How to select the best gap filler solution for your application?

Ad Musters

28 May 2024

Thal Technologies company profile

PERFORMANCE MATERIALS

Protect electronics with Thal Thermal Interface and insulation materials

LED solutions

High-End Industrial LED modules design and manufacturing

THERMAL INTERFACE MATERIALS

INNOVATION

ENGINEERING

RESEARCH & DEVELOPMENT

MANUFACTURING

SUPPLY CHAIN

TESTING

QUALITY ASSURANCE

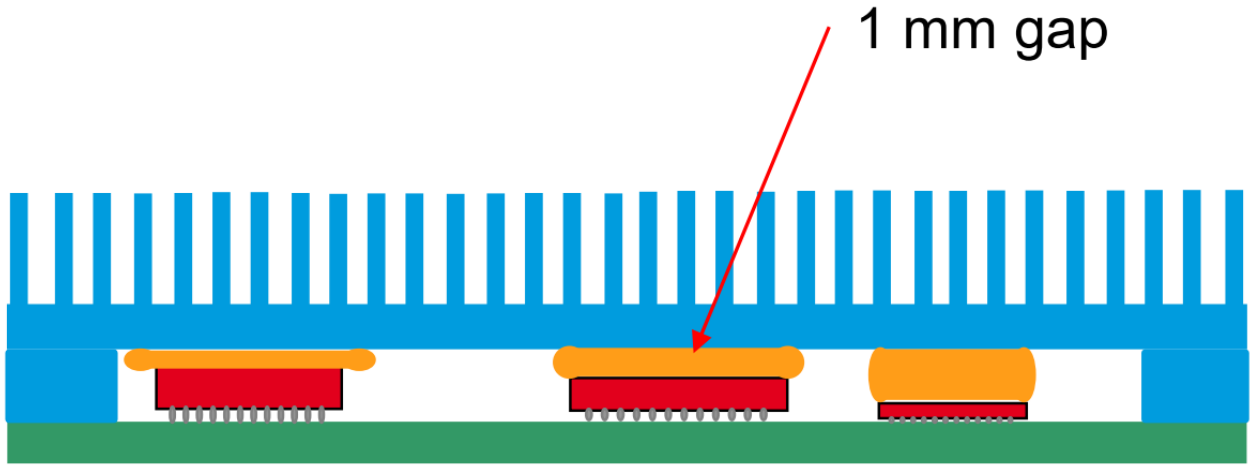
Problem statement

Avoid Electronic components from overheating

Meet lifetime requirement: Cool electronics last longer

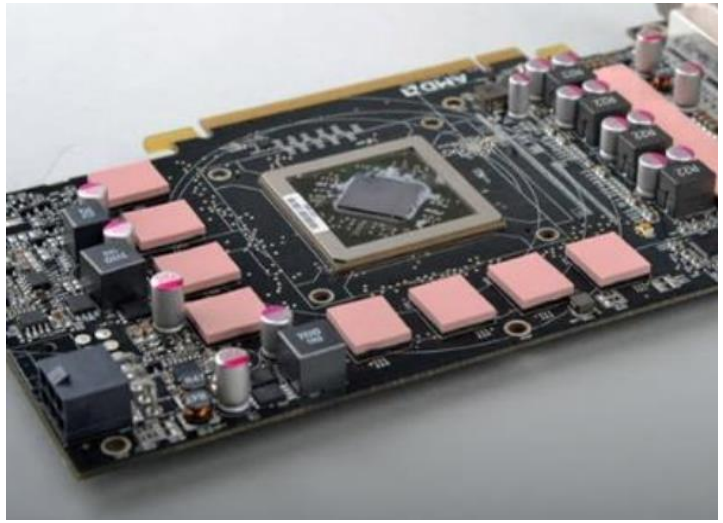
Thin thermal interface materials do not fill a gap with high tolerance

Avoid fan cooling

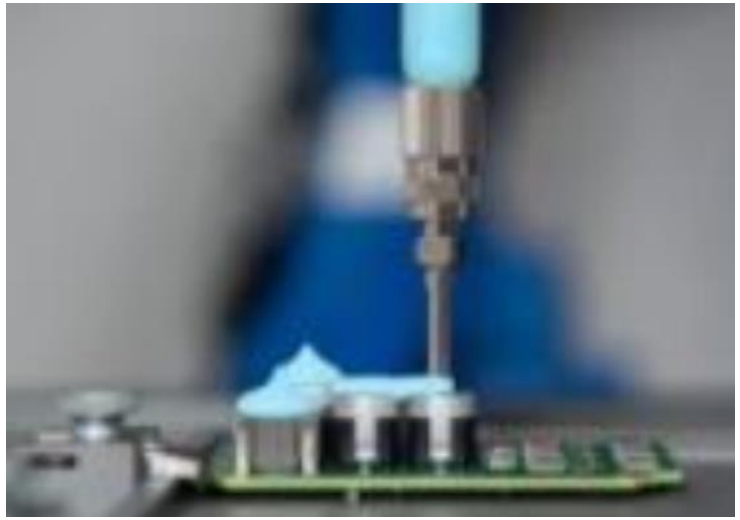


THAL TECHNOLOGIES

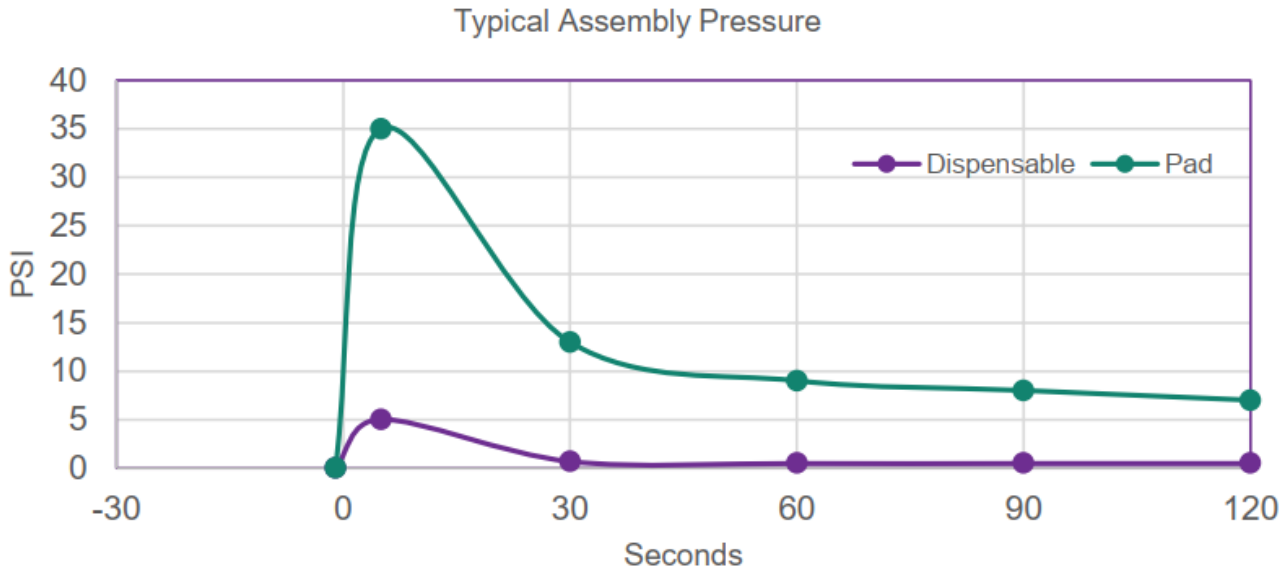
Type of gap fillers



- Gap pads



- Liquid gap filler



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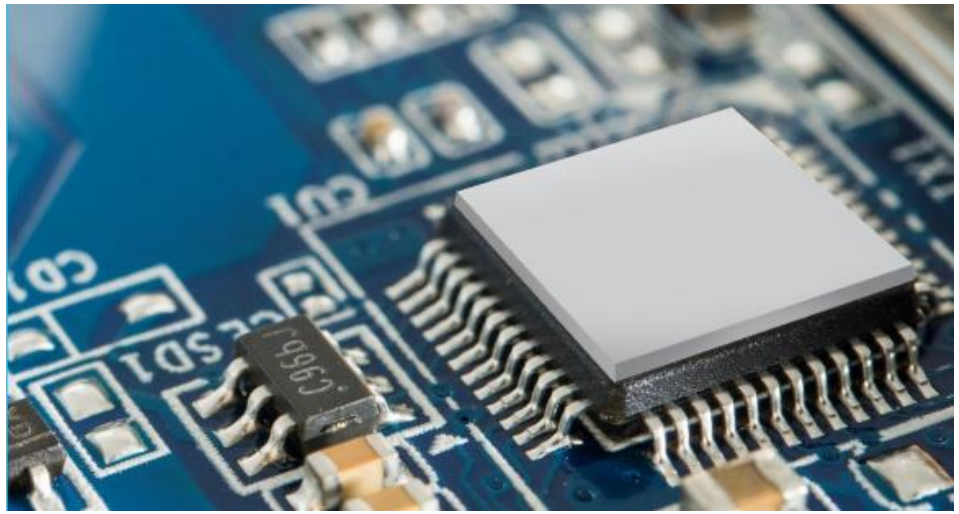
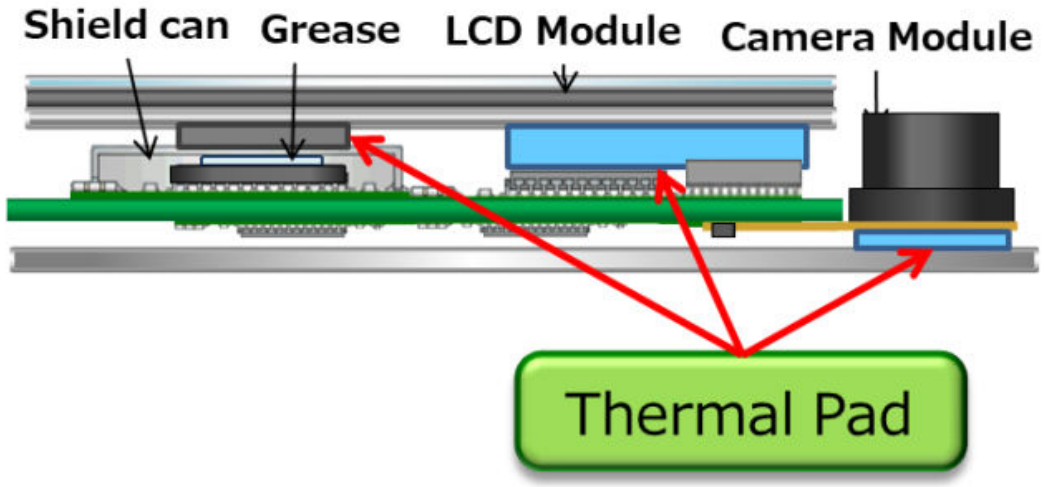
Gap pad types



- Silicone
- Non silicone
  - PU
  - Acrylic



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Material selection Silicone vs PU vs Acrylic

Property	Silicone	PolyUrethane	Acrylic
Softness	+++	+	++
Temperature range	+++	+	++
Price *	$$$$	$$	$$
Lifetime (proven)	+++	+	++
Sustainability	+	++	+++
Availability	+++	+	++
Thermoset/plast	Thermoset	Thermoplast	Thermoplast

* Thermal conductive filler material may be highest cost in the material stack

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Innovations in gap filler material

- Higher thermal conductivity
- Softer
- Trend to use, where possible, acrylic instead of silicone
- PFAS free
- Reduce or use no plasticizers (weekmakers)
- Lower abresive fillers for liquid gap fillers

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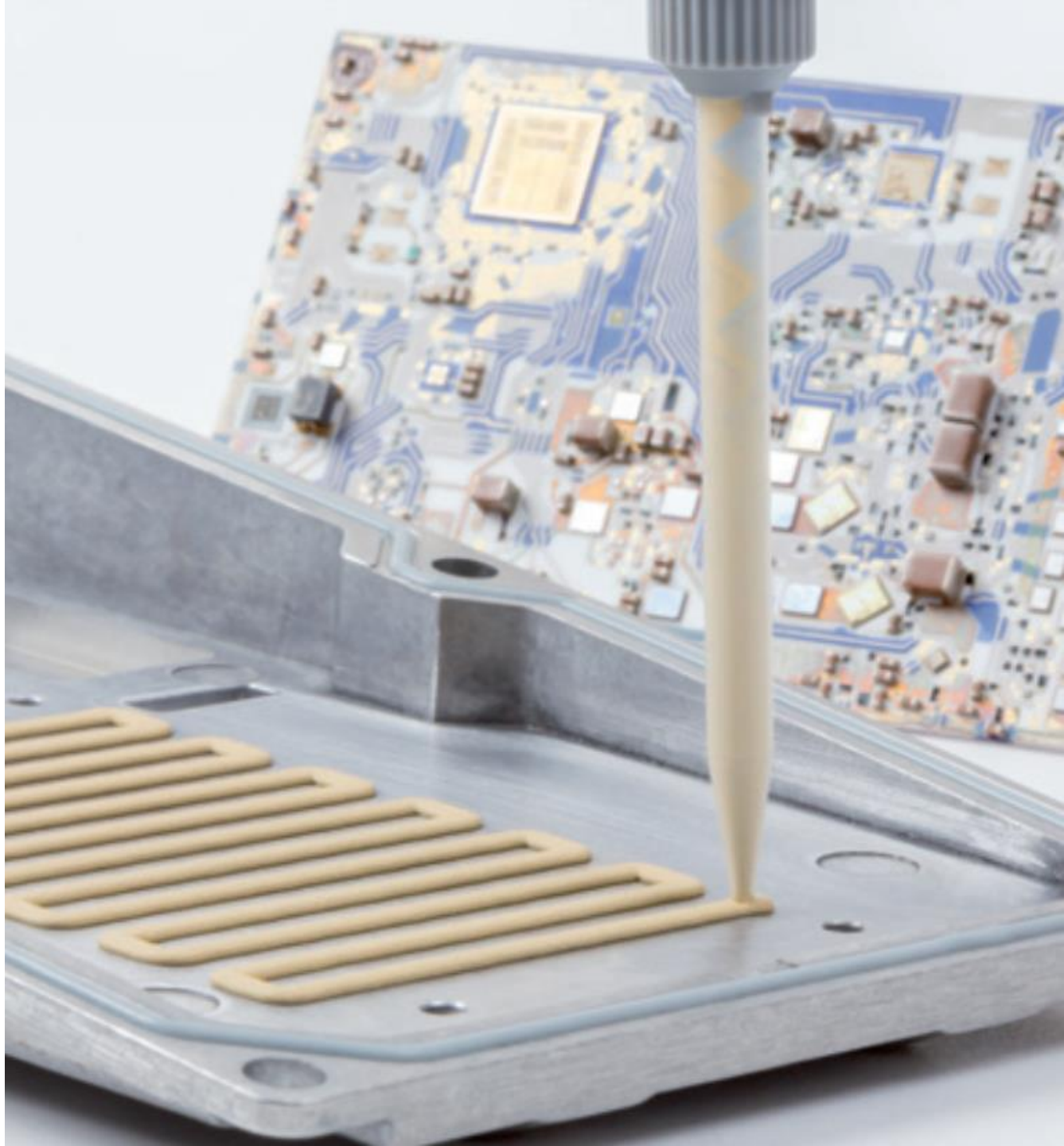
Liquid Gap filler

2-componenten
Cure in place

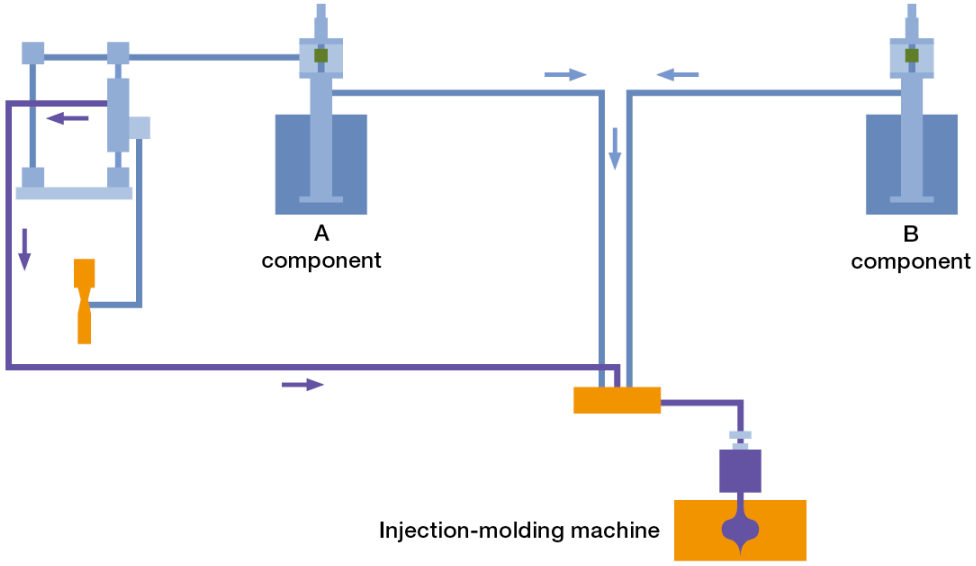
- **Silicone**
- **Non silicone (PU)**



Liquid gap filler applicatie

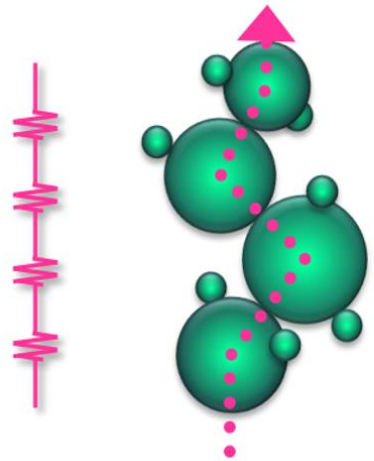
Dual cartridge 2x50ml, 2x200ml

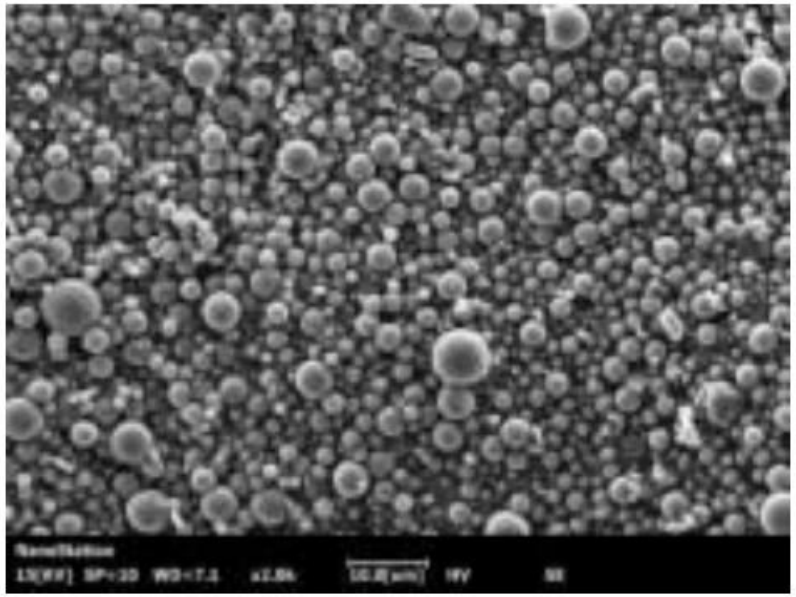
20kg bails or 200kg drums

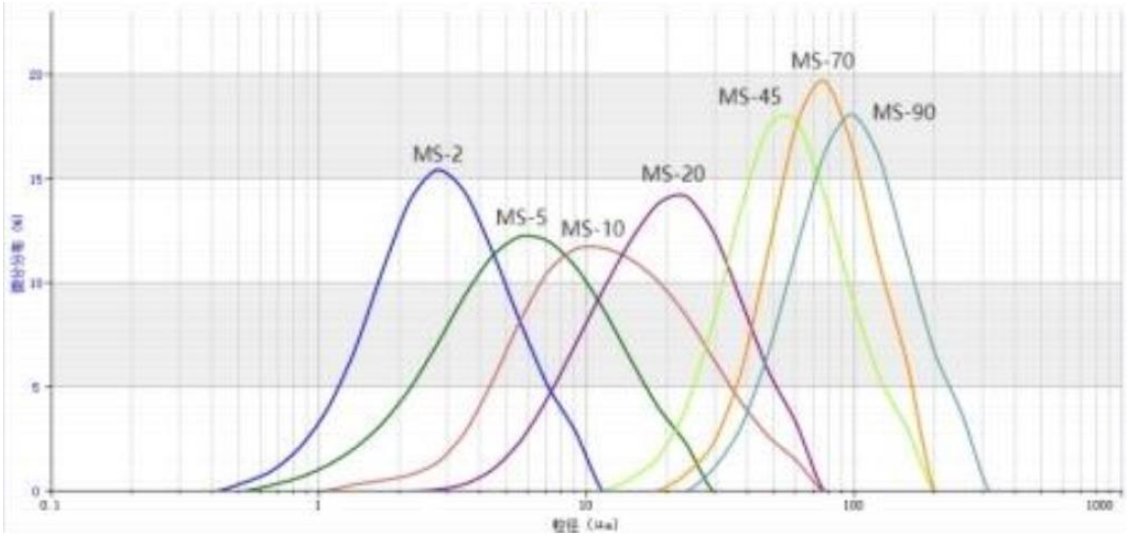


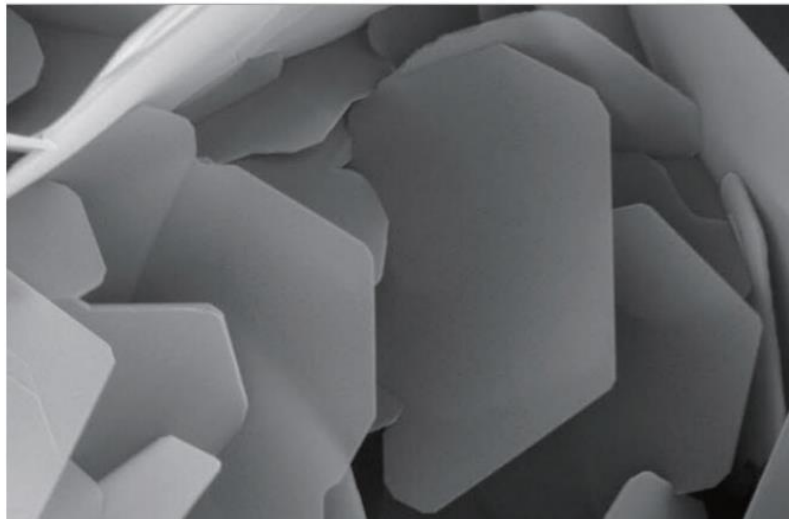
Fillers in gap filler material

Thermal Conductive Filler

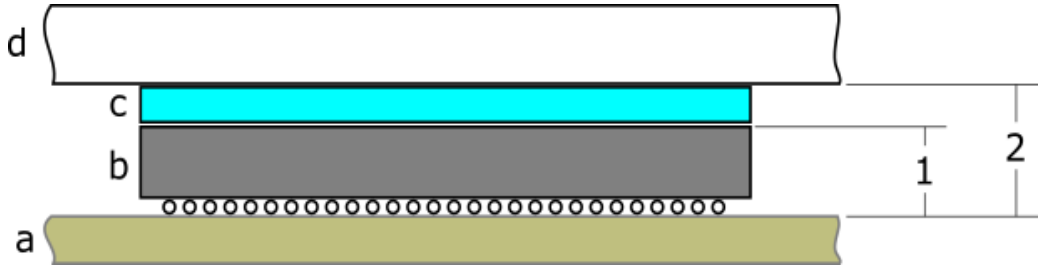




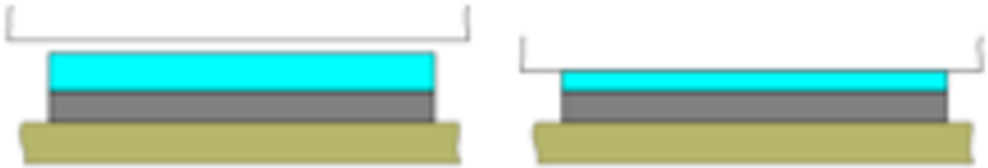




Calculate the gap



- Example:
  - Gap filler pad compression between 10% and 40%
  - Gap filler tolerance thickness +/- 10%
  - Dimension 1 = 1.25mm +/- 0.15mm
  - Dimension 2 = 2.8 mm +/- 0.1mm
  - Calculated Gap (c) is minimum 1.3mm and max 1.8mm
  - A gap pad of 2.0 mm would fit best here
- Avoid airgap and avoid high compression force



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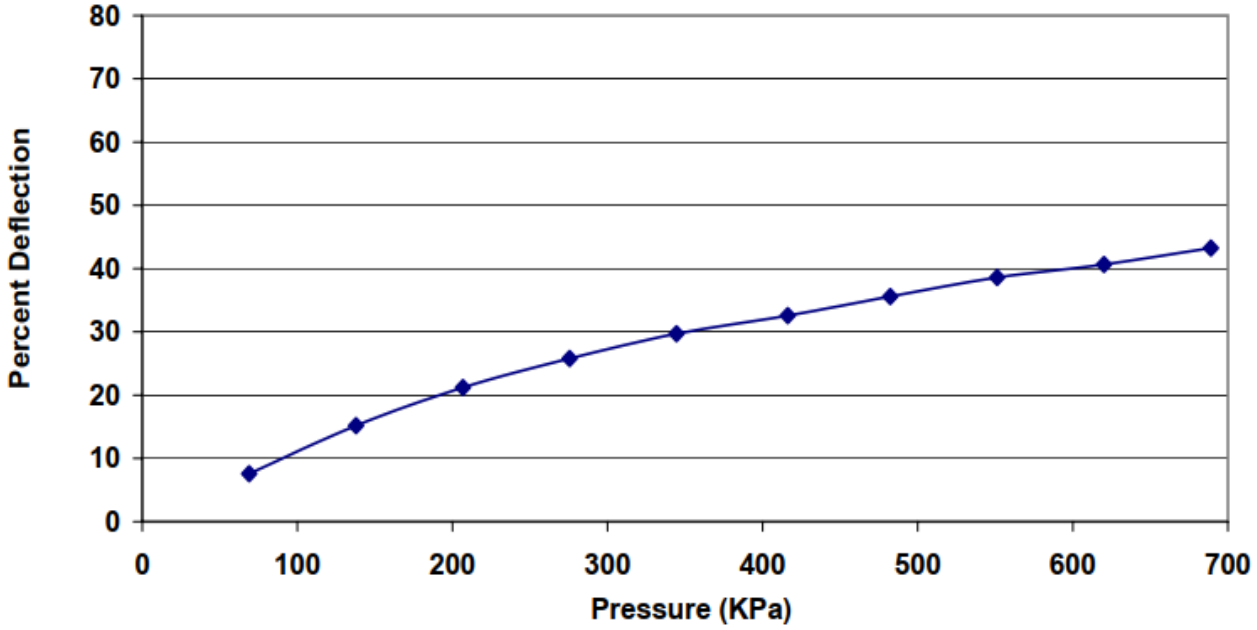

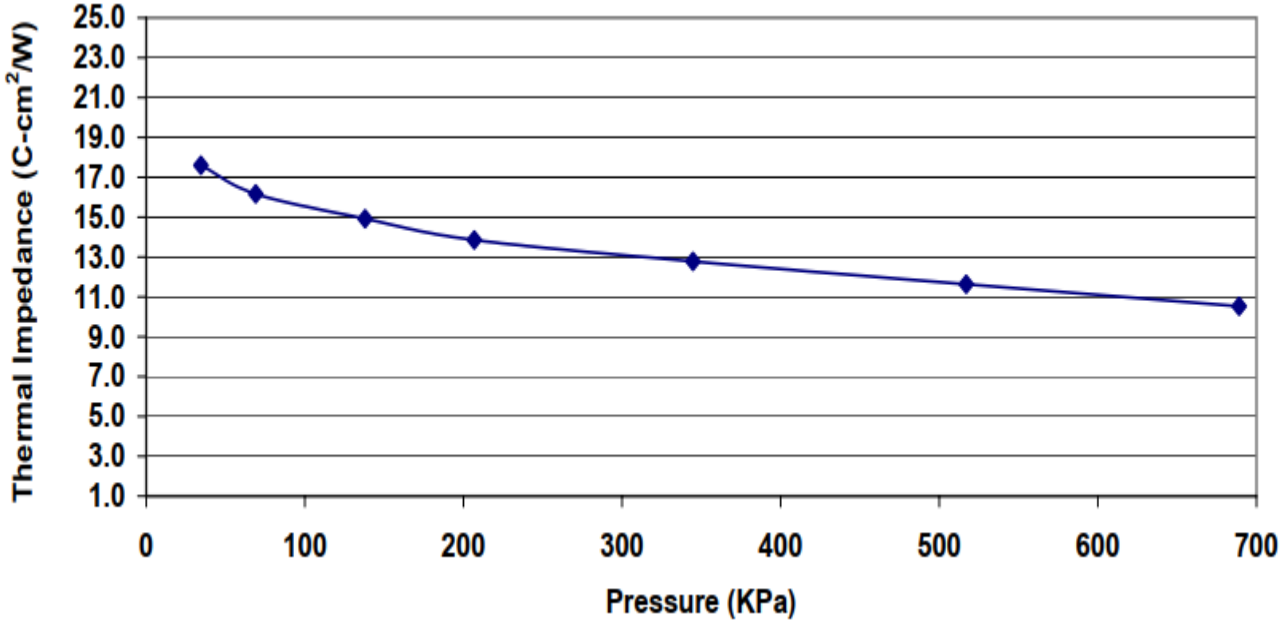

Pressure - Deflection - Thermal resistance

Typical 2.0 mm
Silicone Gap filler
Of 50 Shore 00

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Calculate the thermal resistance

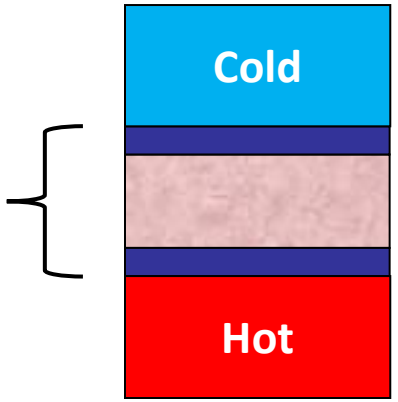
Construction & Composition	Reinforced boron nitride filled silicone elastomer
Color	Blue-Violet
Thickness	0.020" (0.51mm)
Thickness Tolerance	± 0.003" (± 0.08mm)
Density	1.38 g/cc
Hardness	40 Shore 00
Tensile Strength	N/A
% Elongation	N/A
Outgassing TML (Post Cured)	0.13%
Outgassing CVCM (Post Cured)	0.05%
UL Flammability Rating	UL 94 V0
Temperature Range	-45°C to 200°C
Thermal Conductivity	3 W/mK
Thermal Impedance @ 10 psi @ 69KPa	0.46 °C-in²/W 2.97 °C-cm²/W
Thermal Expansion	600 ppm/°C
Breakdown Voltage	3,000 Volts AC
Volume Resistivity	2 x 10^{13} ohm-cm
Dielectric Constant @ 1MHz	3.31

Thermal interface resistance

$$R_{i1} = {}^{1}/_{Ah_{i1}}$$

$$R_m = {}^{L}/_{kA}$$

$$R_{i2} = {}^{1}/_{Ah_{i2}}$$



$$T_h - T_c = \dot{Q}_{12} * R_{int}$$

$$R_{int} = \frac{h'}{A} \qquad h' = thermal\ impedance$$

Example component of 20mmx20mm, Gap filler of 0.51mm thickness

$$R_{int} = \frac{2.97}{2*2} = 1.19\text{K/W}$$

$$R_m = \frac{L}{kA} = \frac{0.51 * 10^{-3}}{3 * 20 * 20 * 10^{-6}}$$

$R_m = 0.43$ K/W → $R_{i1} = R_{i2} = 0.38$ K/W

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Gap filler properties

- Silicone or Non-silicone material
- High deflection
- Cost Effective
- Electricaly insulating
- Liquid gap filler can be abrasive or non/low abrasive
- Low bleed / Fogging
- Low / medium / high Thermal conductivity
- Softness/Hardness Shore 00
- Elastic/plastic behavior

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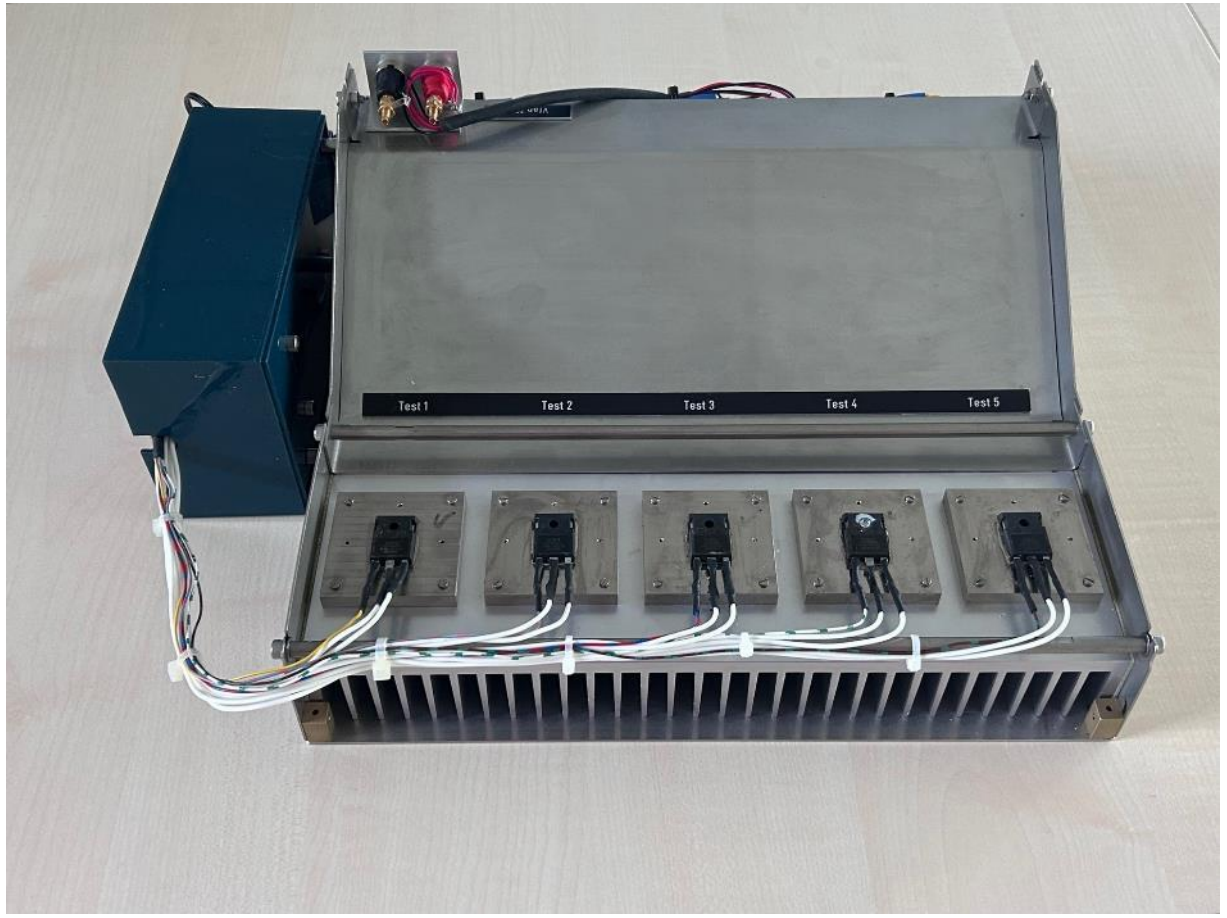
Life Demo at exhibition

- Special thanks to Optical Thermal Solutions who provided this test setup for us.
- 5 different type of gap fillers life under test.
- Thermal load by FETs mounted on 50x50mm Copper plates
- Large Heatsink fan cooled to have maximum cooling, maximum deltaT
- deltaT visible on laptop screen



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How can we help you?

- Ing. Ad Musters

Business Development Manager
Thal Technologies
adm@thal-technologies.com
www.thal-technologies.com
Tel. +31 36 2026060