

Dow Corning Electronics: Thermal Fabricated Materials

MEETING THE CHALLENGES
Across Applications and Industries

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Dow Corning INTERNAL

Overview

- Dow Corning Corporation
- Dow Corning Thermal Management
- Thermal Gap Pads
 - Products
 - Advantages and Benefits
- How to Find the Right Gap Pad for Your Application
- Application Success Stories

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Dow Corning Corporation

**We are innovative leaders
unleashing the power of silicon
to benefit everyone, everywhere.**



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Dow Corning Corporation

- Formed in 1943 in Midland, Michigan
- Company shares are equally owned by
The Dow Chemical Company and
Corning Incorporated



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Working Together to Help You Invent the Future

- 8,500 employees worldwide, including customer service, researchers, engineers, technicians, industry and manufacturing experts
- 22 global manufacturing sites, including facilities in China, Belgium, Germany, and U.S.
- 7,000 products and services; 25,000 customers
- 2006 sales of \$4.39 billion
- Global leader in silicone-based materials technology, development and manufacturing

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You Get More with Dow Corning

- Material, process and equipment integration
 - Development, testing, equipment procurement, production startup and optimization
- Product and application development expertise
 - Prototype production, process development, contract formulation and manufacturing, EH&S and packaging
- Total supply chain management
 - Optimizing the quality and flow of goods and information across the entire value chain

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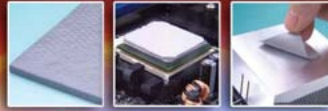
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Dow Corning® brand Thermal Interface Management Solutions

KEEPING IT COOL

*with pads, encapsulants,
greases and adhesives.*



How can you control and dissipate the increased heat generated by constantly evolving technologies?

Coordinate with a global company: Our ongoing technology development is part of a global network of sales, manufacturing, supply and support.

Focus on design: Dow Corning's thermal interface products are specifically designed to combine mechanical demands with superior thermal performance.

Add value: We assist in ensuring that you have access to the most cost-effective and process-efficient thermal solutions to serve current and emerging applications.

Please visit us at www.dowcorning.com/electronics for more information on our thermal solutions.

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Dow Corning Thermal Management Capabilities

- Broad thermal silicone formulation expertise.
- Global sales and supply chain capabilities.
- Market leader in dispensible, printable and curable wet thermal materials.
 - Our performance thermal grease designed for TIM 1 and TIM 2 applications and our industry standard thermal adhesives are used everywhere from automotive to packaging applications.
- We continue to invest in our thermal greases, adhesives, conductive lidseals and thermal pads product lines.

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Thermal Gap Pads

For Your Thermal Interface Needs

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Dow Corning® 15XX Gap Pads

Description:

- Cost competitive, fiberglass reinforced, thermally conductive silicone gel pad.
- Flame retardant and one-side tacky options.
- Electrically insulating material that is shock absorbing, easy-to-handle and moderately tacky.

Applications:

- Low-power, heat-generating components
- Applications requiring complex die cut shapes (i.e., heat sinks, boards, chassis, etc.)

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Dow Corning® 15XX Gap Pads

Features and Benefits

- Thermal conductivity: 1.3 W/mK
- One side tacky, easy-to-handle
- Re-workable and excellent for complicated die cut shapes
- Good compression for stress relief and shock dampening
- Flame retardant (UL 94 V0)
- Electrically insulating

Applications

- Computer memory chips
- CD-ROM/DVD
- LCD TV backlight unit
- Handheld devices

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Dow Corning® 15XX Gap Pads

- *Dow Corning® TP-1500 Thermal Pad*
- *Dow Corning® TP-1502 Thermal Pad*
- *Dow Corning® TP-1560 Thermal Pad*
- *Dow Corning® TP-1562 Thermal Pad*

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Dow Corning® 21XX Gap Pads

Description:

- Cost-competitive, highly compressible silicone gel with moderate bulk conductivity.
- This extremely compressible gel uses foam reinforcement to maintain compressibility; while providing ease of application and long-term reliability.

Applications:

- Low-power applications requiring heat transfer across any large air gap.

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Dow Corning® 21XX Gap Pads

Features and Benefits

- Thermal conductivity: 0.73 W/mk
- Both sides compressible
- Foam reinforcement
- V0 flammability rating
- Alumina filled system

Applications

- Low-power applications like NB and DT memory
- DIM modules
- Handheld devices
- Flat panel displays
- When some heat transfer is required
- When noise/drop vibration dampening is required

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Dow Corning® 21XX Gap Pads

- Dow Corning® TP-2100 Thermal Pad
- Dow Corning® TP-2101 Thermal Pad
- Dow Corning® TP-2160 Thermal Pad

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Dow Corning® 22XX Gap Pads

Description:

- Fiberglass reinforced, cost-competitive, thermally conductive silicone gel pad.
- This electrically insulating material provides shock absorption and easy handling with moderate tackiness on one side.

Applications:

- Low-power heat-generating components.
- Applications requiring complex die cut shapes (i.e., heat sinks, boards, chassis, etc.).

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Dow Corning® 22XX Gap Pads

Features and Benefits

- Thermal conductivity: 1.6 W/mK
- Reworkable
- Easy to die cut
- Compressible
- Electrically insulating

Applications

- Display driver IC
- Computer memory chips
- Game consoles
- Telecommunications
- CDROM, DVD
- Gap between CPU and heat spreader

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Dow Corning® 22XX Gap Pads

- *Dow Corning® TP-2200 Thermal Pad*
- *Dow Corning® TP-2260 Thermal Pad*

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Dow Corning® 23XX Gap Pad

Description:

- Cost-competitive, highly compressible, thermally conductive silicone gel pad.
- This filled gel delivers above average bulk thermal properties and industry leading thermal resistance in moderate to high-heat flux applications.

Applications:

- Heat-generating components and related heat sinks, boards or chassis.

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Dow Corning® 23XX Gap Pad

Features and Benefits

- Thermal conductivity: 1.4 W/mK
- Excellent handling and ease of assembly
- High compressibility
- Flame retardant (UL 94 V0 for 4.6 mm)

Applications

- Graphics CPUs
- Chipsets
- Memory
- Optical drive devices
- Mass storage devices
- Telecom equipment and other mid-to-high power devices requiring heat transfer across a gap between chassis heat sink
- Heat pipe or other component assembly

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Dow Corning® 23XX Gap Pad

– Dow Corning® TP-2300 Thermal Pad

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Dow Corning® 35XX Gap Pads

Description:

- Thermally conductive silicone gel pad with a good combination of high thermal conductivity and compressibility, along with one-side tacky feature.
- This fiberglass reinforced gel gives reduced interfacial thermal resistance along with shock absorption and ease of application.

Applications:

- High-power, heat-generating components and related heat sinks, boards or chassis.

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Dow Corning® 35XX Gap Pads

Features and Benefits

- Thermal conductivity: 3.5 W/mK
- Reworkable
- Easy to die cut
- High compressibility
- Electrically insulating

Applications

- Display driver IC
- Computer memory chips
- Game consoles
- Telecommunications
- CDROM/DVD cooling
- Gap between CPU and heat spreader

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Dow Corning® 35XX Gap Pads

- *Dow Corning® TP-3500 Thermal Pad*
- *Dow Corning® TP-3560 Thermal Pad*

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Benefits of Dow Corning

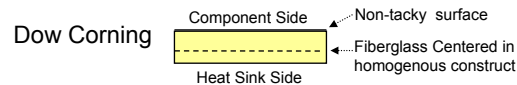
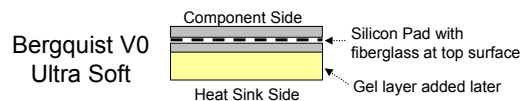
- **Ease of use** — Cold-applied, requiring no heating or curing. Assemblers can remove them with minimum effort, allowing quick, efficient cleaning without special tools. Well suited to automated application with pick-and-place equipment.
- **Broad functionality** — Effective as heat-transfer media, dielectric barriers and stress-relieving shock/vibration absorbers.
- **Flexibility** — High performance and durability over an extremely wide range of temperature and humidity. Excellent compressibility allows varying component height with low clamping force. Numerous thickness options to fill any gap, while helping to minimize system costs.

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Advantages of Dow Corning

Dow Corning's pad construction is unique in the market. Our fiberglass reinforced pad is compressible on both sides.



Additional Advantages:

1. Less interfacial concerns
2. Ability to formulate to unmet needs
3. Handleability (no crumble)
4. Better compression set

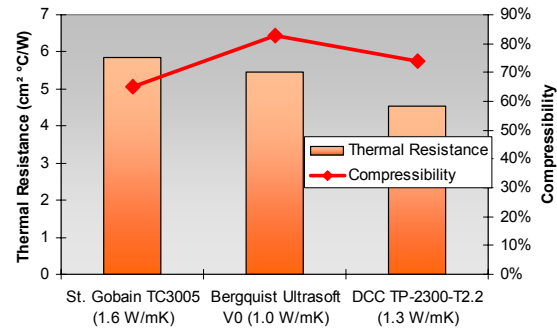
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Advantages of Dow Corning

Head-to-Head :

When comparing the same size and thickness, Dow Corning delivers better thermal performance and equivalent compressibility.



lower resistance = higher thermal properties
higher compressibility = softer, more compliant pad

Samples of same size and thickness tested per method below on same equipment:
Thermal resistance by Guarded Hot Plate technique.
Thermal resistance in chart measured at applied pressure of 50N/cm² using samples with initial 1mm nominal thickness.
Compressibility measured by % change in thickness from initial (1mm) thickness under 50N/cm² applied pressure.



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Converter Capability

- Converters provide customized part solutions and improve responsiveness to meet the needs from design phase to production.
- Dow Corning has established Converters in North America, Europe and Asia.
- To contact our Converters, please email electronics@dowcorning.com.



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How to Find the Right Gap Pad for your Application

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Definitions

- **Bond Line Thickness (BLT)** – the gap or area to fill between two surfaces.
- **Bulk Thermal Conductivity** – the natural ability of any material to transfer heat, regardless of thickness.
 - Higher values are better – units (W/mK)
 - This value is important for applications with thicker bond lines (> 0.5 mm).
- **Thermal Resistance** – the amount of resistance to transferring heat across an interface or through a material. This property is thickness and area dependent.
 - The lower value for the material is better – units ($^{\circ}\text{C}/\text{W}$) or ($\text{in}^2\text{C}/\text{W}$)
 - Conformability of the material is critical.
 - This value is important for application with thin bond lines (<0.5 mm).

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Features of Gap Pads

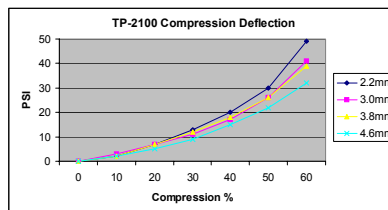
- Soft/compressible
- Provides low stress on the component
- Perfect for non-parallel or rough surfaces

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Pressure vs. Thickness

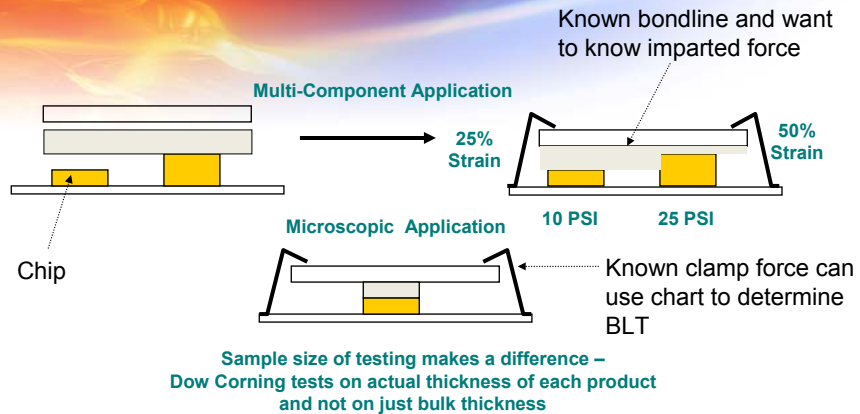
- Pressure vs. thickness data shows what the compression force is at various thicknesses.
- It is useful to determine:
 - If the material is soft/compressible.
 - The amount of stress on the component.



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Thick vs. Thin



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Thick vs. Thin

- Pads with the same thickness may be applicable for different height components under the same back lid/cover.
- Larger and thicker pads may be the best choice to cover larger areas with differential component heights.
 - This allows for a one-step application vs. multiple steps with several small piece applications per component.

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Thick vs. Thin

– Cost/throughput considerations of using a larger gap pad:

- One-step application vs. several small pieces in a multiple-step application.
- Reduce the possible risk of misplacement.
- Stays in place better than several small pads when exposed to vibration during assembly, packaging, transportation and use

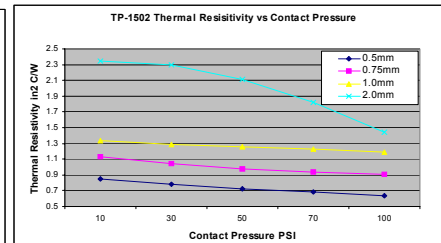
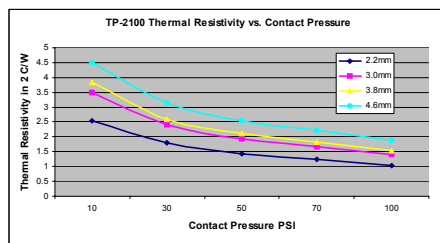
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Pressure vs. Thermal Resistance

– We have the flexibility to design according to your performance needs and stress tolerance threshold.



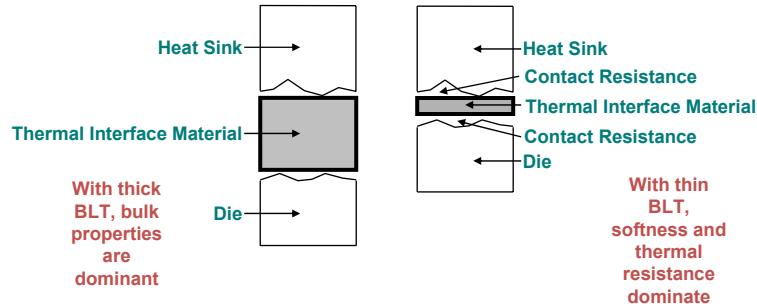
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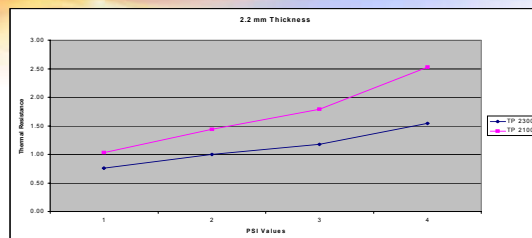
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What is the Dominant Resistance?

Dominant Resistance helps to determine if a high bulk thermal material is needed or if compressibility/hardness is dominant product attribute.



Thickness vs. Thermal Resistance



- Higher slope material is ideal for a low BLT application.
- Lower slope material can be used for higher thickness application without sacrificing thermal performance significantly.
- Note: A straight line would indicate a homogeneous material.

Metric Conversions

- For metric conversions on compression deflection and thermal resistance for all 12 of the thermal gap pads, please view this PDF.
 - Compression Deflection (%) at given pressure ASTM D575 (Measured at specified thickness)
 - Thermal Resistance ($^{\circ}\text{C}\text{-cm}^2/\text{W}$) ASTM D5470

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Application Success Stories

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Application Success Stories

- Customer: Safety and Security Equipment Manufacturer
 - Needed to transfer heat from a NAACO motor controller and housing currently using 340 and moving to a pad.
 - Product Solution: *Dow Corning*[®] TP-1500 thermal gap pad
- Customer Physical Fitness Equipment Manufacturer
 - Need a thermal pad at the interface of a heat sink and a heat producing sensor for physical fitness equipment.
 - Product Solution: *Dow Corning*[®] TP-1500 thermal gap pad

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Application Success Stories

- Customer: Gaming Manufacturer
 - Needed to transfer heat from a band of low-power LEDs to the heat sink for arcade machines.
 - Product Solution: *Dow Corning*[®] TP-1500 thermal gap pad
- Customer: PDP (Plasma Display Panel) Manufacturers
 - Need a thermal gap filling pad to transfer heat from both sides of the Driver IC.
 - Product Solutions: *Dow Corning*[®] TP-1562 thermal gap pad, *Dow Corning*[®] TP-2260 thermal gap pad and *Dow Corning*[®] TP-3560 thermal gap pad

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Application Success Stories

- Customer: Manufacturer of Components for Utility, Industrial and Recreational Vehicles
 - Needed a thermal gap filling pad to transfer heat between the electric motor and housing for hydraulic brake actuation trailer axles.
 - Product Solution: *Dow Corning*[®] TP-1560 thermal gap pad
- Customer: Beverage Dispensing Company
 - Needed to transfer heat from white LEDs to printed circuit board for a beverage dispensing machine.
 - Product: *Dow Corning*[®] TP-1560 thermal gap pad

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Application Success Stories

- Customer: Security Systems Manufacturer
 - Needed a gap pad to transfer heat between PCB and the housing for camera system in stores and supermarkets.
 - Product Solution: *Dow Corning*[®] TP-2100 thermal gap pad
- Customer: Survey Equipment Manufacturer
 - Needed a gap filler solution between two microprocessors on the PCB and the housing for seismic wireless devices used to locate oil and gas.
 - Product Solution: *Dow Corning*[®] TP-2101 thermal gap pad

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How to control and dissipate the heat generated by evolving technologies.

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