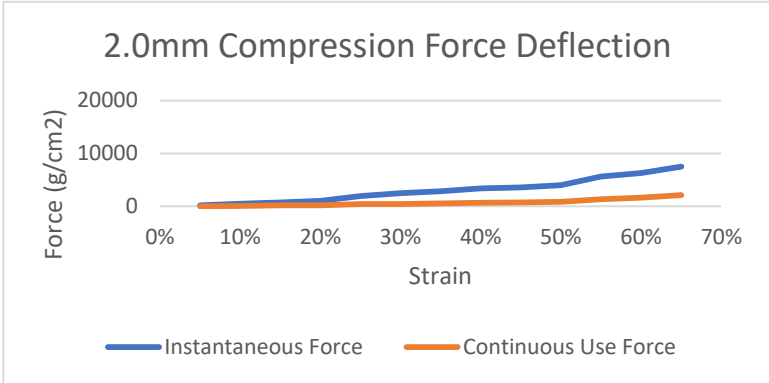
Applications:

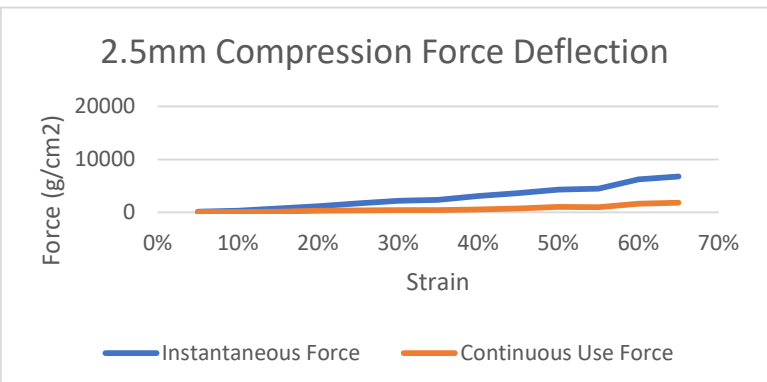
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

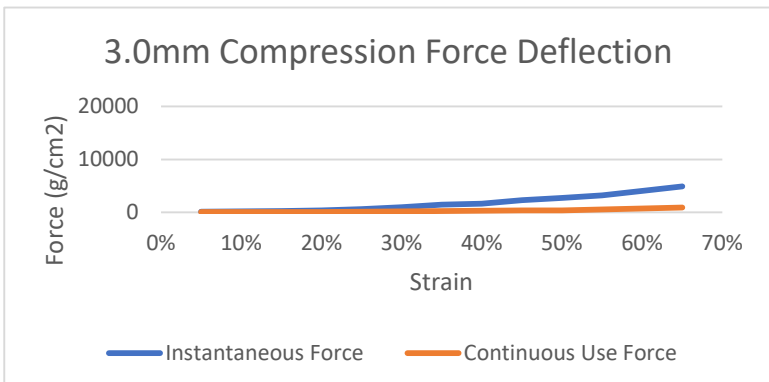












PS-1513

Product Description:

P-THERM® PS-1513 is a hyper-soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

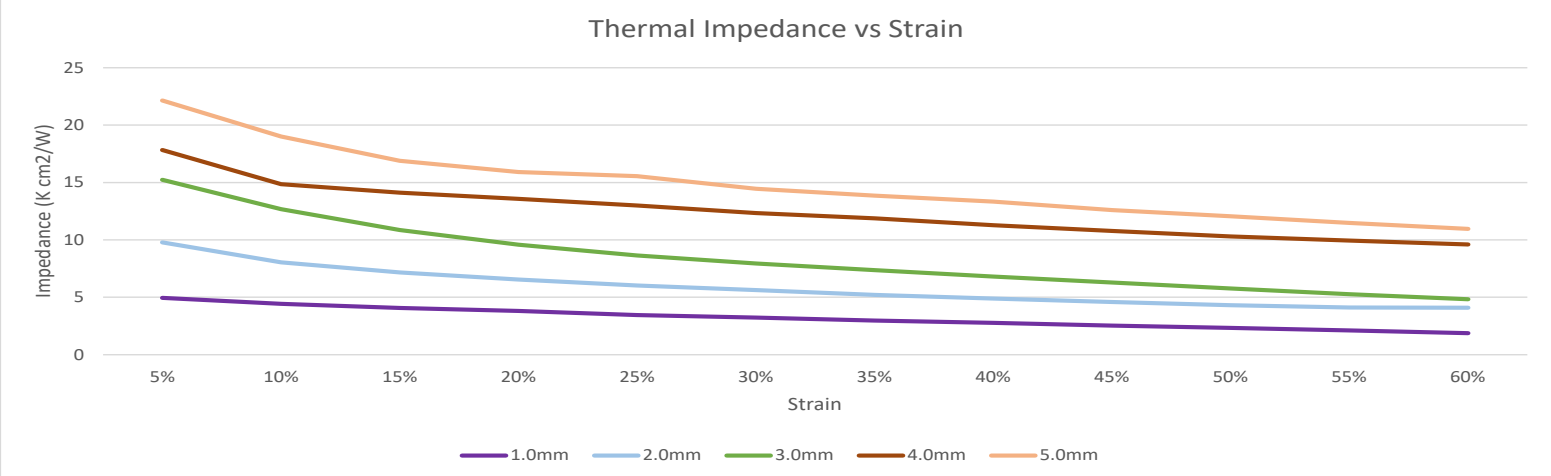
Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	2.51	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.84	ASTM E1269
	Hardness (Shore 00)	14	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.06%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	9.88	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+18	ASTM D257

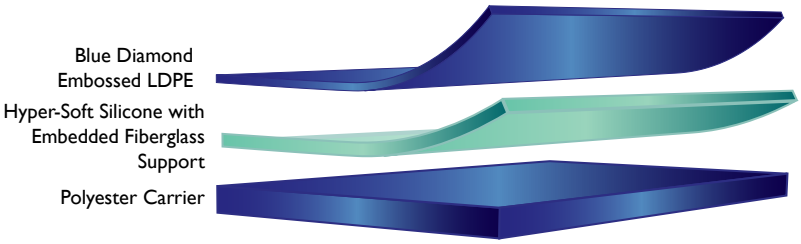
	Property	Value			Test Method
Thermal	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	4.42	3.81	3.23	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



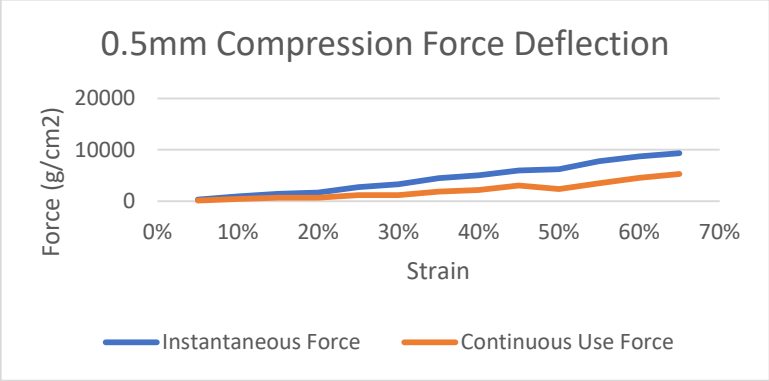
Features:

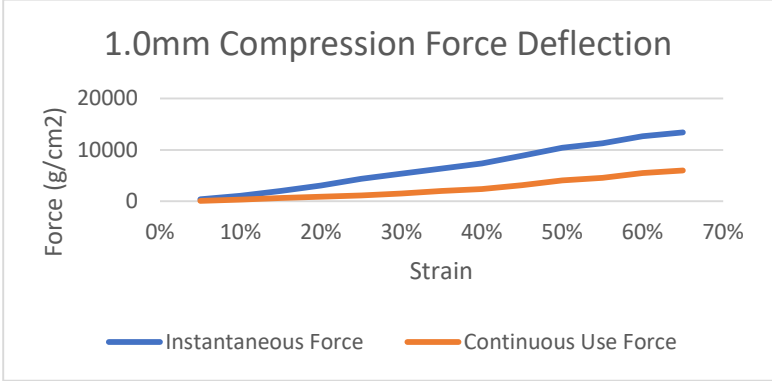
- Good Thermal Conductivity
- Excellent Compression Characteristics
- Excellent Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

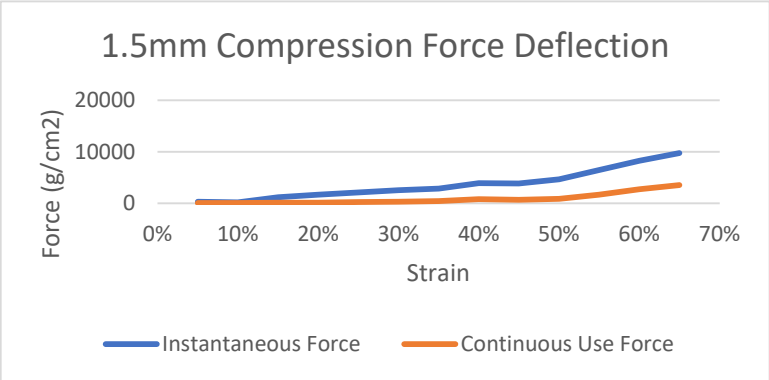


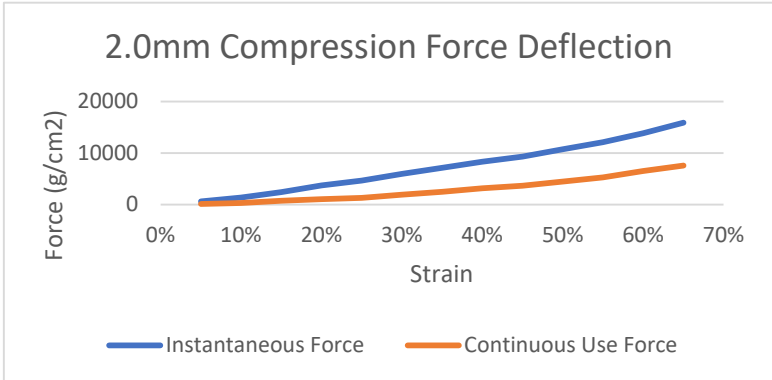
Applications:

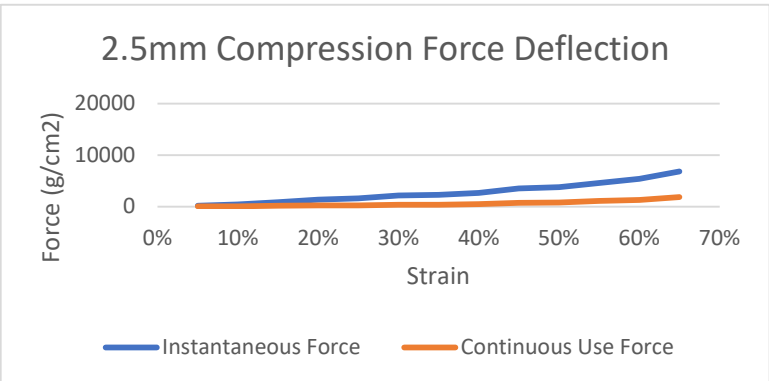
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

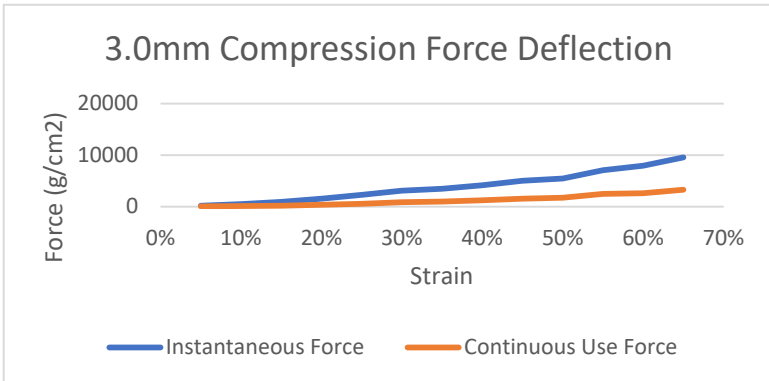












PS-1541

Product Description:

P-THERM® PS-1541 is an ultra-soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

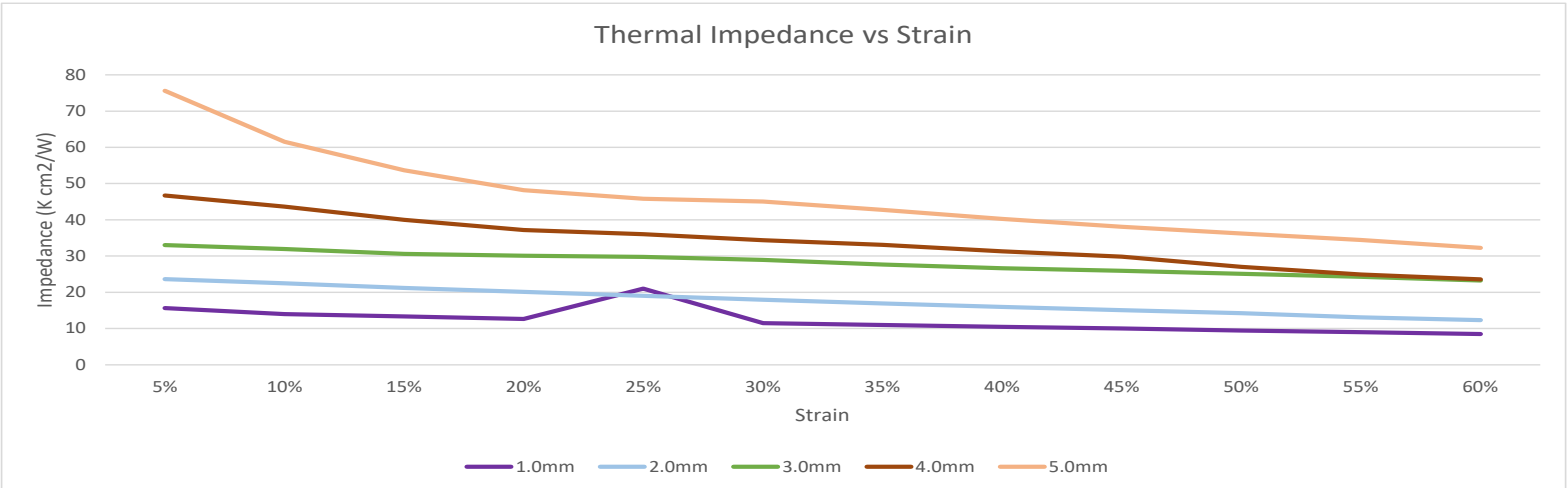
Construction / Properties:

	Property	Value	Test Method
General	Color	Gray	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	1.63	ASTM D792
	Heat Capacity (J/g K) @ 50 C	1.27	ASTM E1269
	Hardness (Shore 00)	9	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.28%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	9.36	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+18	ASTM D257

	Property	Value			Test Method
Thermal	Thermal Conductivity	1 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	13.98	12.65	11.46	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



Features:

- Good Thermal Conductivity
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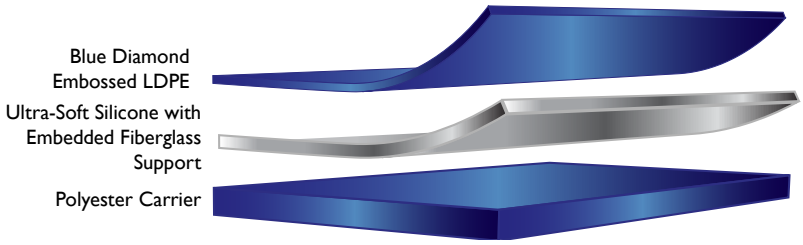

Applications:

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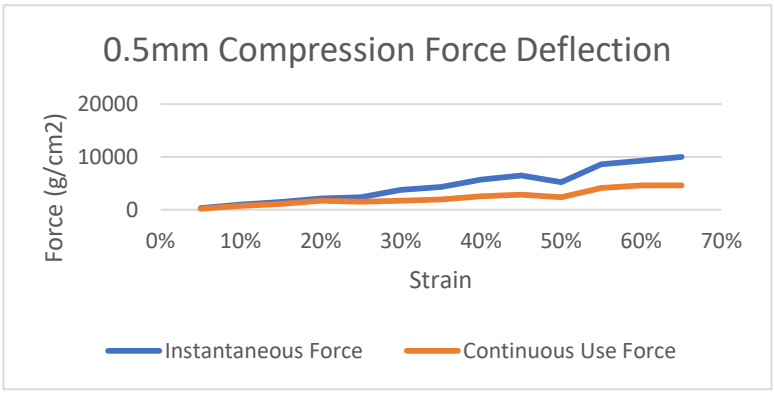
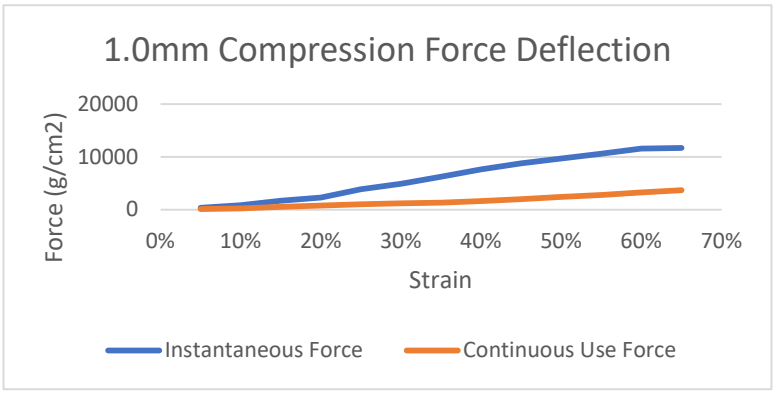
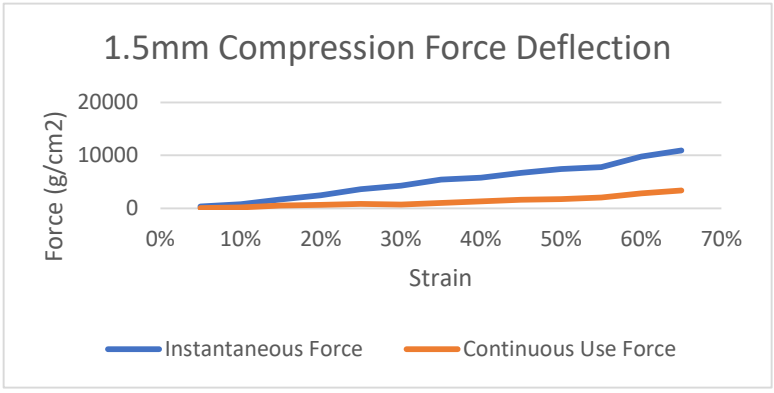
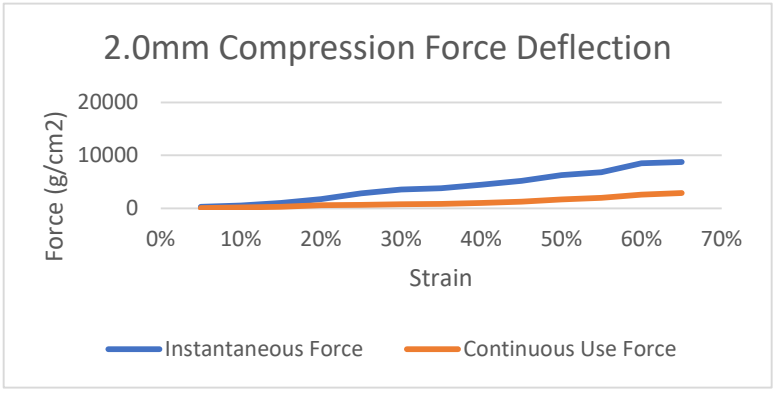
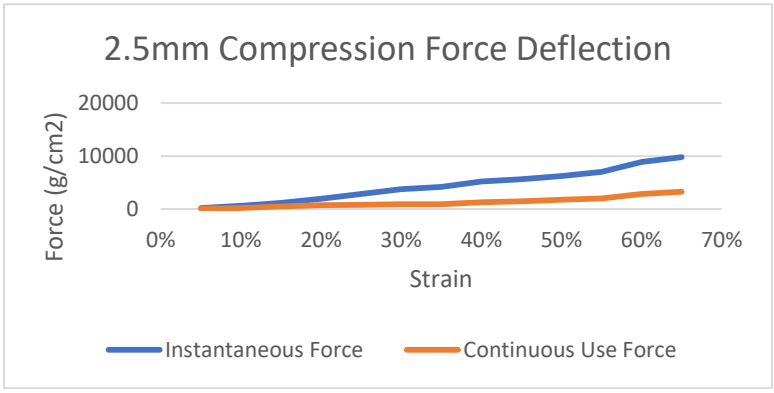
- Digital Personal Assistants
- Automotive Lighting

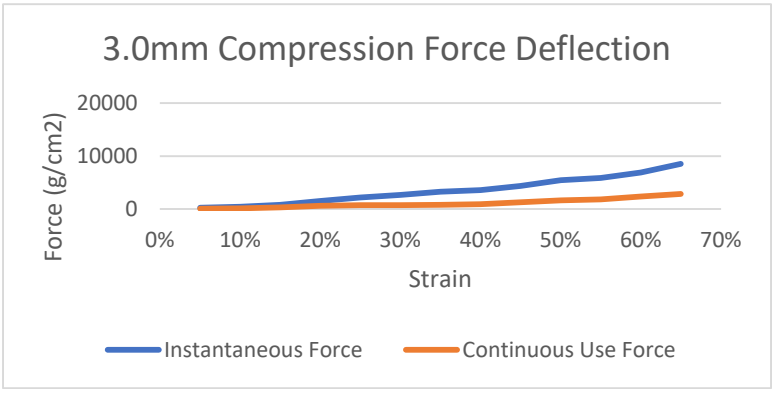












PS-1543

Product Description:

P-THERM® PS-1543 is an ultra-soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

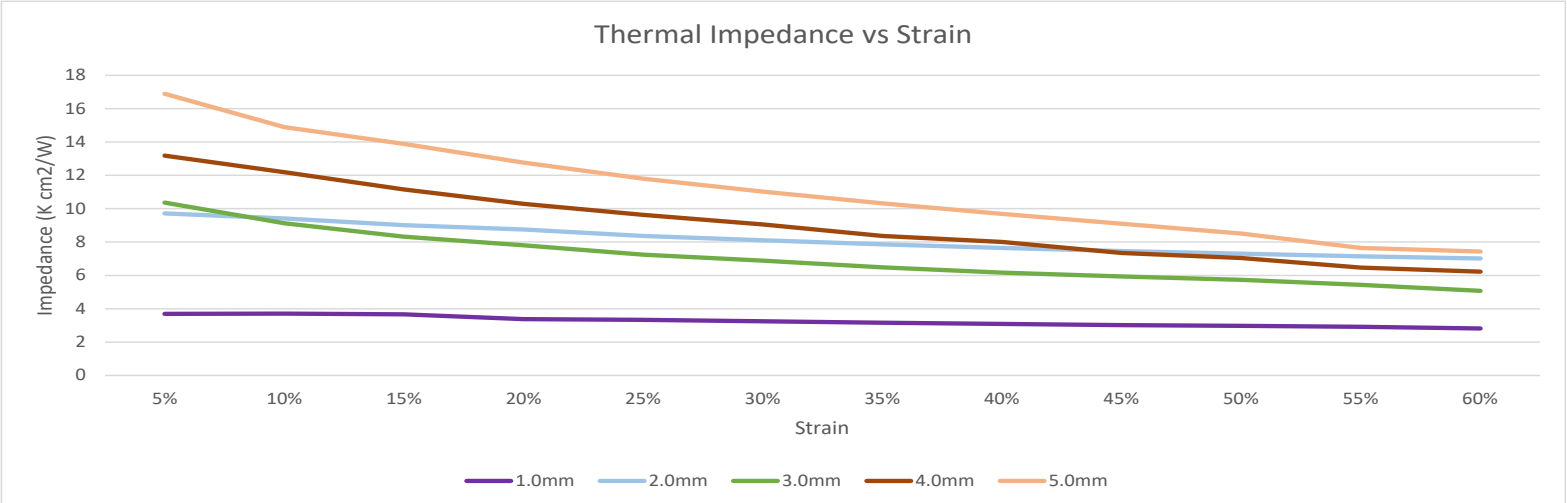
Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	2.44	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.83	ASTM E1269
	Hardness (Shore 00)	47	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.07%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	6.80	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+18	ASTM D257

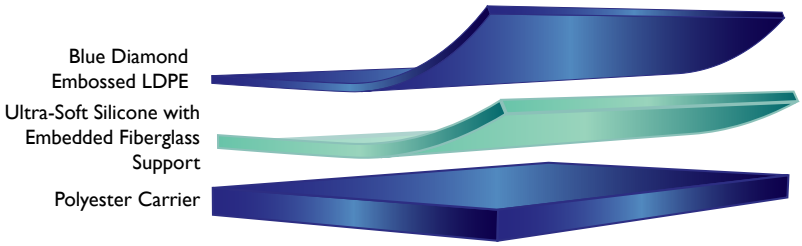
	Property	Value			Test Method
Thermal	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	3.70	3.38	3.25	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



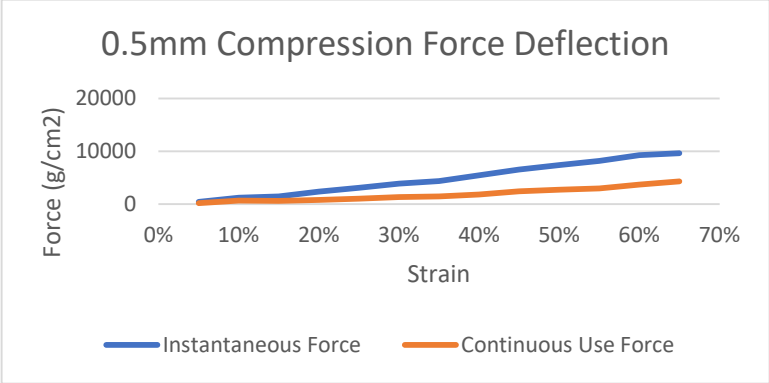
Features:

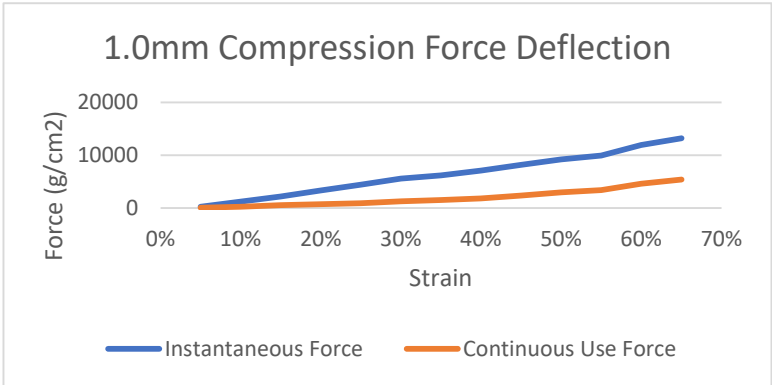
- Excellent Thermal Conductivity
- Excellent Compression Characteristics
- Good Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

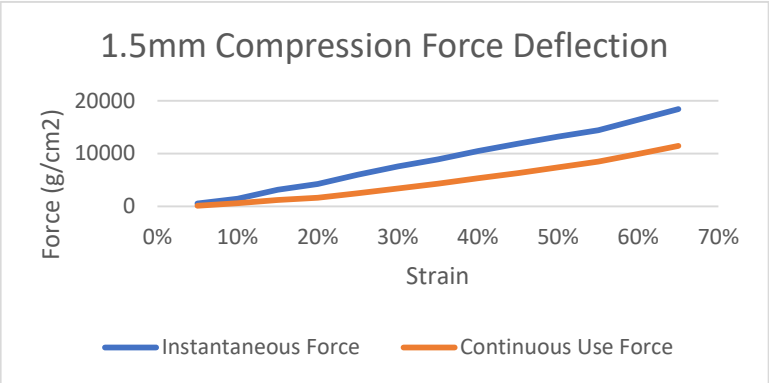


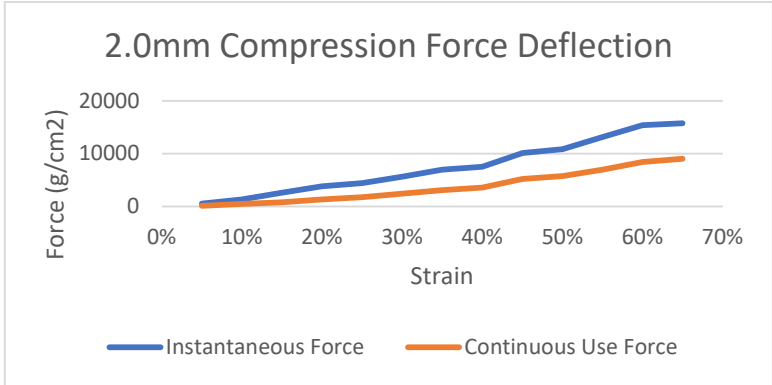
Applications:

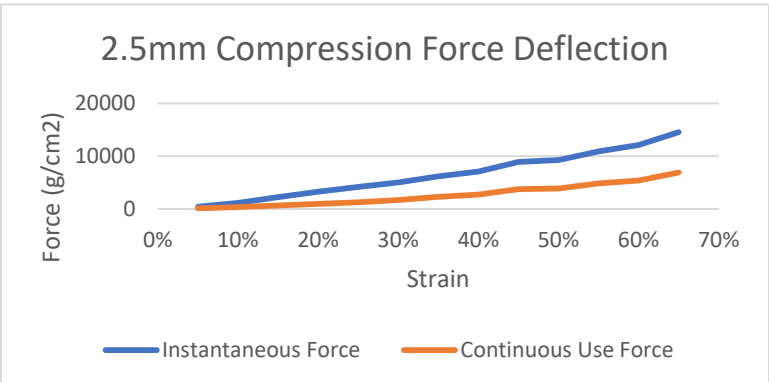
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

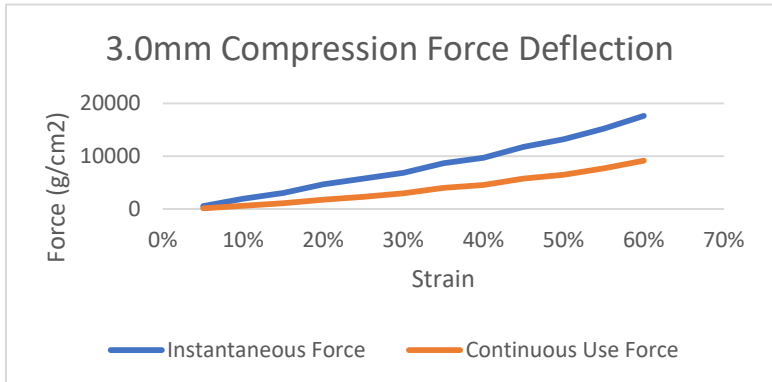












PS-1593-0.25

Product Description:

P-THERM® PS-1593-0.25 is an ultra-soft silicone based thermally conductive gap filler with an embedded fiberglass support. PS-1593-0.25 boasts enhanced flexibility with its lower profile fiberglass dielectric layer over similar products used for thermal management in consumer electronic and automotive applications.

Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Thickness Range	0.25 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	2.44	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.80	ASTM E1269
	Hardness (Shore 00)	47	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.12%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

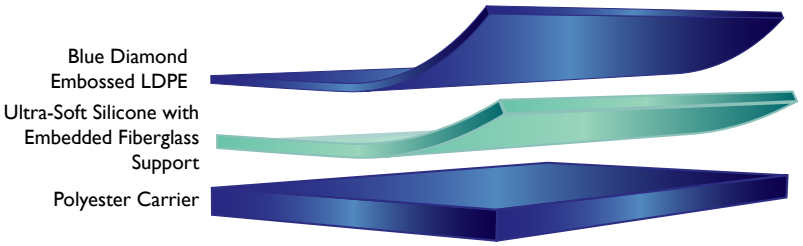
	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	8.30	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+09	ASTM D257

	Property	Value			Test Method
Thermal	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 0.25mm	1.82	1.66	1.57	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.

Features:

- Excellent Thermal Conductivity
- Excellent Compression Characteristics
- Good Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant



Applications:

- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

PS-2505

Product Description:

P-THERM® PS-2505 is a soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

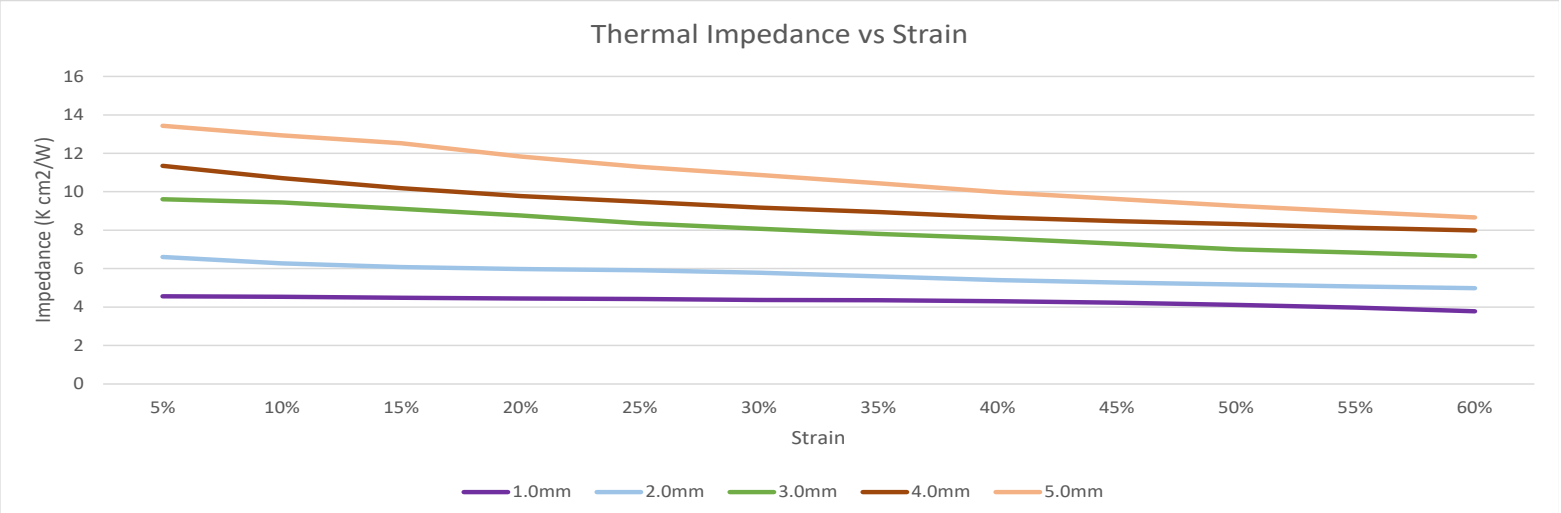
Construction / Properties:

	Property	Value	Test Method
General	Color	Light Gold	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	2.77	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.84	ASTM E1269
	Hardness (Shore 00)	54	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.13%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	18.00	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+12	ASTM D257

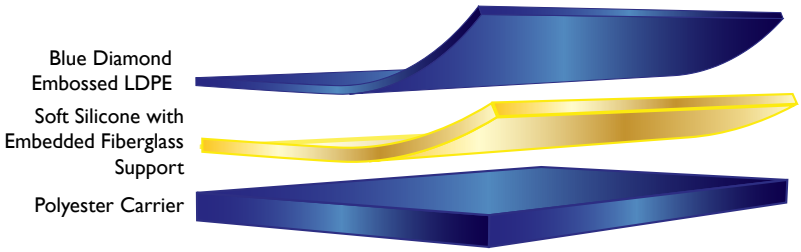
	Property	Value			Test Method
Thermal	Thermal Conductivity	5 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	4.54	4.45	4.37	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



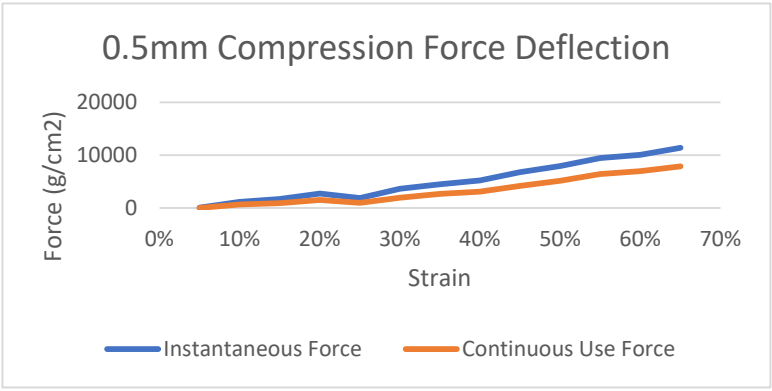
Features:

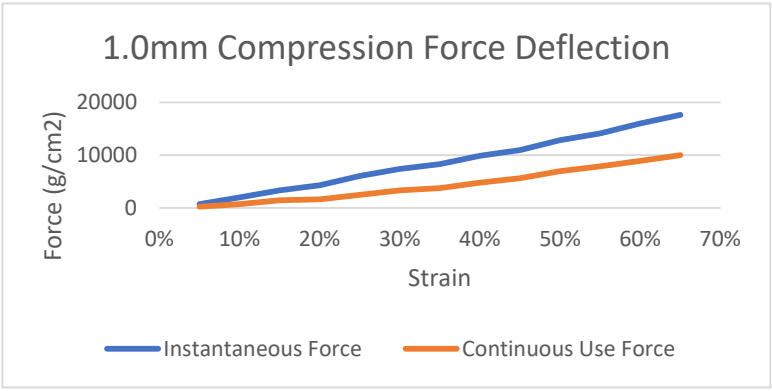
- Superior Thermal Conductivity
- Excellent Compression Characteristics
- Excellent Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

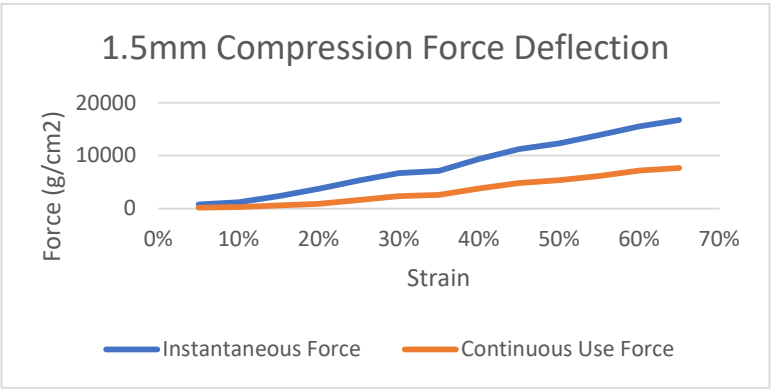


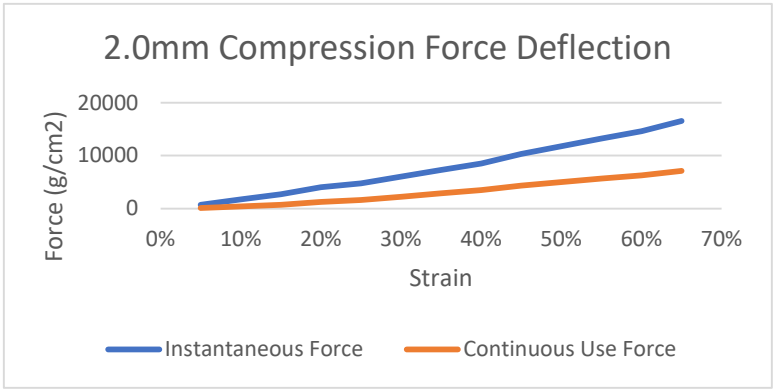
Applications:

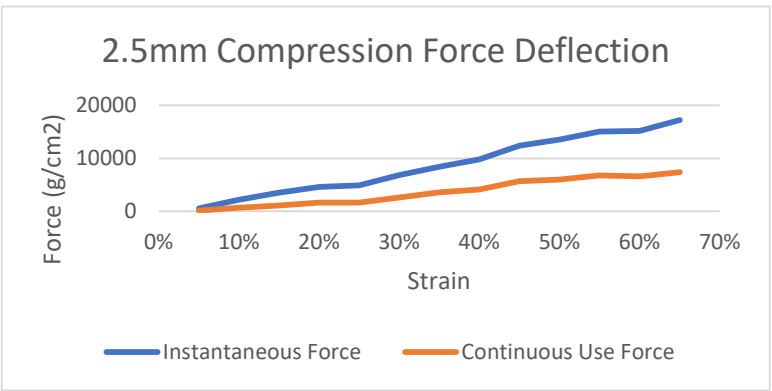
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

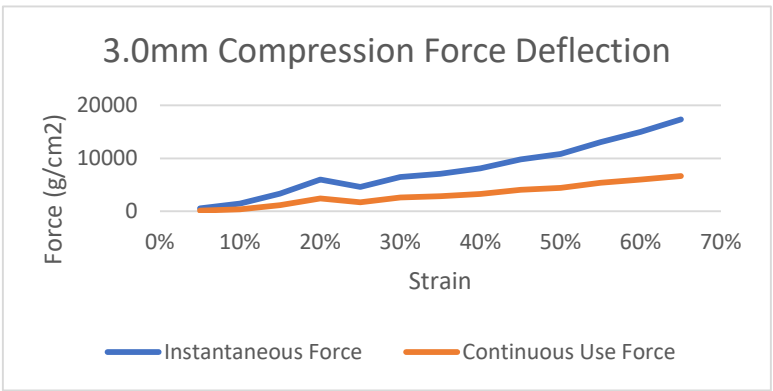












PS-2543

Product Description:

P-THERM® PS-2543 is a soft silicone based thermally conductive gap filler on a 25 micron polyurethane carrier.

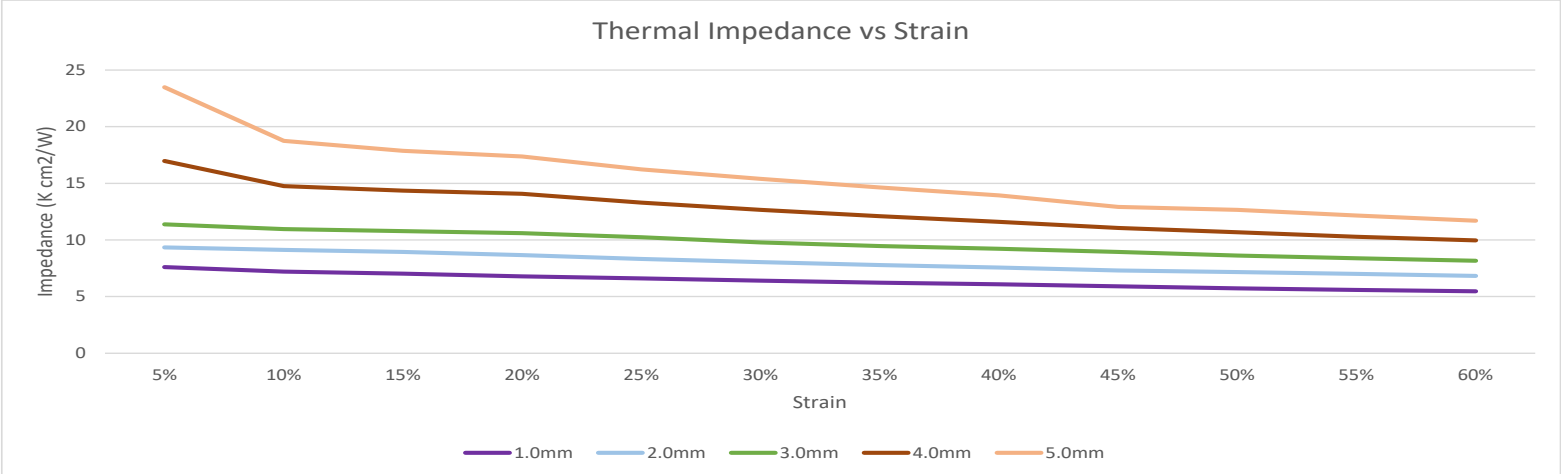
Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Polyurethane	--
	Density (g/cc)	2.44	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.90	ASTM E1269
	Hardness (Shore 00)	47	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.13%	ASTM E595**
	Flammability Rating	V-0	Internal Test Method
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	9.92	ASTM D149

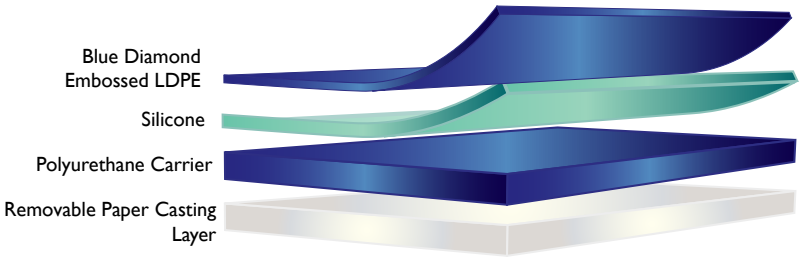
	Property	Value			Test Method
Thermal	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	7.20	6.79	6.40	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



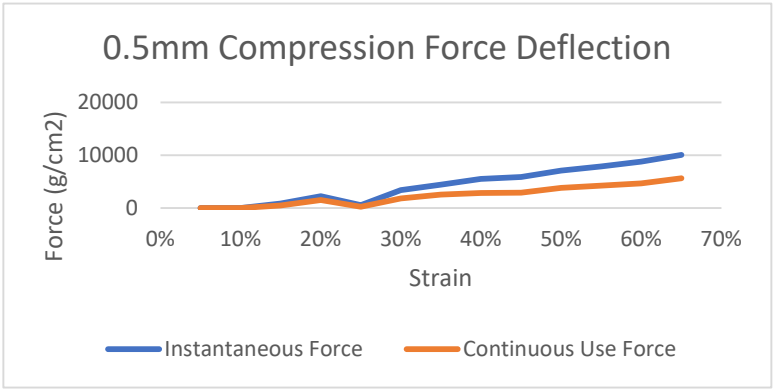
Features:

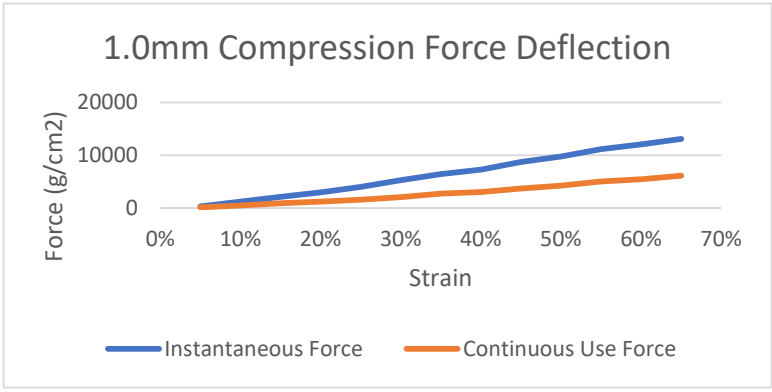
- Excellent Thermal Conductivity
- Excellent Compression Characteristics
- Good Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

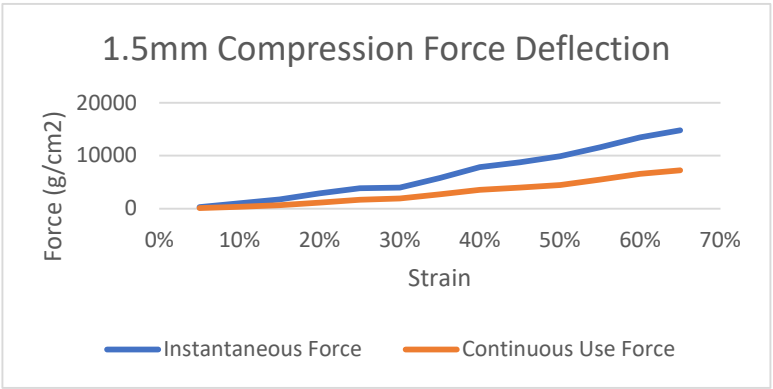


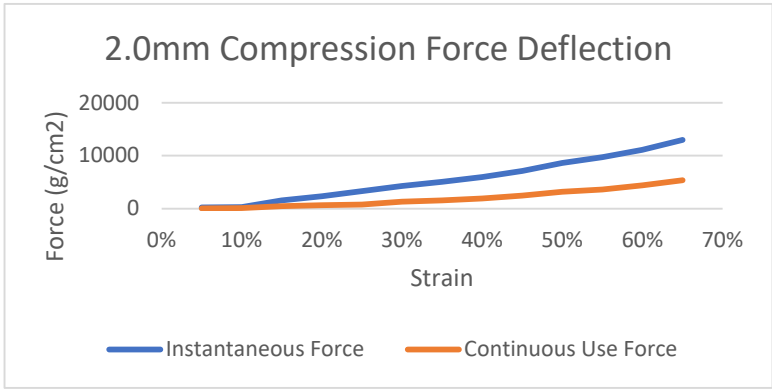
Applications:

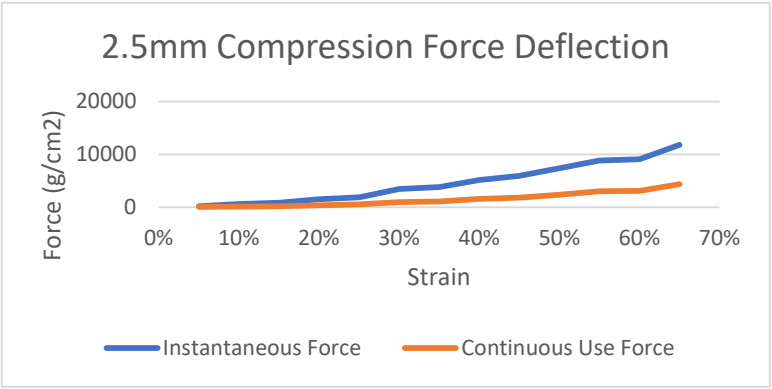
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

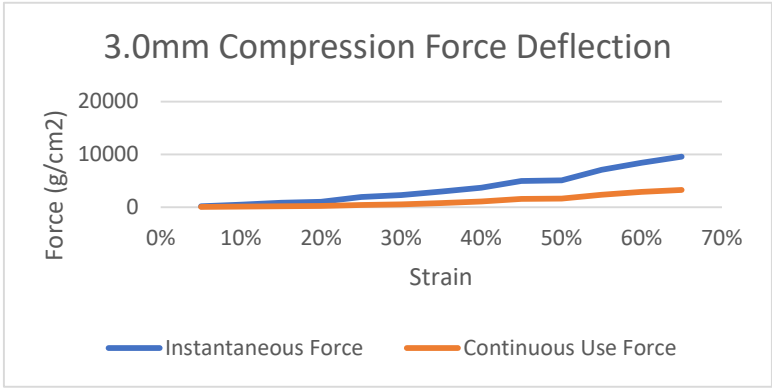












PS-2563

Product Description:

P-THERM® PS-2563 is a soft silicone based thermally conductive gap filler with a 25 micron polyester carrier single coated with high adhesion acrylic adhesive.

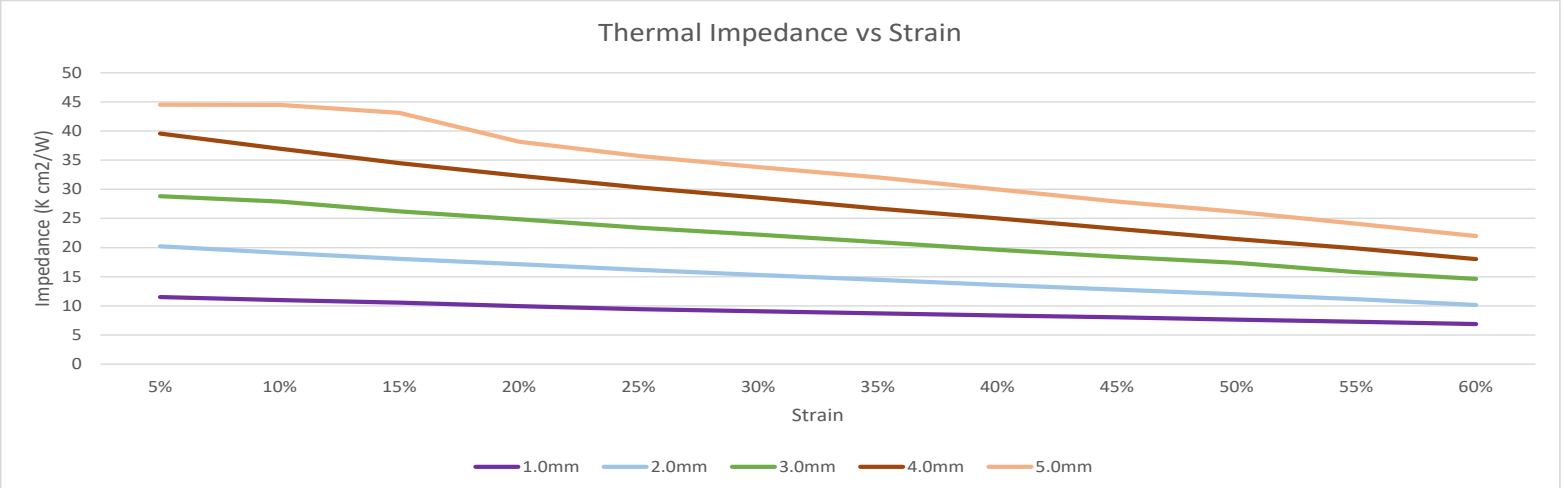
Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Polyester	--
	Density (g/cc)	2.44	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.76	ASTM E1269
	Hardness (Shore 00)	47	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.04%	ASTM E595**
	Flammability Rating	V-0	Internal Test Method
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	9.99	ASTM D149
	Volume Resistivity (ohm-cm)	N/A	ASTM D257

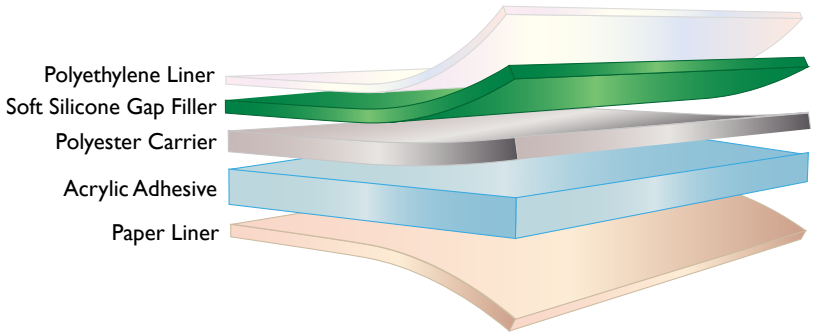
	Property	Value			Test Method
Thermal	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 1mm	10.20	9.67	9.13	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



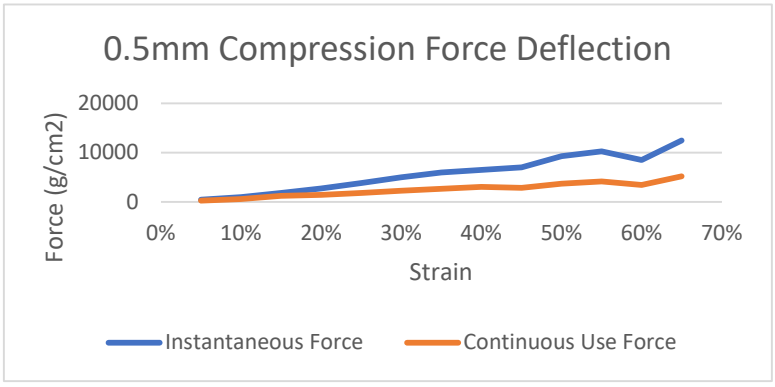
Features:

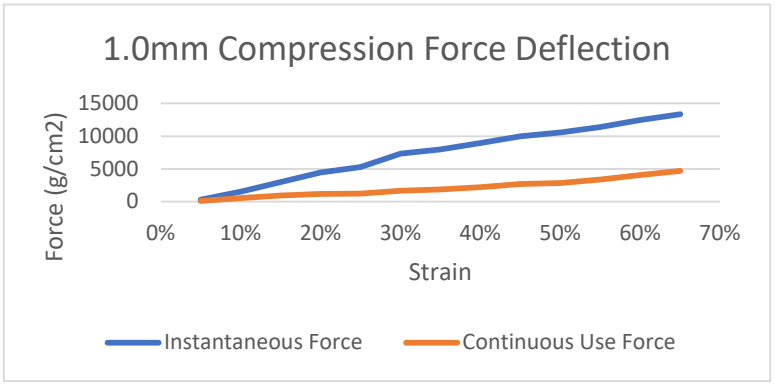
- Excellent Compression Characteristics
- Excellent Wet-Out
- Excellent Converting Properties
- RoHS and HF Compliant

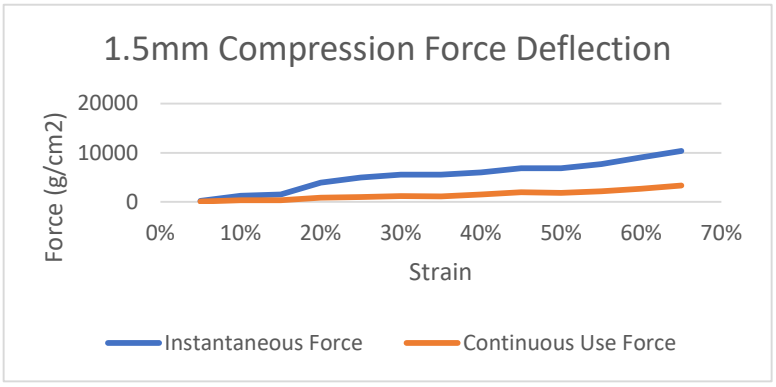


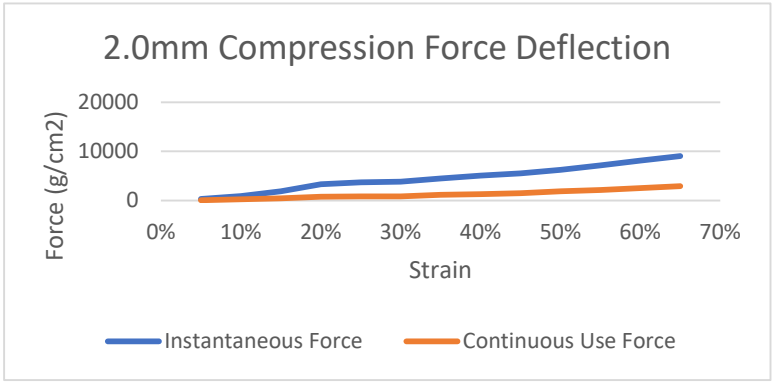
Applications:

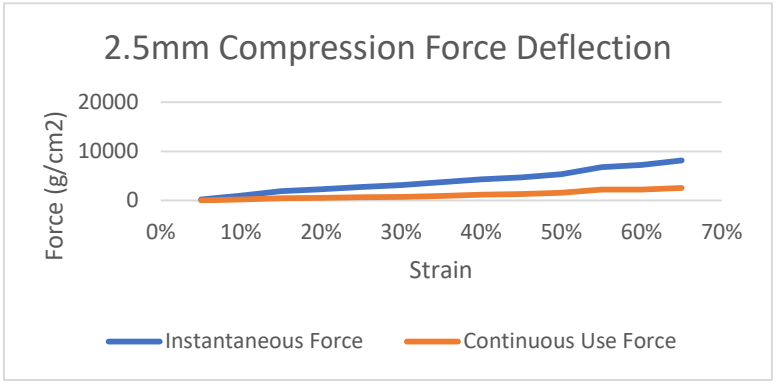
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

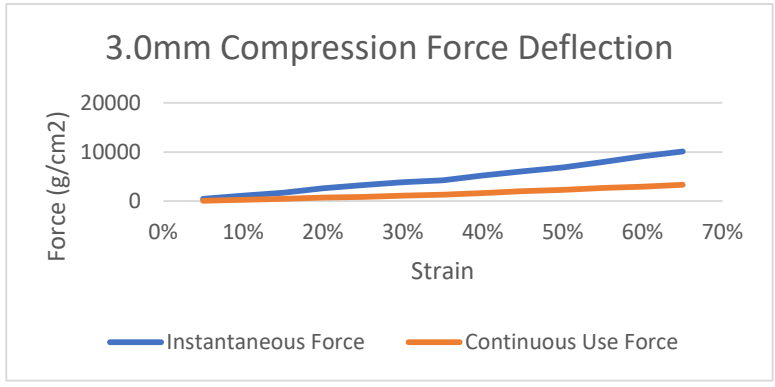












PS-2622

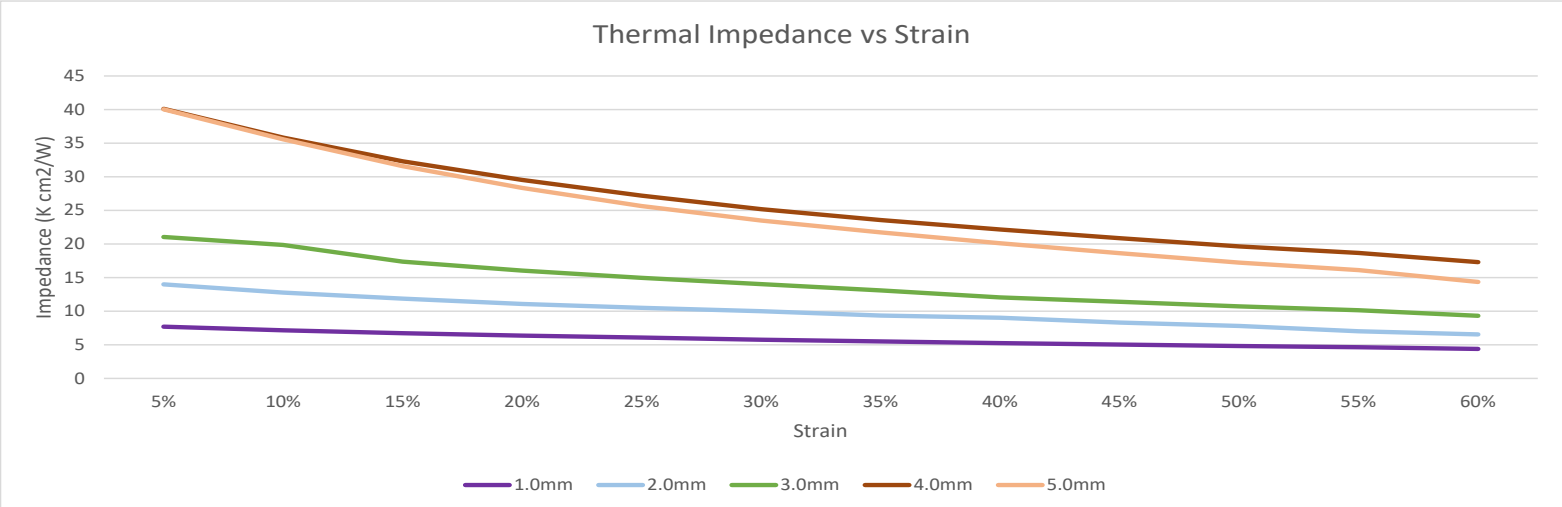
Product Description:

P-THERM® PS-2622 is a soft silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

Construction / Properties:

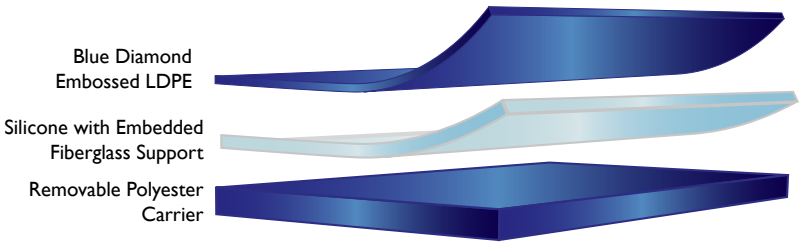
	Property	Value			Test Method
General	Color	Light Blue			Visual
	Thickness Range	0.5 mm - 5.0 mm			ASTM D374
	Reinforcement Carrier Type	Fiberglass			--
	Density (g/cc)	1.67			ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.78			ASTM E1269
	Hardness (Shore 00)	29			ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.06%			ASTM E595**
	Flammability Rating	V-0			UL 94
	Continuous Use Conditions	-60 - 200 C			QSP-754
Electrical	**Property**	**Value**			**Test Method**
	Dielectric Breakdown Strength (kV/mm)	17.00			ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+10			ASTM D257
Thermal	**Property**	**Value**			**Test Method**
	Thermal Conductivity	1.8 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 1mm	7.17	6.36	5.77	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



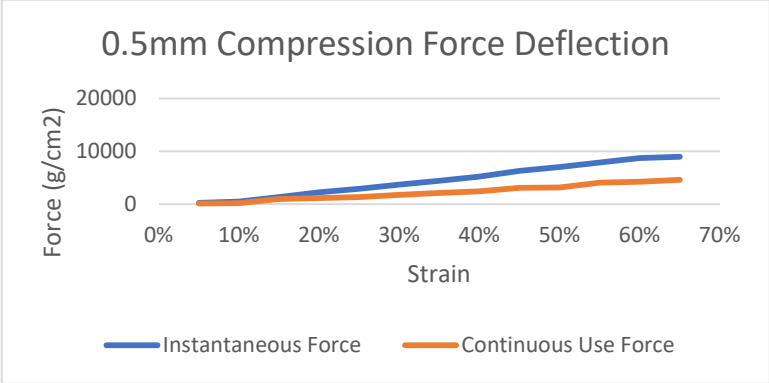
Features:

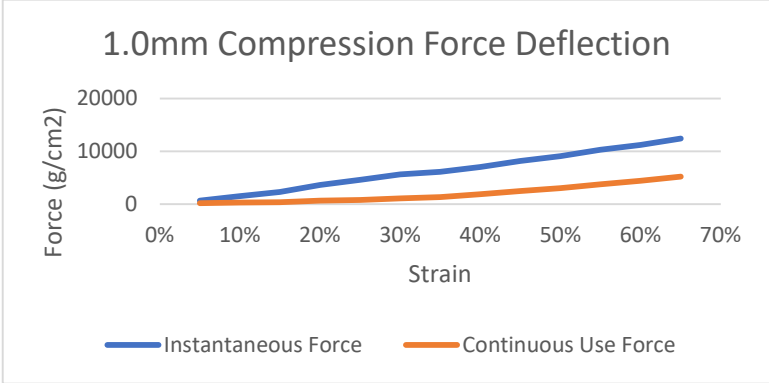
- Excellent Compression Characteristics
- Excellent Wet-Out
- Excellent Converting Properties
- RoHS and HF Compliant

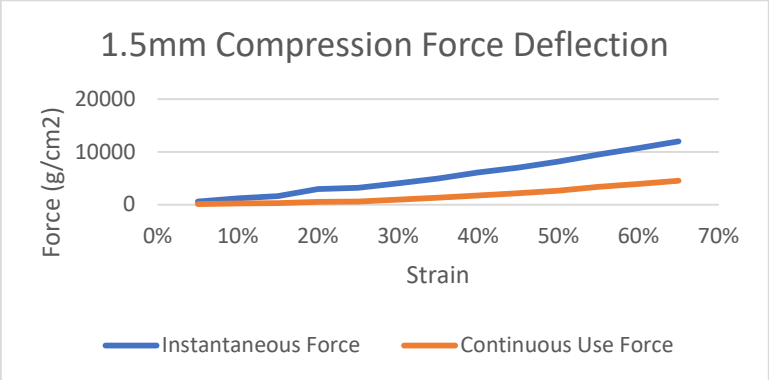


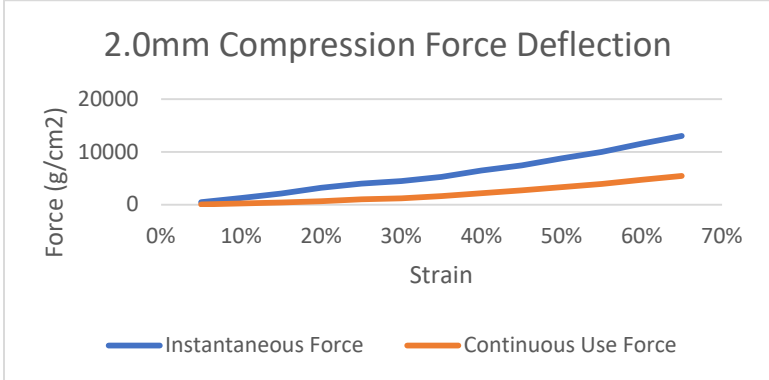
Applications:

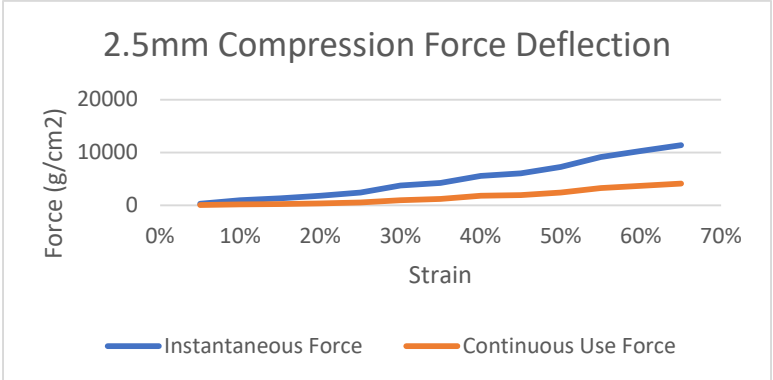
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

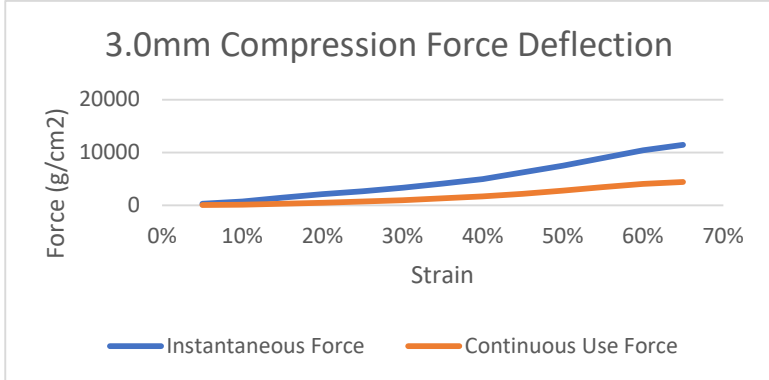












PS-2641

Product Description:

P-THERM® PS-2641 is a silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

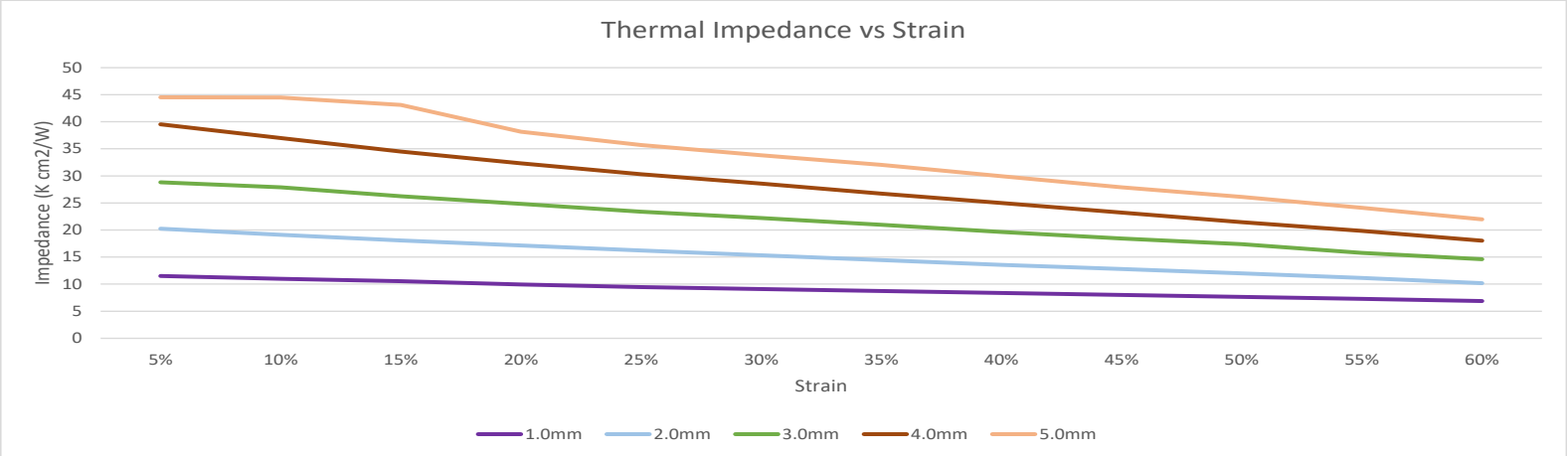
Construction / Properties:

	Property	Value	Test Method
General	Color	Gray	Visual
	Thickness Range	0.5 mm - 5.0 mm	ASTM D374
	Reinforcement Carrier Type	Fiberglass	--
	Density (g/cc)	1.82	ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.97	ASTM E1269
	Hardness (Shore 00)	22	ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.15%	ASTM E595**
	Flammability Rating	V-0	UL 94
	Continuous Use Conditions	-60 - 200 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	12.00	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+09	ASTM D257

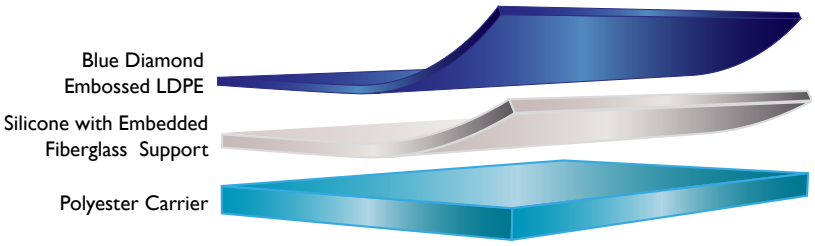
	Property	Value			Test Method
Thermal	Thermal Conductivity	1 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	10.99	9.94	9.08	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



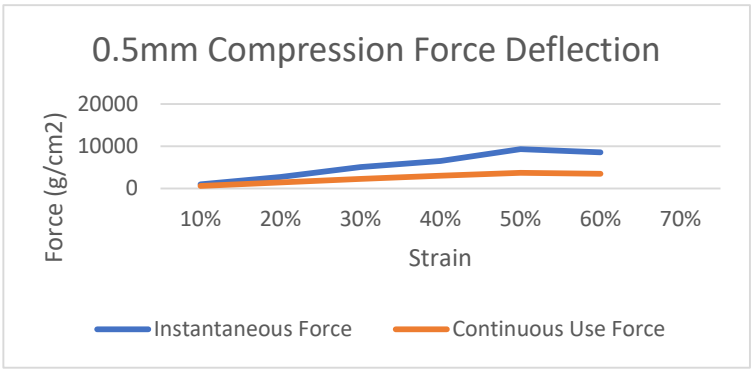
Features:

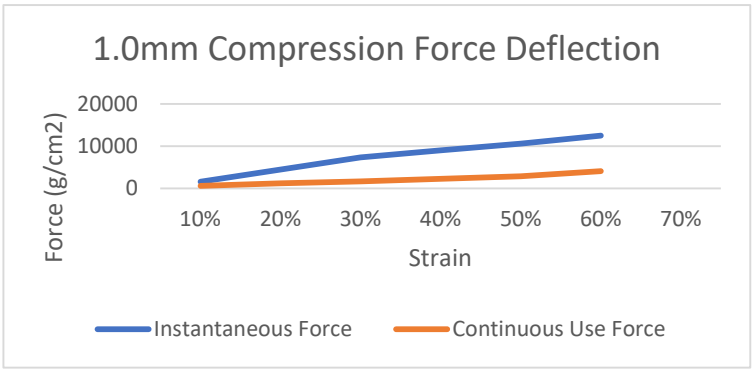
- Good Thermal Conductivity
- Excellent Compression Characteristics
- Excellent Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

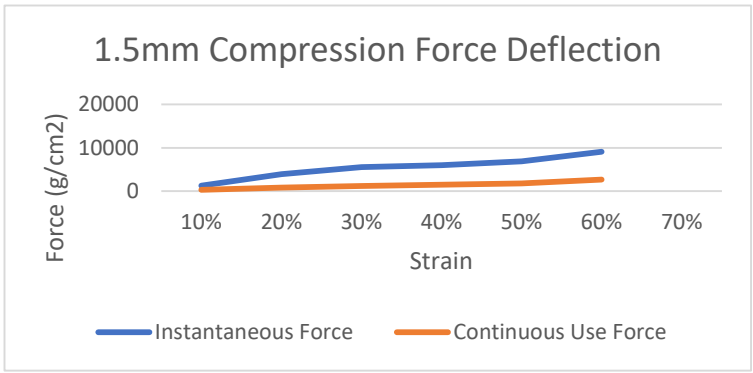


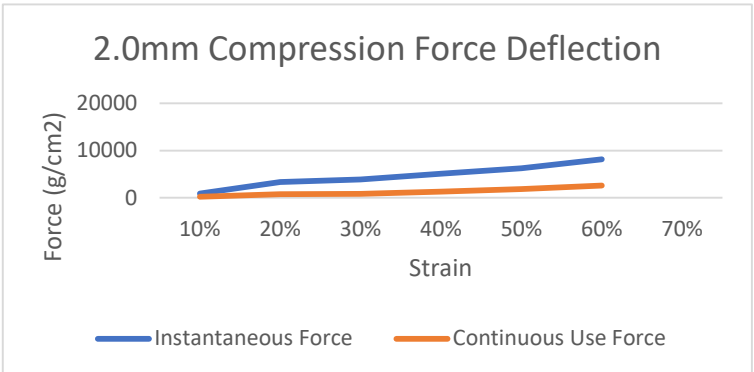
Applications:

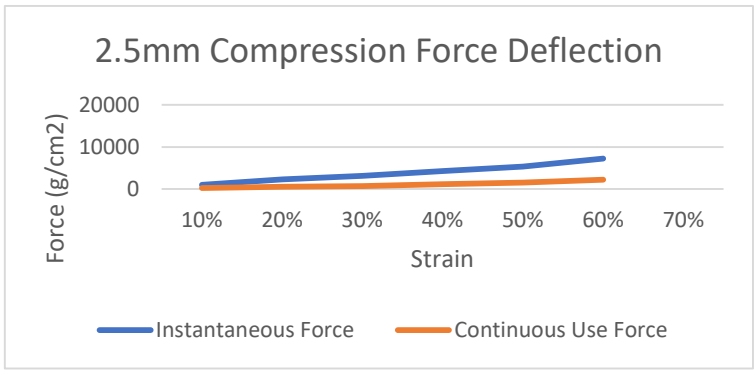
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

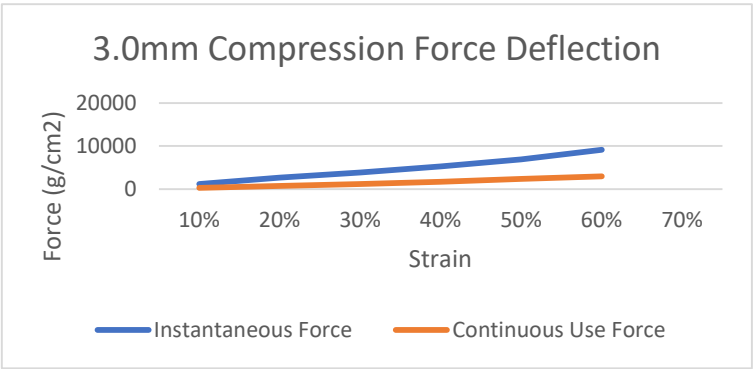












PS-2642

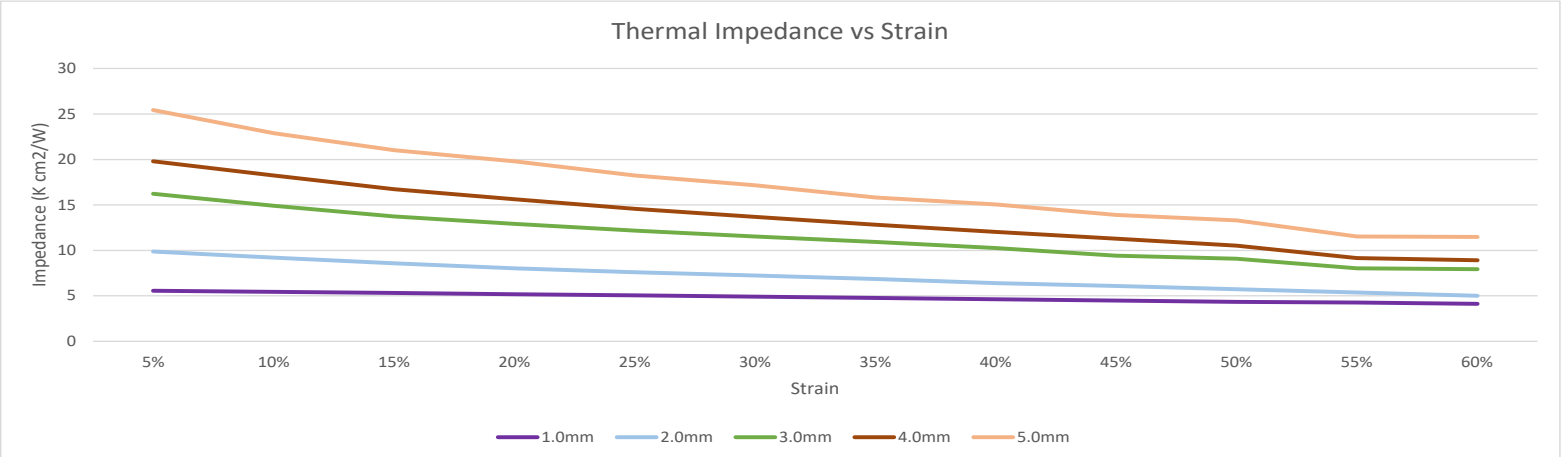
Product Description:

P-THERM® PS-2642 is a silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

Construction / Properties:

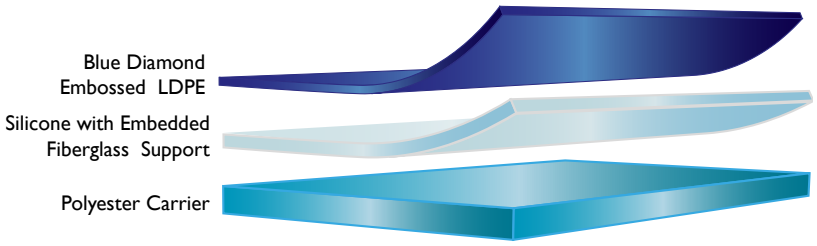
	Property	Value			Test Method
General	Color	Blue			Visual
	Thickness Range	0.5 mm - 5.0 mm			ASTM D374
	Reinforcement Carrier Type	Fiberglass			--
	Density (g/cc)	2.43			ASTM D792
	Heat Capacity (J/g K) @ 50 C	1.08			ASTM E1269
	Hardness (Shore 00)	47			ASTM D2240
	Total Mass Loss (@ 125 C/24 hrs)	0.08%			ASTM E595**
	Flammability Rating	V-0			UL 94
	Continuous Use Conditions	-60 - 200 C			QSP-754
Electrical	**Property**	**Value**			**Test Method**
	Dielectric Breakdown Strength (kV/mm)	20.00			ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+11			ASTM D257
Thermal	**Property**	**Value**			**Test Method**
	Thermal Conductivity	2 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm²/W) @ 1mm	5.45	5.18	4.91	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



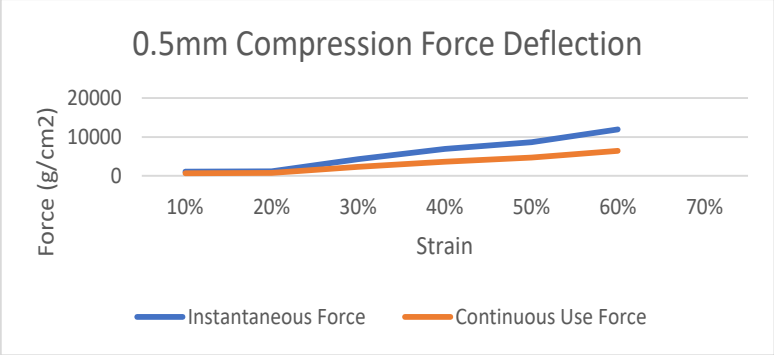
Features:

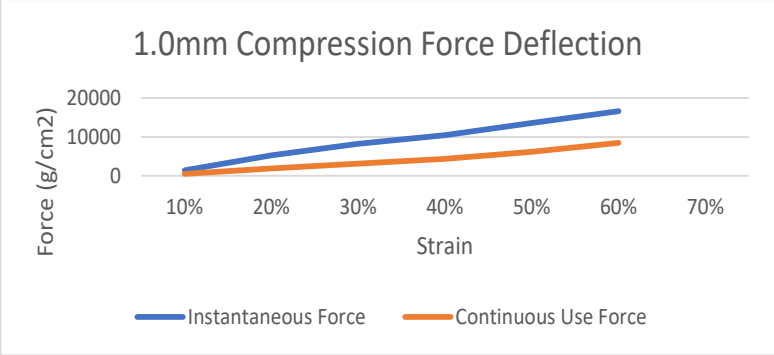
- Good Thermal Conductivity
- Excellent Compression Characteristics
- Excellent Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant
-

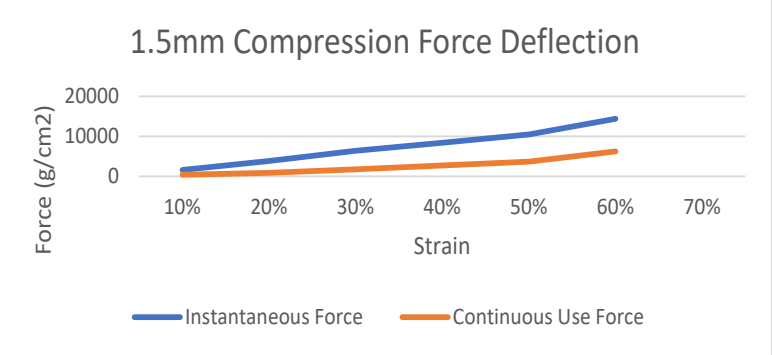


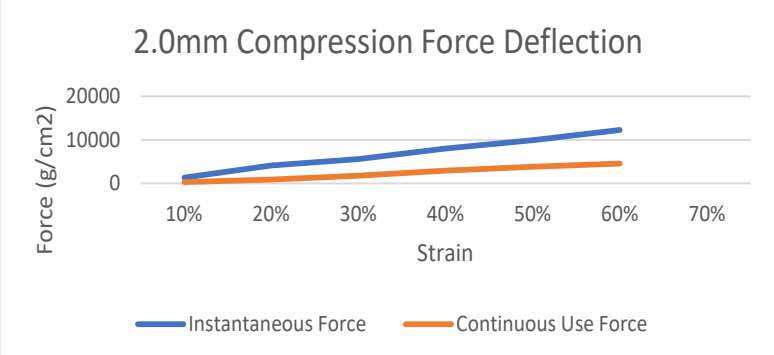
Applications:

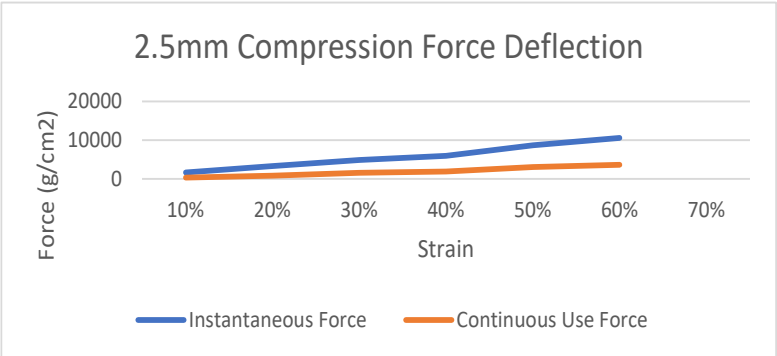
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

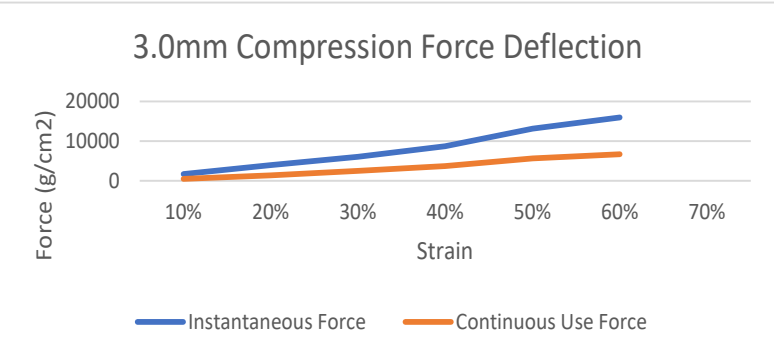












PS-2643

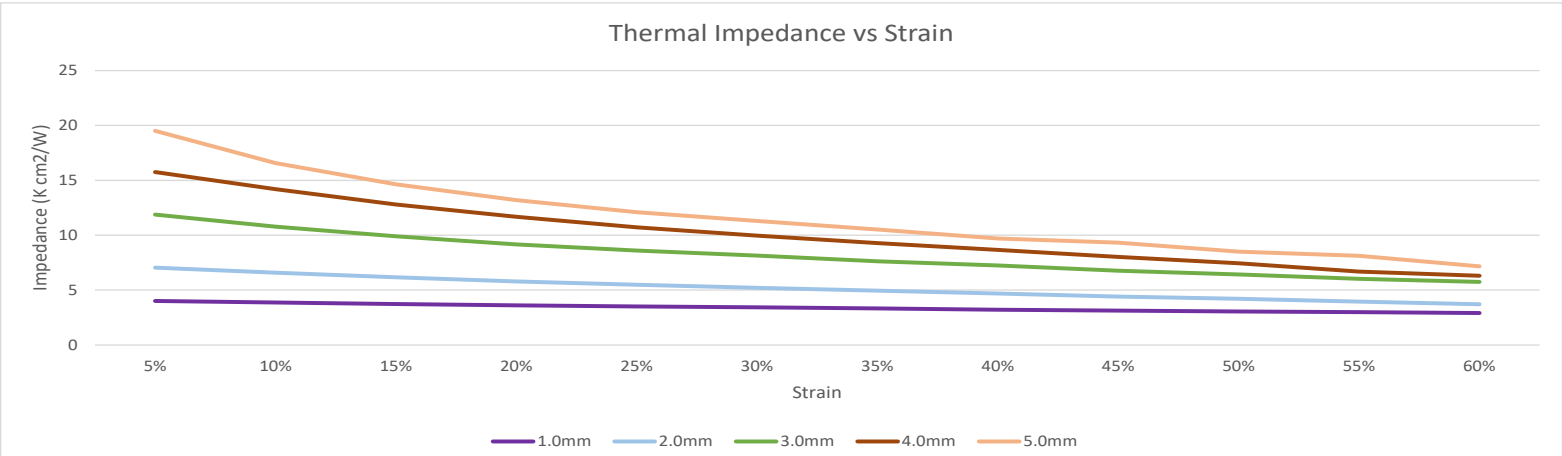
Product Description:

P-THERM® PS-2643 is a silicone based thermally conductive gap filler with an embedded fiberglass support and 125 micron removable polyester carrier.

Construction / Properties:

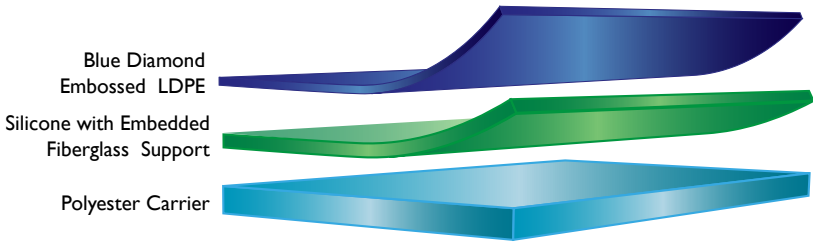
	Property	Value			Test Method
General	Color	Green			Visual
	Thickness Range	0.5 mm - 5.0 mm			ASTM D374
	Reinforcement Carrier Type	Fiberglass			--
	Density (g/cc)	2.73			ASTM D792
	Heat Capacity (J/g K) @ 50 C	0.66			ASTM E1269
	Hardness (Shore 00)	41			ASTM D2240
	Total Mass Loss (@125 C/24 hrs)	0.09%			ASTM E595**
	Flammability Rating	V-0			UL 94
	Continuous Use Conditions	-60 - 200 C			QSP-754
Electrical	**Property**	**Value**			**Test Method**
	Dielectric Breakdown Strength (kV/mm)	13.00			ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+11			ASTM D257
Thermal	**Property**	**Value**			**Test Method**
	Thermal Conductivity	3 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 1mm	3.87	3.62	3.43	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.



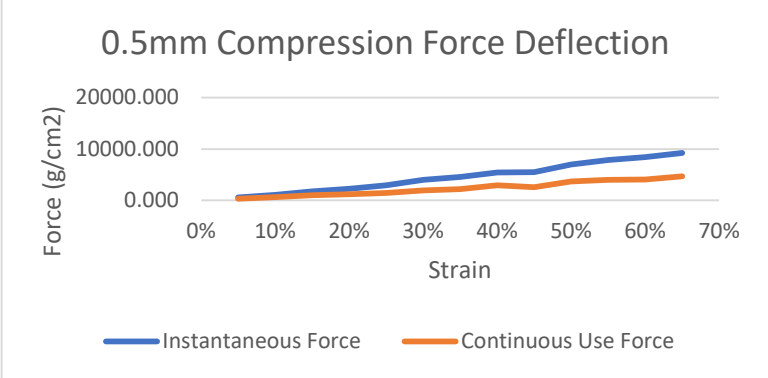
Features:

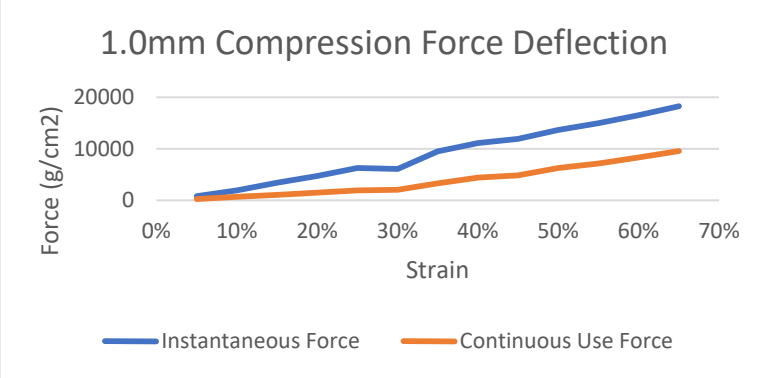
- Excellent Thermal Conductivity
- Excellent Compression Characteristics
- Good Wet-Out
- Superb Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

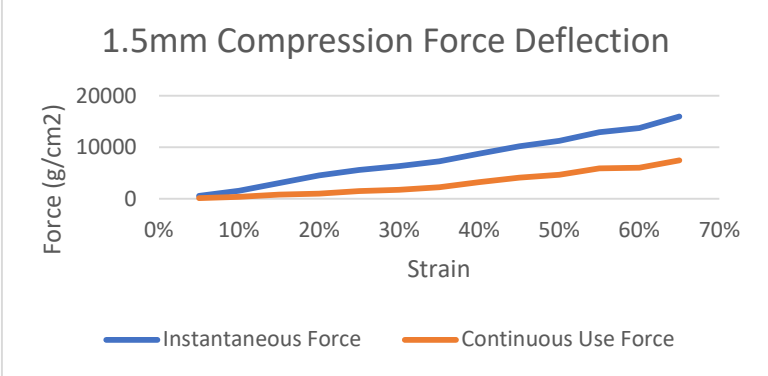


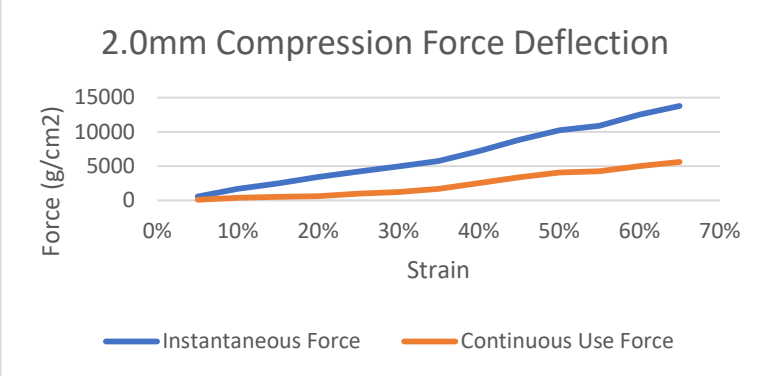
Applications:

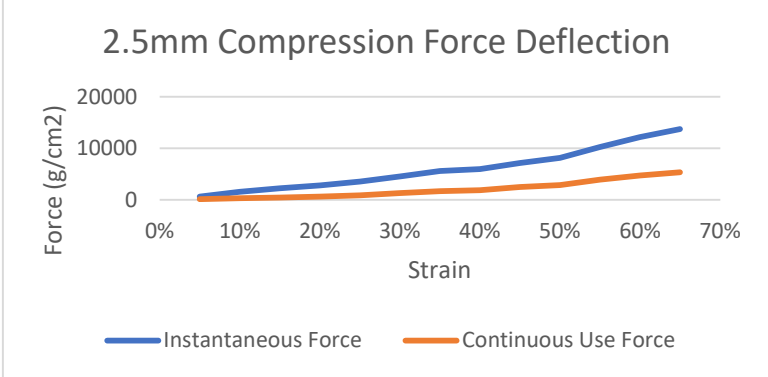
- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

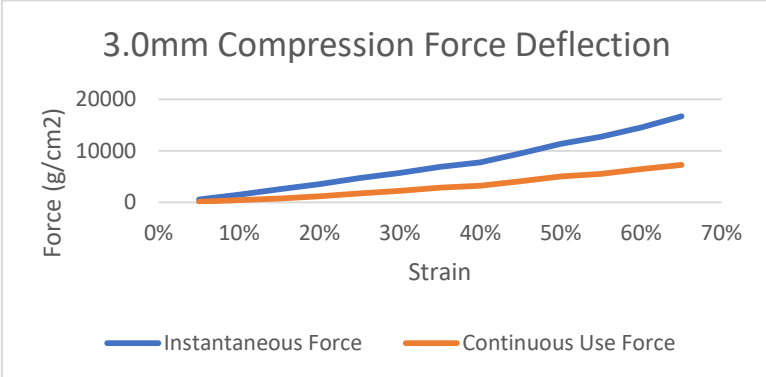












PS-1931

Product Description:

P-THERM® PS-1931 is an ultra-soft thermally conductive silicone putty supplied as a two-component liquid dispensable material. The thixotropic gap filler is designed to remain where it is dispensed, conform to the surface and cure in place providing thermal protection at thin bond lines with little to no stress on the components during assembly.

Construction / Properties:

	Property	Value	Test Method
General	Color	Gray	Visual
	Binder	Silicone	--
	Filler	Ceramic	--
	Mix Ratio	1:1 by weight	--
	Number of Components	2-Part	--
	Viscosity (after cured) [2/10/25]	928,000 cP	ASTM D2196
	Total Mass Loss (@ 125 C/24 hrs)	0.28%	ASTM E595**
	Heat Capacity (J/g K) @ 50 C	1.27	ASTM E1269
	Cure Condition	7.5 hrs (@ 40 C)	--
	Continuous Use Conditions	-60 - 200 C	QSP-754
Electrical	**Property**	**Value**	**Test Method**
	Dielectric Breakdown Strength (kV/mm)	9.36	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+18	ASTM D257
Thermal	**Property**	**Value**	**Test Method**
	Thermal Conductivity	1 W/m K	ASTM D5470*

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure

Features:

- Excellent Thermal In-Plane Conductivity
- Low Density Option for Control of Hot Spots
- Excellent Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant

Applications:

- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

PS-1933

Product Description:

P-THERM® PS-1933 is an ultra-soft thermally conductive silicone putty supplied as a two-component liquid dispensable material. The gap filler is designed to conform to the surface and cure in place providing thermal protection at thin bond lines with little to no stress on the components during assembly.

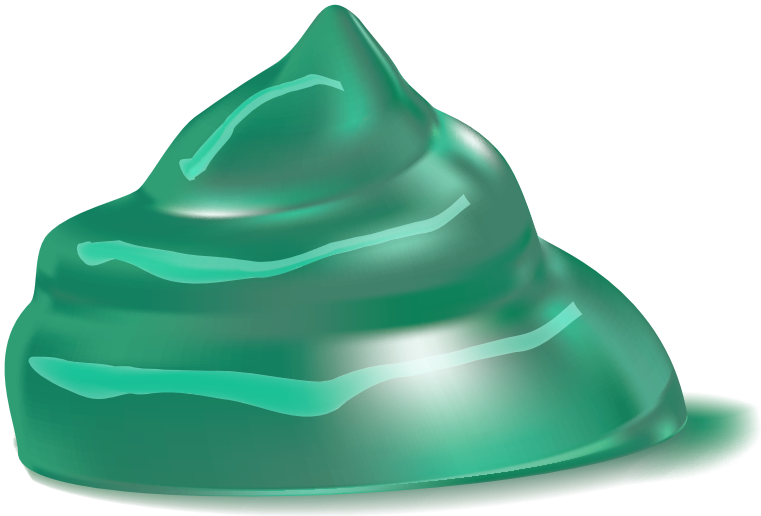
Construction / Properties:

	Property	Value	Test Method
General	Color	Green	Visual
	Binder	Silicone	--
	Filler	Ceramic	--
	Mix Ratio	1:1 by weight	--
	Number of Components	2-Part	--
	Viscosity (after cured) [2/10/25]	756,000 cP	ASTM D2196
	Total Mass Loss (@ 125 C/24 hrs)	0.07%	ASTM E595**
	Heat Capacity (J/g K) @ 50 C	0.83	ASTM E1269
	Cure Condition	5 hrs (@ 40 C)	--
	Continuous Use Conditions	-60 - 200 C	QSP-754
Electrical	**Property**	**Value**	**Test Method**
	Dielectric Breakdown Strength (kV/mm)	6.80	ASTM D149
	Volume Resistivity (ohm-cm)	1.0E+ 18	ASTM D257
Thermal	**Property**	**Value**	**Test Method**
	Thermal Conductivity	3 W/m K	ASTM D5470*

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure

Features:

- Dispensable Two-Part Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

PS-1935

Product Description:

P-THERM® PS-1935 is an ultra-soft thermally conductive silicone putty supplied as a two component liquid dispensable material. The thixotropic gap filler is designed to conform to the surface and cure in place providing thermal protection at thin bond lines with little to no stress on the components during assembly.

Construction / Properties:

	Property	Value	Test Method
General	Color	Gold	Visual
	Binder	Silicone	--
	Filler	Ceramic	--
	Mix Ratio	1:1 by weight	--
	Number of Components	2-Part	--
	Viscosity (after cured) [2/10/25]	324,000 cP	ASTM D2196
	Total Mass Loss (@ 125 C/24 hrs)	9.10%	ASTM E595**
	Heat Capacity (J/g K) @ 50 C	1.10	ASTM E1269
	Cure Condition	3 hrs (@ 40 C)	--
	Continuous Use Conditions	-60 - 200 C	QSP-754
Electrical	**Property**	**Value**	**Test Method**
	Dielectric Breakdown Strength (kV/mm)	11.00	ASTM D149
	Volume Resistivity (ohm-cm)	--	ASTM D257
Thermal	**Property**	**Value**	**Test Method**
	Thermal Conductivity	5 W/m K	ASTM D5470*

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure

Features:

- Dispensable Two-Part Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant

Applications:

- LED Lighting
- Battery Components
- Infotainment Modules
- Smartphones
- Tablets
- Computers
- Digital Personal Assistants
- Automotive Lighting

PS-1595

Product Description:

P-THERM® PS-1595 is a non-silicone, thermally conductive tacky phase change material with a siliconized paper release liner.

Construction / Properties:

	Property	Value	Test Method
General	Color	Yellow	Visual
	Thickness Range	0.25 mm	ASTM D374
	Carrier Type	--	--
	Density (g/cc)	2.39	ASTM D792
	Heat Capacity (J/g K) @ 50 C	1.09	ASTM E1269
	Hardness (Shore 00)	--	ASTM D2240
	Total Mass Loss (@125 C/24 hrs)	1.00%	ASTM E595**
	Phase Change Temperature	55 C	UL 94
	Continuous Use Conditions	-25 - 125 C	QSP-754

	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	15.03	ASTM D149
	Volume Resistivity (ohm-cm)	--	ASTM D257

	Property	Value			Test Method
Thermal	Thermal Conductivity	4 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 0.25mm	3.48	2.07	1.72	

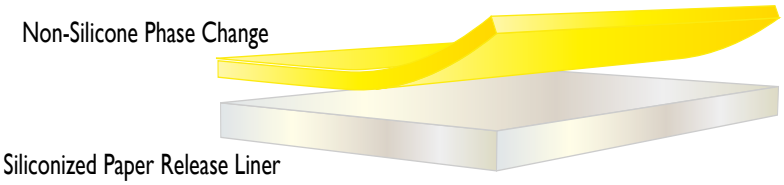
* Thermal conductivity tested at 20% strain.

** Tested at atmospheric pressure

*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.

Features:

- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Gaming Systems
- Battery Components
- Solar Panels
- Infotainment and Navigation Systems
- Smartphones
- Tablets
- Computers

PS-1672

Product Description:

P-THERM® PS-1672 is a copper foil and graphite hybrid heat spreader trilaminate with a clear acrylic adhesive on the copper side of the construction and a black acrylic on the graphite side of the construction. There is a removable release liner on the clear adhesive side and a non-removable polyester film carrier on the black acrylic side.

Construction / Properties:

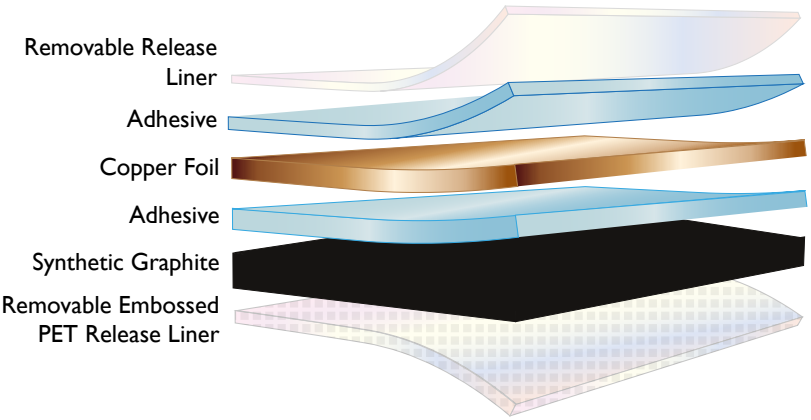
	Property	Value	Test Method
General	Color	Copper/Black	Visual
	Thickness Range	0.15 mm	ASTM D374
	Carrier Type	Copper Foil/Synthetic Graphite	--
	Carrier Thickness	140 micron	ASTM D374
	Adhesive Type	Acrylic	--
	Acrylic Adhesion	800 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 400 C	QSP-754
	Recommended Application Specification	2 kg/square inch for 2 seconds	--

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	>1300 W/m K	QSP-749
	Thermal Conductivity (Z-Axis)	15 W/m K	ASTM D5470
	Flammability Rating	V-0	UL 94

* 20% thermal conductivity tested at 20% strain.

Features:

- Superior Converting Properties
- Good Adhesive and Cohesive Strength
- Good Conformity to Non-Flat Substrates
- Good Thermal Conductivity
- Resists Flow During Thermal Cycling
- Excellent Converting Properties



Applications:

- Solar Panels
- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1681

Product Description:

P-THERM® PS-1681 is a copper foil multi-laminate tape with a conductive black nano-thermal diffusion coating on one side and a conductive adhesive on the other. The copper has been laminated to a reinforcing conductive fabric which has been coated with an electrically conductive acrylic adhesive to offer electromagnetic shielding and thermal heat protection.

Construction / Properties:

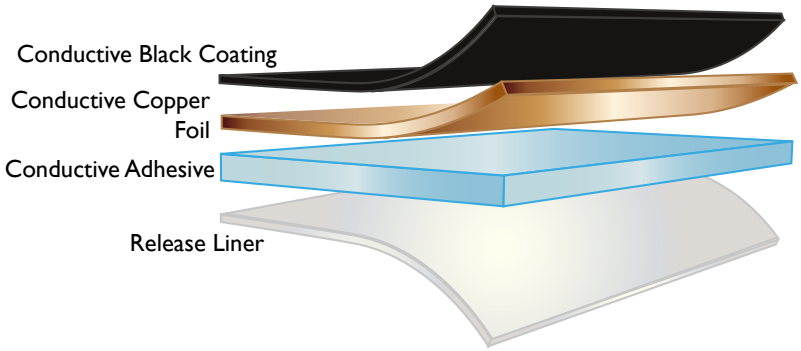
	Property	Value	Test Method
General	Color	Black	Visual
	Total Thickness	0.08 mm	ASTM D374
	Carrier Type	Copper Foil/Conductive Fabric	--
	Acrylic Adhesion	> 1000 g/25mm	QSP-722
	Continuous Use Conditions	-10 - 80 C	QSP-754
	Recommended Application Specifications	2 kg/square inch for 2 seconds	--

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	> 400 W/m K	ASTM D5470
	Surface Resistivity	<0.03 Ω/sq	QSP-741
	Z-Axis Resistivity	<0.15 Ω/in^2	QSP-741
	Shielding Effectiveness (10 MHz - 3 GHz)	> 90 dB	--

* 20% thermal conductivity tested at 20% strain.

Features:

- Superior Converting Properties
- Good Adhesive and Cohesive Strength
- Good Conformity to Non-Flat Substrates
- Good Thermal Conductivity
- RoHS and HF Compliant



Applications:

- Solar Panels
- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1692

Product Description:

P-THERM® PS-1692 is a single coated, thermally conductive acrylic adhesive with a copper foil carrier. The adhesive is used for application to the heat source. The heat spreader allows for quick dissipation in the x-y direction.

Construction / Properties:

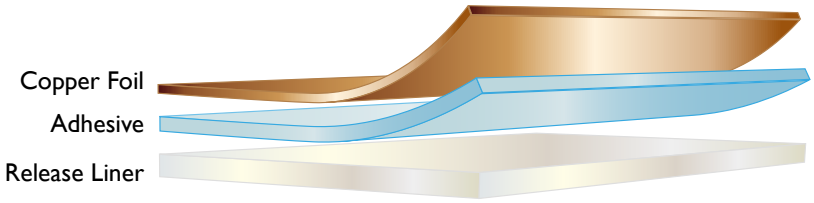
	Property	Value	Test Method
General	Color	Copper	Visual
	Total Thickness	0.06 mm	ASTM D374
	Carrier Type	Copper Foil	--
	Acrylic Adhesion	800 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 85 C	QSP-754
	Recommended Application Specifications	2 kg/square inch for 2 seconds	--

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	100 W/m K	ASTM D5470
	Shielding Effectiveness (10 MHz - 1.5 GHz)	90 - 100 dB	--
	Flammability Rating	V-0	UL 94

* 20% thermal conductivity tested at 20% strain.

Features:

- Good Tack
- Excellent Thermal Conductivity
- Good Adhesion to Low Surface Energy Substrates
- RoHS and HF Compliant



Applications:

- Solar Panels
- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1693

Product Description:

P-THERM® PS-1693 is a heat spreader using the construction of a foil and polyester with a thermally conductive adhesive for application to the heat source. The heat spreader allows for quick dissipation of heat in the x-y direction.

Construction / Properties:

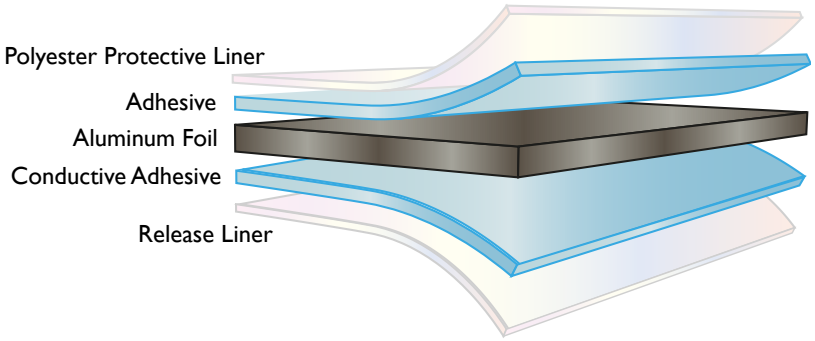
	Property	Value	Test Method
General	Color	Silver	Visual
	Total Thickness	0.15 mm	QSP-726
	Carrier Type	Aluminum	--
	Adhesive Peel Strength (to SUS)	1000 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 85 C	QSP-754
	Recommended Application Specifications	2 kg/square inch for 2 seconds	--

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	200 W/m K	ASTM D5470
	Shielding Effectiveness (10 MHz - 1 GHz)	>60 dB	--
	Flammability Rating	V-0	UL 94

* 20% thermal conductivity tested at 20% strain.

Features:

- Good Tack
- Excellent Thermal Conductivity
- Good Adhesion to Low Surface Energy Substrates
- RoHS and HF Compliant



Applications:

- Solar Panels
- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1996

Product Description:

P-THERM® PS-1996 is a flexible synthetic graphite film tape. The graphite sheet has been coated with an acrylic pressure sensitive adhesive to aid in handling during assembly. The construction provides a low density option to eliminate hot spots on many types of consumer electronics including phones, notebook and tablets, flat panel TVs as well as automotive infotainment and guidance modules.

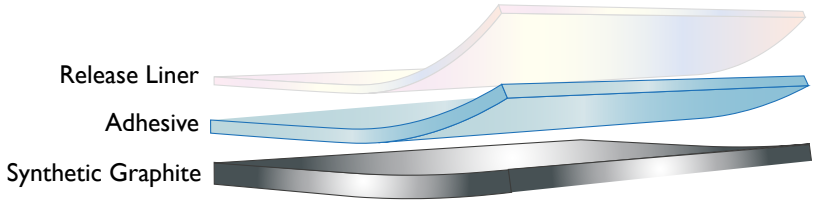
Construction / Properties:

	Property	Value	Test Method
General	Color	Dark Gray	Visual
	Total Thickness	0.05 mm	ASTM D3652
	Carrier Type	Graphite	--
	Acrylic Adhesion	800 g/25mm	QSP-722
	Continuous Use Conditions	-20 - 80 C	QSP-754
Physical	**Property**	**Value**	**Test Method**
	Composite X-Y Thermal Conductivity	>1200 W/m K	ASTM D5470
	Flammability Rating	V-0	UL 94

* 20% thermal conductivity tested at 20% strain.

Features:

- Excellent Thermal In-Plane Conductivity
- Low Density Option for Control of Hot Spots
- Excellent Flexibility
- Excellent Converting Properties
- RoHS and HF Compliant



Applications:

- Solar Panels
- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-0266

Product Description:

P-THERM® PS-0266 is a single coated, thermally conductive acrylic transfer adhesive with a 54# dense kraft siliconized paper release liner.

Construction / Properties:

	Property	Value	Test Method
General	Color	White	Visual
	Thickness Range	0.05 mm	ASTM D374
	Carrier Type	--	--
	Density (g/cc)	0.98	ASTM D792
	Heat Capacity (J/g K) @ 50 C	1.35	ASTM E1269
	Hardness (Shore 00)	--	ASTM D2240
	Total Mass Loss (@125 C/24 hrs)	3.81%	ASTM E595**
	Flammability Rating	--	UL 94
	Continuous Use Conditions	-40 - 85 C	QSP-754

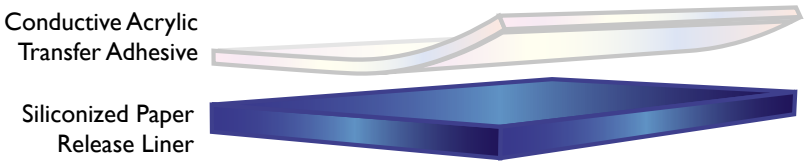
	Property	Value	Test Method
Electrical	Dielectric Breakdown Strength (kV/mm)	3.59	ASTM D149
	Volume Resistivity (ohm-cm)	--	ASTM D257

	Property	Value			Test Method
Thermal	Thermal Conductivity	0.55 W/m K			ASTM D5470*
	Thermal Performance vs. Strain				
	Deflection (% Strain)	10	20	30	ASTM D5470***
	Thermal Impedance (K cm^2/W) @ 0.05mm	4.03	4.00	3.99	

* Thermal conductivity tested at 20% strain.
** Tested at atmospheric pressure
*** Values tested include interfacial thermal resistance: Application performance is directly related to surface roughness, flatness and pressure applied.

Features:

- Non-Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1651

Product Description:

P-THERM® PS-1651 is a double coated, thermally conductive acrylic adhesive with an aluminum foil carrier and siliconized paper release liner.

Construction / Properties:

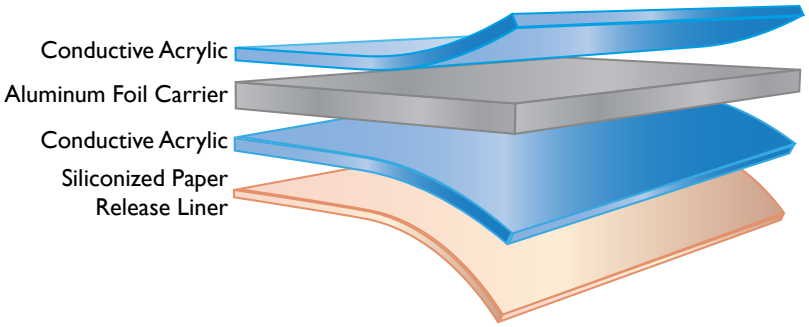
	Property	Value	Test Method
General	Color	White	Visual
	Total Thickness	0.15 mm	ASTM D374
	Carrier Type	Aluminum Foil	--
	Acrylic Adhesion	2270 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 85 C	QSP-754

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	0.55 W/m K	ASTM D5470
	Intermittent Max Use Conditions	< 120 C (less than 8 minutes)	QSP-754

* 20% thermal conductivity tested at 20% strain.

Features:

- Non-Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1652

Product Description:

P-THERM® PS-1652 is a double coated, thermally conductive acrylic adhesive with a fiberglass carrier and siliconized paper release liner.

Construction / Properties:

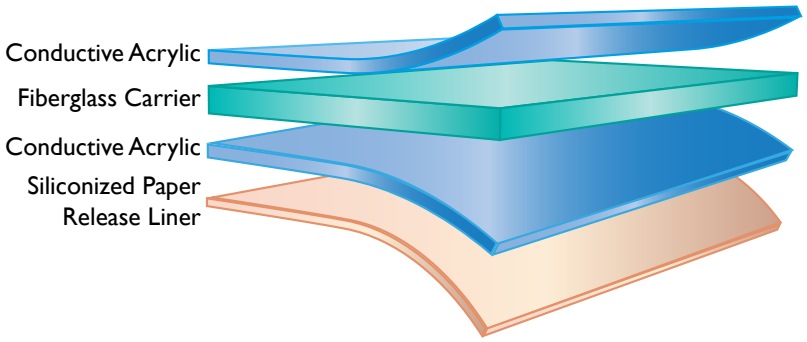
	Property	Value	Test Method
General	Color	White	Visual
	Total Thickness	0.25 mm	ASTM D374
	Carrier Type	Fiberglass	--
	Acrylic Adhesion	2270 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 85 C	QSP-754

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	0.55 W/m K	ASTM D5470

* 20% thermal conductivity tested at 20% strain.

Features:

- Non-Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1656

Product Description:

P-THERM® PS-1656 is a double coated, thermally conductive acrylic adhesive with a polyester carrier and siliconized paper release liner.

Construction / Properties:

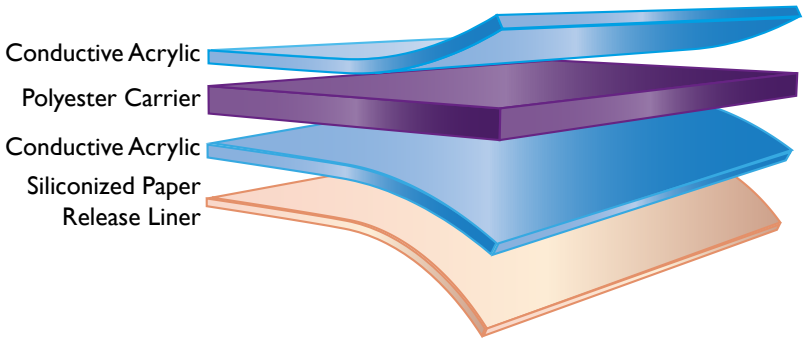
	Property	Value	Test Method
General	Color	White	Visual
	Total Thickness	0.13 mm	ASTM D374
	Carrier Type	Polyester	--
	Acrylic Adhesion	1850 g/25mm	QSP-722
	Continuous Use Conditions	-40 - 85 C	QSP-754

	Property	Value	Test Method
Physical	Composite X-Y Thermal Conductivity	0.8 W/m K	ASTM D5470
	Flammability Rating	V-0	UL 94
	Dielectric Breakdown Strength (kV/mm)	> 5.00	ASTM D149

* 20% thermal conductivity tested at 20% strain.

Features:

- Non-Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

PS-1659

Product Description:

P-THERM® PS-1659 is a double coated, thermally conductive acrylic adhesive with a fiberglass carrier and siliconized paper release liners.

Construction / Properties:

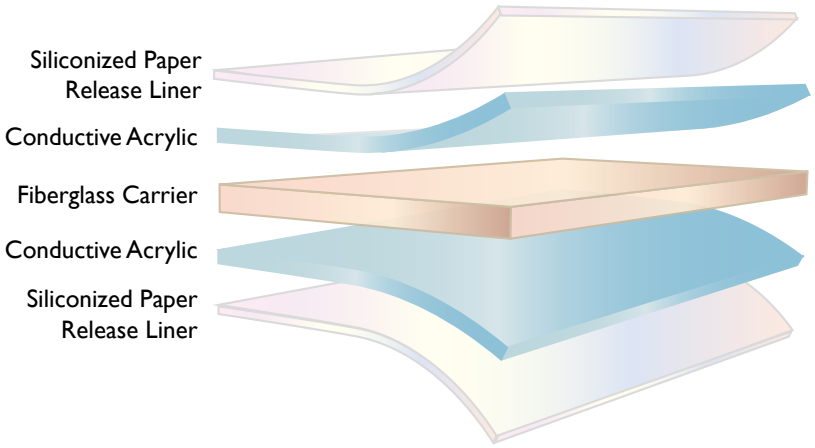
	Property	Value	Test Method
General	Color	White	Visual
	Total Thickness	0.25 mm	ASTM D374
	Carrier Type	Fiberglass	--
	Acrylic Adhesion	≥ 1200 g/25mm	QSP-722
	Continuous Use Conditions	-30 - 85 C	QSP-754
	Intermittent Max Use Conditions	< 120 C (less than 8 minutes)	QSP-754

	Property	Value	Test Method
Physical	Thermal Conductivity	≥ 0.8 W/m K	ASTM D5470
	Dielectric Breakdown Strength (kV/mm)	> 5.00	ASTM D149

* 20% thermal conductivity tested at 20% strain.

Features:

- Non-Silicone
- High Temperature Resistance
- Low Stress on Components
- Shock Absorbing
- Low VOC
- RoHS and HF Compliant



Applications:

- Computers
- Smartphones
- Tablets
- Infotainment & Navigation Systems

FAQ

Q: What is thermal conductivity?
A: Thermal conductivity is the measure of a material's ability to conduct heat. Thermal conductivity is a bulk property of the material so does not take into account thickness, geometry or other application-specific characteristics.

Q: What thermal conductivity test method is used to achieve the values reported on the data sheets of P-THERM® gap filler products?
A: Thermal conductivity is measured using the guarded heat plate method outlined in ASTM D5470. 1"x1" samples are compressed at 20% to determine the thermal impedance. Three thicknesses are tested and the inverse of the slope of the measured impedances is used to determine the bulk thermal conductivity of the product.

Q: What is the difference between thermal conductivity and thermal impedance?
A: Thermal impedance is the sum of the thermal resistance of the material as well as the contact resistance at each interface at a given compression. Thermal impedance takes into account all forms of resistance of heat flow including thickness of the TIM, surface irregularities or smoothness and area of the component. Thermal conductivity is a bulk property of the material and good for general comparisons, but thermal impedance is better to use for simulating heat transfer efficiency of the system.

Q: How does the thermal conductivity test measurement for P-THERM® Phase Change Material differ from that of gap filler?
A: P-THERM® Phase Change Materials are tested using the guarded heat plate method outlined in ASTM D5470. The difference is that phase change materials are treated as viscous liquids, defined as a Type 1 material. Conductivity testing is performed at 60 C and tested across a range of pressure rather than thickness which is used for gap fillers.

Q: Why do compression force deflection curves for P-THERM® gap fillers show two values?
A: The force exerted on a component upon initial compression is the instantaneous force. After the initial force, the gap filler will have an opportunity to equilibrate over 1 minute of the continuous use force which is based upon the elastic properties of the gap filler to demonstrate the force the assembly will see during long term use.

Q: Is durometer of the P-THERM® gap filler determined by thickness of the gap filler?
A: Durometer of the P-THERM® gap fillers is measured as a bulk property from a 10mm thickness cured puck of material which does not contain any type of reinforcement. The reinforcement scrim may have an impact based upon the thickness of the sample being tested.

Q: What test method is used to determine total mass loss on drying of the P-THERM® gap fillers?
A: To determine the volatile content of the gap filler, the sample is heated to 125 C and held for 24 hours. The sample is weighed on a microbalance to determine weight loss over the period of heat exposure at atmospheric pressure to simulate actual use conditions. Small molecular weight silicones and additives commonly volatilize and leach from the silicone gap filler products.

Q: In what format are P-THERM® thermal management products supplied?
A: P-THERM® thermal management products are all available in roll formats.

Q: Is there any required surface preparation required when using a P-THERM® thermal management product?
A: Although no surface preparation is required, applying any thermal management material to a clean, dry surface is preferred. Contamination on the surface from dust or debris may act as a source of resistance and impede the effectiveness of the thermal management material.

Q: What is the continuous use range for P-THERM® silicone gap fillers?
A: Silicone gap fillers are able to be used across a wide range of temperatures, -60 C – 200 C. The gap fillers are not expected to change in rigidity, thermal performance or shock resistance across this temperature range. Short exposure to 250 C for five minutes and 300 C for 1 minute should not negatively impact the functionality of the P-THERM® silicone gap fillers.

Q: What characteristics should be considered when choosing a P-THERM® gap filler?
A: The two functional characteristics of a gap filler used to determine how effective it will work in your application are thermal conductivity, which is the bulk property associated with the rate of heat transfer across a gap of given length, and the resistance, which is the gap filler has at each of planar interface. This resistance may be a result of incomplete wetting of the surface by the gap filler as well as air gaps or voids in between the gap filler and the heat sink or heat source. These resistance sources may be a result of surface roughness or stepped faces in the application. In addition to thermal conductivity, durometer and conformability of the gap filler mitigates interfacial resistance.

Q: Are gap fillers repositionable?
A: Gap fillers with natural tack or containing a velvet finish are repositionable. There will be little impact on the functionality of the pad after repositioning as long as care is taken not to damage the pad during the repositioning process.

Q: What is the thickness tolerance of the silicone gap fillers?
A: The thickness tolerance for product 0.5mm and greater is ±10%. The thickness tolerance for gap fillers less than 0.5mm is ±20%.

Q: The surface of the gap filler feels tacky, is this normal?
A: The surface of the gap filler will have a small amount of tack, referred to as a "natural tack" as a result of the soft silicone wetting out smooth or semi-smooth surfaces. This tack is useful because it allows the material to stay in place during assembly. This surface tack is high enough to keep the material in place, but low enough to be easily removed and repositioned or allow for reworking an assembly if subsequent repairs or replacement are required.

Q: What is the Polymer Science proprietary "velvet finish?"
A: Polymer Science may offer its gap fillers coated with a thin, thermally conductive coating which decreases the natural tack on the surface of the coated gap filler. Some products are coated with the velvet finish as the standard, but can be offered without this coating if a natural tack is needed on both sides of the gap filler.

Q: Can a pressure sensitive adhesive be added to the P-THERM® Gap Filler?
A: The typical configuration of the material does not include a pressure sensitive adhesive, but can be added if mechanical anchorage is not present in the design or securement of the pad to the device is required. The gap pad can be supplied with an adhesive, or an adhesive that will adhere to silicone can be utilized to provide an adhesive layer to the construction.

Q: What is the shelf life of P-THERM® silicone gap fillers?
A: The shelf life of the gap fillers are 3 years from date of manufacture for materials shipped without an adhesive. After 3 years, the material should be reassessed for fitness of use in the particular application with regard to the natural tack of the product. The addition of an adhesive may reduce the shelf life.

Q: Are P-THERM® thermal management products electrically insulating?
A: Silicone gap fillers are electrically insulating. In addition to the silicone and ceramic additives being electrical insulators, a layer of fiberglass provides additional insulation. Polymer Science electronic control interface products are specifically designed to offer higher levels of insulation than other P-THERM® product types.

Q: What is P-THERM® Phase-Change Material (PCM)?
A: Phase change materials are thin non-silicone materials that have been loaded with thermally conductive additives which do not flow, but soften to a tacky interface which will conform into microscopic inconsistencies found at an interfacial boundary. P-THERM® PCMs will soften at 55 C and will cycle to and from this softened state over the life of the device after assembly. Applications where a Phase Change Material should be considered are when operating temperatures are greater than 55 C, but do not exceed the maximum use temperature of 93 C.

Q: Can P-THERM® Phase Change Materials be used without a mechanical fastener?
A: P-THERM® Phase change materials do not possess any pressure sensitive adhesive characteristics so will require the use of a mechanical fastener.

Q: What type of fastener should be used when using a P-THERM® PCM?

A: Phase change materials work best when a consistent amount of pressure is applied to the interface. 10 psi is the recommended application pressure. A spring mount or clip which can apply consistent pressure is preferred over a screw mount which is better suited for gap filler products.

Q: Can P-THERM® Phase Change Materials be reworked?

A: Phase change materials are able to be repositioned prior to heating. Once heat is applied to the system and the temperature exceeds 55 C, the material will soften and bond to the heat sink. This bond may require removal where it can be peeled away from the surface and should be replaced with a new piece of P-THERM® Phase Change Material.

Q: When should P-THERM® heat spreaders be used?

A: Heat spreaders are specifically designed to transfer heat in the x-y plane or spread the heat from a generation point across a larger surface area. They are used when thin profile, high heat applications such as high temperature LED or high heat generating components of smaller handheld devices need to be dispersed for protection of the component or the user of a device.

Q: What type of P-THERM® heat spreaders are available?

A: P-Therm® heat spreaders are available in aluminum and copper foil formats. Aluminum offers higher conformability, whereas copper offers a higher thermal conductivity in the x-y plane. Because foils offer the benefit of electrical conductivity, versions are available laminated to a dielectric film to help protect against shorting between charged components.

Q: Do P-THERM® heat spreaders have an adhesive?

A: Due to the non-adhesive characteristic of the foils used for P-THERM® heat spreaders, all foil based heat spreaders have been coated with a thermally conductive pressure sensitive acrylic adhesive. Polymer Science recommends that the adhesive be applied with 2 kg force per square inch for 2 seconds to ensure proper anchorage after the surface has been cleaned to remove surface dust and debris.

Q: Which P-THERM® gap filler is right for my application?

A: Gap fillers are available in a variety of bulk thermal conductivities, hardness and compression profiles. Polymer Science recommends a minimum of 20% compression for gap filler products. To determine the best gap filler product for the application, the gap to be filled, the amount of heat or rate of heat that needs to be transferred and the amount of compression force deflection which can be withstood by the components in the application should be understood. Compression force deflection profiles as well as thermal impedance vs compression data is available for all P-THERM® gap filler products upon request.

Glossary

Alumina (Al_2O_3): Common name given to aluminum oxide

Ambient Temperature: The temperature of the air surrounding a component

Apparent Thermal Conductivity: Measure which includes the measure of contact resistance

Arcing: Also known as electric arc, is the discharge between the edges of two metal surfaces

Binder: Material used in TIMS to get the desired mechanical characteristics and properties in conjunction with the fillers. These materials are generally good insulators and can be made up of silicone, urethane, acrylic, etc.

Bondline Thickness: The average distance between two surfaces. For example, the heat spreading material and the components. See MBLT

Breakdown Voltage: The voltage required to cause a failure through an insulator when tested using a specific set of conditions

Burr: A thin, jagged piece of metal left by the cutting or punching process

Calorie: A unit of energy measurement equal to the quantity of heat required to raise the temperature of 1 gram of water by one degree Celcius (C)

Compression Set: The amount of permanent deformation that occurs when a material is compressed to a specific deformation, for a specified time, at a specific temperature

Conduction: The transfer of heat energy through matter

Convection: The transfer of heat energy that results from motion of a fluid (can be liquid or gas)

Corona Discharge: A partial discharge within an insulator by ionization of the air within or on a contact surface

Creep Distance: Shortest path along the surface of the insulator between the conductive ends of the insulator

Cut-Through: This occurs when a *burr* punctures a thermal pad reducing or eliminating the insulating strength

Deflection: A change in thickness of the interface material in response to a compressive load. This generally leads to a proportional increase to its area

Degreaser or Degreasing Solvent: Solvent used to clean *flux* and other organic residues from circuit boards after manufacturing

Dielectric: Material that acts as an insulator

Dielectric Constant: The ratio of the electric permeability of the material to the electric permeability of free space (i.e., vacuum) and its value can be derived from a simplified capacitor model. See also *permittivity*

Dielectric Strength: For a pure electrically insulating material, the maximum electric field that the material can withstand under ideal conditions without undergoing electrical breakdown and becoming electrically conductive

Shore Durometer: Measures the hardness of material, its viscoelastic properties, and the resistance to the penetration of an indentor point into the surface of the material

Electric Insulator: A material whose internal electric charges do not flow freely; very little electric current will flow through it under the influence of an electric field

Elongation: Measure of the ductility of a material as determined by a tension test by the increase in the gauge-length of a test specimen after fracture divided by its original gauge-length

Filler: A fine, dispersible ceramic or metallic powder (*alumina*, boron nitride, graphite, silver, etc.) whose thermal conductivity is at least 20 times greater than the binder

Flow Rate: The volume, mass or weight of fluid which passes through per unit of time

Footprint: The area of the base of an electronic device which comes in contact with the TIM

Hard Tooling: A die cutting or converting tool manufactured from a metal block

Hardness: A measure of the ability of a material to withstand penetration by an indentor point

Heat (Q): A form of energy generated by the movement of atoms or molecules resulting in a change in temperature

Heat Flow: The rate at which heat is flowing per unit of time, expressed as Watts (W)

Heat Flux (Q/A): The rate of heat flow per unit of surface area, expressed as W/cm^2

Heat Transfer: The movement of heat from one body to another via *conduction, convection,* or *radiation*

Junction: The active part of the semiconductor where the current flow causes heat generation

MBLT: Minimum *bondline thickness;* when two substrates obtain the closest possible distance under pressure

Micro-Inch: A unit of measurement equal to 1millionth of an inch

Mil: A unit of measurement equal to 1 thousandth of an inch (0.001")

Outgassing: Release of volatile gases when materials are exposed to elevated temperatures and/or low atmospheric pressures

PCM: Abbreviation of phase change material

Permanent Set: The amount of residual displacement in rubber after the distorting load has been removed

Permeability: The degree of magnetization that a material obtains in response to an applied magnetic field

Permittivity: The ability of a substance to store electrical energy in an electric field

Poisson Ratio: The ratio of transverse strain to corresponding axial strain on a material stressed along one axis

Polyimide: An organic polymer with superior electrical insulation and high temperature capacities

Power Supply: A self contained unit which converts AC to DC for electronic device usage

Pressure Sensitive Adhesive (PSA): A type of non reactive adhesive which forms a bond when pressure is applied to bond the adhesive with the adherend

Radiation: The transfer of heat as a result of electromagnetic radiation, usually infrared rays

Reinforcement: A woven glass mesh or polymer film that is used as a support in TIMs

Relaxation: The gradual increase in deformation in elastomers under constant load over a period of time

Rheology: The branch of physics that deals with the deformation and flow of matter

Semiconductor: An electronic material that under one condition acts as an insulator and can act as a conductor under a different condition

Silicon: A nonmetal with semi-conducting properties, used in making electronic circuits

Solder: A mix of metals which melts at a lower temperature that connects electronic devices to the copper patterns on printed circuit boards

Solvent Resistance: The ability of a TIM to resist swelling when exposed to degreasers or organic solvents

Specific Gravity: The ratio of the density of a substance to the density of water

Surface Finish: Also known as surface texture or surface topography, is the nature of a surface as defined by the three characteristics of lay, surface roughness and waviness

Swelling: A result of elastomeric exposure and absorption to degreasing solvents

Tear Strength: The measure of the ability of a material to withstand tearing and ripping forces

Temperature: A measure of the average kinetic energy of a material

Temperature Gradient (ΔT): The direction and rate of temperature change between two points

Tensile Strength: The measure of a materials ability to withstand pulling forces

Thermal Conductivity (k): The measure of its ability to conduct heat

Thermal Contact Resistance (R_i): The resistance to the flow of heat from air, or other contaminants, trapped between the irregularities of the contacting solid surfaces

Thermogravimetric Analysis: The method of thermal analysis in which the mass of a sample is measured over time as a function temperature changes

Thermal Impedance: The resistance to heat flow defined as the sum of the material's resistance to all thermal contact resistances

TIM: The abreviation of thermal interface material

Thermal Interface Material: A material that is inserted between two components in order to enhance the thermal coupling between them

Thermal Resistivity: A heat property and a measurement of a temperature difference by which an object or material resists a heat flow; K m/W is the reciprocal of thermal conductivity

Thermocouple: An electrical device consisting of two dissimilar electrical conductors forming an electrical junction

Thixotropic: A time-dependent shear thinning property. Certain gels or fluids that are thick or viscous under static conditions will flow (become thinner, less viscous) over time when shaken, agitated, shear-stressed, or otherwise stressed

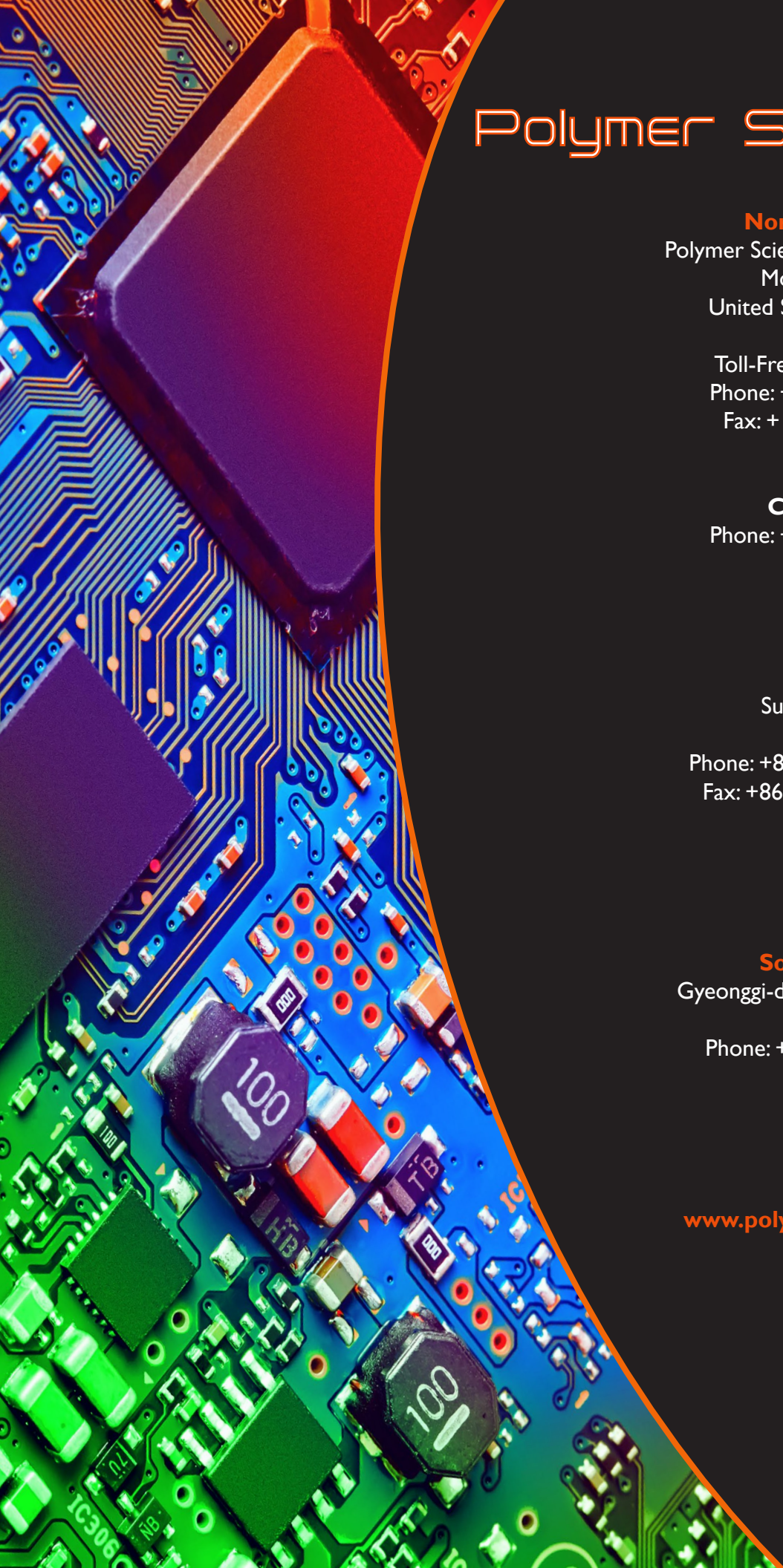
Tolerance: The permissible or allowable variations in the dimensions of materials

Torque: A twisting force that tends to cause rotation

Viscoelastic Material: The property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. Viscous materials, like honey, resist shear flow and strain linearly with time when stress is applied. Common types of these materials are referred to as "plastics"

Volume Resistivity: Represents an insulating material's resistance to leakage current through its body. It calculates the ratio of the potential gradient in relation to the current in a material with the same density

Watt: The SI unit of power equal to one joule per second



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