KEEP COOL — PERFORM BETTER.

Thermal Interface Materials for Today’s Electronics

Portfolio of Products
As an advanced materials supplier, Honeywell has been meeting the application needs of electronic device manufacturers for more than 50 years, and we continue to provide vital materials for thermal management solutions across multiple industries.

**THERMAL INTERFACE MATERIALS FOR TODAY’S ELECTRONICS**

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| High Compressibility Gap Filler | Thermal Gap Pads | TGP1200 | Cost Effectiveness | 1.2 |
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| Thermal Putty Pads | Thermal Conductivity Electrical Insulation | TIP1500 | High Breakdown Voltage | 1.5 |
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| HLT3500 | Cost Effectiveness | 3.5 |
| HLT7000 | High Reliability, Easy to Dispense | 7.0 |
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| HLT10000 | High Reliability, Easy to Dispense | 10.0 |
HONEYWELL STRENGTH

For over half a century, Honeywell has been a key supplier to the worldwide electronics industry, providing critical materials to enhance the performance and reliability of our customers’ products.

SOLVING INCREASING THERMAL CHALLENGES FOR TODAY AND TOMORROW

Our ongoing investment in research for more advanced materials has resulted in breakthroughs for key applications—thermal interface materials (TIMs) such as phase change materials, and low alpha particle materials for electrical interconnect. The modern electronics industry is constantly advancing toward higher power consumption and more integrated functions and miniaturization, resulting in a sharp increase in the power density of modern electronic devices. In fact, we have entered the era of 5G. Therefore, efficient heat dissipation has become an even more critical requirement for the design of modern electronic packages. Thermal interface materials (TIMs) are widely employed to manufacture the most critical parts in the heat dissipation system, to cool and protect integrated circuit (IC) chips.

Honeywell TIMs are based on proprietary technologies of polymer matrices and thermally conductive fillers, enabling them to handle challenging heat dissipation issues with long-term reliability and low cost of ownership.

A FOUNDATION OF EXPERTISE

Honeywell’s commitment to advanced materials research is evidenced by its three global centers for excellence in the US and China. Whether adapted from our extensive portfolio of proven materials, or created for a specific customer, all Honeywell products undergo rigorous research, testing and quality control protocols.

Honeywell’s research and development center in Shanghai, China.

TARGETED MATERIALS

Smartphones and tablets experience sudden temperature spikes, requiring very high thermal performance, while power electronics in automobiles need extreme thermal stability to meet warranties that stretch over long lifetimes. Our TIMs portfolio is designed to meet these varying needs and more.

OUR APPROACH

We have designed our products to optimize thermal impedance. This means that we look at the entire thermal path, not just the TIM itself. This includes the material interfaces, the thermal expansion of the joining interfaces, contact resistance and bond line thicknesses. Our portfolio of materials dissipate heat away from the IC, in an appropriate way for the device structure, packaging design and application. The design of Honeywell’s phase change materials (PCMs) is driven by an innovative polymer technology and advanced filler systems, which can be customized to fit diverse product applications and end uses.

COUNT ON HONEYWELL

- 50+ years providing materials for electronic products.
- More than 1,000 employees across the United States, Europe and Asia.
- 3 major R&D centers located in California, Washington and China.
- Continuous investment in research and development.
- Worldwide strategic collaborations.
- Approximately 400 granted and pending patents.

Determining Your TIM Requirements

The role of Thermal Interface Materials is to dissipate heat as quickly and effectively as possible from the device. But not all devices are the same. Requirements are driven by product use, product life cycle, packaging design, and operating conditions:

Thermal Performance

Increasing power densities are raising device temperatures — requiring more effective TIM solutions that must deliver low thermal impedance and high bulk conductivity. Reducing operating temperature can reduce device throttling, while increasing efficiency and design flexibility.

Product Life Cycle & Reliability

Mobile products such as tablets and smartphones have a relatively short product life, but still require thermal management to protect from extreme and sudden bursts of energy and temperature spikes. Conversely, automotive, power and server products must remain robust for significantly longer product life cycles. These applications involve harsh operating conditions such as extreme heat and humidity, which must be taken into account in choosing the best TIM material.

The key requirement in these applications is not just immediate performance but also sustained, long-term thermal stability.

Gaps & Bondline Thickness

IC designers are continually looking for ways to achieve more processing power in less space. Additionally, high power devices with dedicated heat sinks aim to achieve an extremely thin TIM bond line with low thermal impedance and a reduced thermal path. To add to the complexity, chip-scale packages assembled on a PC board will share the same heat spreader but will have different heights with varying gaps, requiring a TIM that delivers both thermal and compressible properties.

Taking all this into consideration, it is important for today’s TIMs to provide effective thermal management in increasingly constrained environments and different assembly designs.
Phase change materials (PCM) are often used as matrix materials for thermal interface applications, because they are solid at room temperature, and soften when heated. They can fully fill the gaps of contact surfaces, therefore providing a thin bondline and high reliability without pump-out issues.

**TYPICAL APPLICATIONS**
- Power control unit, inverter, onboard electronics
- IGBT
- Servers, supercomputing, video graphic array (VGA) cards, AI, GPU/Desktop, solid state drives (SSD)
- Switches, routers, base stations
- Tablets, gaming, notebooks, smartphones, action cameras
- Lighting

**THERMALLY CONDUCTIVE PHASE CHANGE MATERIAL**

For many applications, the Honeywell solution, which adds a TC filler to the PCM matrix, forms a phase change composite with high heat transfer performance that solves these pump-out issues. Honeywell offers both pad and paste formats for its thermally conductive PCM. These products were designed to minimize thermal resistance at interfaces and maintain stable performance through the rigorous reliability testing required for long product life applications.

Based on a robust polymer PCM structure, this material exhibits effective wetting properties during typical operating temperature ranges, resulting in very low surface contact resistance. The proprietary material provides superior reliability and maintains low thermal impedance, making PCM desirable for high-performance integrated circuit devices.

For almost 20 years, PCM products have been a Honeywell mainstay for thermal solutions in a wide variety of applications.

**FEATURES**
- High performance filler and polymer technology
- Phase change at 45˚C
- Highly conductive filler loading to optimize performance
- Superior handling and reworkability
- Superior reliable thermal performance
- Range of thermal properties to fit different needs

**LTM6300, PCM45F, PTM5000, PTM6000, PTM6000HV, PTM7000, PTM7900, PTM7950**

**Recommended Application**
Clamping pressure and temperature are suggested to achieve a minimum bond line thickness, typically less than 1.5 mil (0.038mm) for best thermal performance.

**Storage & Use**
Shelf Life: 12 months at 23±2˚C

**Availability**
PCM material is available in both sheet and roll formats. Stencil printable (SP) material is available in 300cc syringes or 1kg jars.

**Thickness Range:** 0.2mm–1.0mm (PTM7950 is only available in 0.25mm thickness)

**Thickness Tolerance:** ±0.075mm

**TYPICAL PROPERTIES**

<table>
<thead>
<tr>
<th>PROPERTY DESCRIPTION</th>
<th>LTM SERIES</th>
<th>PCM45F SERIES</th>
<th>PTM5000 SERIES</th>
<th>PTM6000 SERIES*</th>
<th>PTM7000 SERIES</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.8</td>
<td>2.2</td>
<td>2.3</td>
<td>2.3</td>
<td>2.7</td>
<td>ASTM D374</td>
</tr>
<tr>
<td>Thickness Range (mm)</td>
<td>NA</td>
<td>0.20-1.00</td>
<td>0.20-1.00</td>
<td>0.20-1.00</td>
<td>0.20-1.00</td>
<td>NA</td>
</tr>
<tr>
<td>Thermal Conductivity (W/m·K)</td>
<td>1.8-2.4</td>
<td>2.0-2.5</td>
<td>3.5-4.5</td>
<td>3.5-4.5</td>
<td>6.0-8.5</td>
<td>ASTM D5470</td>
</tr>
<tr>
<td>Thermal Conductivity @ no shim (°C·cm/ W)</td>
<td>0.12-0.14</td>
<td>0.09-0.12</td>
<td>0.06-0.08</td>
<td>0.06-0.08</td>
<td>0.04-0.06</td>
<td>ASTM D5470 Modified</td>
</tr>
<tr>
<td>Electrical Property</td>
<td>Volume Resistivity (ohm cm)</td>
<td>3.0×10¹⁰</td>
<td>8.2×10¹⁰</td>
<td>2.1×10¹⁰</td>
<td>2.1×10¹⁰</td>
<td>2.1×10¹⁰</td>
</tr>
</tbody>
</table>

*PTM6000 has higher reliability than PTM5000 Series

**THEORITICAL CURVE:**
- PCM Viscosity vs. Temperature
- Solid
- Liquid/Gel State
- Optimal surface wetting
- Low contact resistance
- Low thermal impedance

**Increasing Temperature**

**PCM PERFORMANCE**

**THERMALLY CONDUCTIVE PHASE CHANGE MATERIAL**

For many applications, the Honeywell solution, which adds a TC filler to the PCM matrix, forms a phase change composite with high heat transfer performance that solves these pump-out issues. Honeywell offers both pad and paste formats for its thermally conductive PCM. These products were designed to minimize thermal resistance at interfaces and maintain stable performance through the rigorous reliability testing required for long product life applications.

Based on a robust polymer PCM structure, this material exhibits effective wetting properties during typical operating temperature ranges, resulting in very low surface contact resistance. The proprietary material provides superior reliability and maintains low thermal impedance, making PCM desirable for high-performance integrated circuit devices.

Honeywell offers PCM in both pad and paste formats.

**PCM paste is well-suited for the stencil printing application process.**
Honeywell Thermal Gap Pads (TGP)s provide high thermal performance with ease of use for many applications. Ultra-high compressibility enables low stress and excellent conformity to mating surfaces. Honeywell TGP models are naturally tacky, and require no additional adhesive which could inhibit thermal performance.

**Models:** TGP1200, TGP1500, TGP3000, TGP5000, TGP6000, TGP8000

**TYPICAL APPLICATIONS**
- Consumer electronics
- Telecommunications & network servers
- Automotive electronics
- Power devices & modules
- Semiconductor logic & memory

**THERMALLY CONDUCTIVE, HIGH COMPRESSIBILITY GAP PAD**

Honeywell TGP models provide thermal performance with ease of use across a multitude of applications. They have been designed to minimize thermal resistance at interfaces, and maintain effective performance through reliability testing. TGP models are silicone based, therefore they offer a certain anti-shock effect, with electrical isolation and non-flammability.

Honeywell TGP models are naturally tacky, and require no additional adhesive which could inhibit thermal performance. A range of thicknesses from 0.5mm to 5.0mm are available. Honeywell TGP models come with two surface liners, which enables users to remove the liner after installation (before operation), with no contaminant risk and easier handling.

**FEATURES**
- High thermal performance
- Ultra-high compressibility for low stress applications
- Excellent surface wetting for low contact resistance
- High reliability
- Electrically insulating

**Storage & Use**

**Shelf Life:** 12 months at 23±2°C

**Thickness Range:** 0.5-5.0mm with 0.25mm incremental

**Thickness Tolerance:**
- 1mm: ±10%
- 0.5-1mm: ±0.1mm
- <0.5mm: ±0.05mm

Please check thickness availability before ordering.

**FEATURES**
- High thermal performance
- Ultra-high compressibility for low stress applications
- Excellent surface wetting for low contact resistance
- High reliability
- Electrically insulating

**THERMALLY CONDUCTIVE, HIGH BREAKDOWN VOLTAGE GAP PAD**

TGP8000HV is a Thermal Gap Pad which offers a strong combination of low thermal impedance, high breakdown voltage and ease of use across a wide variety of applications. The naturally tacky property means there is no need for an additional adhesive, which could inhibit thermal performance. Available formats for TGP8000HV include standard sheets and custom die-cut parts in a range of thicknesses.

**Applications & Features**

In addition to the features of the TGP1200-TGP8000 line, TGP8000HV is effective for applications that require high breakdown voltage.

**Thermally Conductive Properties**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TGP1200</th>
<th>TGP1500</th>
<th>TGP3000</th>
<th>TGP5000</th>
<th>TGP6000</th>
<th>TGP8000</th>
<th>TEST METHOD</th>
</tr>
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<tbody>
<tr>
<td>Color</td>
<td>Blue</td>
<td>Grey</td>
<td>Yellow</td>
<td>Blue</td>
<td>Grey</td>
<td>Grey</td>
<td>Visual</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>ASTM D374</td>
</tr>
<tr>
<td>Hardness (Shore00)</td>
<td>30</td>
<td>40</td>
<td>40</td>
<td>45</td>
<td>40</td>
<td>30</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.7</td>
<td>1.8</td>
<td>3.1</td>
<td>3.3</td>
<td>3.3</td>
<td>3.4</td>
<td>ASTM D792</td>
</tr>
</tbody>
</table>

**Thermal Properties**

| Thermal Conductivity (W/m·K) | 1.2   | 1.5   | 3.0   | 5.0    | 6.0    | 8.0     | ASTM D5470  |
| Thermo Impedance (˚C·in²/W) @10psi | 1.03  | 0.94  | 0.65  | 0.3    | 0.25   | 0.2     | ASTM D5470  |

**Electrical Properties**

| Dielectric Constant @1MHz | 4.5  | 5.5  | 6.6  | 5.0   | 8.5   | 8.3     | ASTM D150   |
| Volume Resistivity (ohm·cm) | 4.0 x 10¹² | 2.0 x 10¹² | 4.8 x 10¹² | 8.0 x 10¹² | 3.79 x 10¹³ | 6.47 x 10¹³ | ASTM D257   |

**Flammability**

| Flammability Rating | V-0   | V-0   | V-0   | V-0   | V-0   | V-0     | UL94        |

**THERMALLY CONDUCTIVE, HIGH BREAKDOWN VOLTAGE GAP PAD**

TGP8000HV is a Thermal Gap Pad with a high breakdown voltage, providing excellent thermal performance and ease of use. Honeywell TGP8000HV models are naturally tacky and require no additional adhesive, which could inhibit thermal performance. Available formats for TGP8000HV include standard sheets and custom die-cut parts in a range of thicknesses.

**Applications & Features**

In addition to the features of the TGP1200-TGP8000 line, TGP8000HV is effective for applications that require high breakdown voltage.

**Thermally Conductive Properties**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TGP8000HV</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Grey</td>
<td>Visual</td>
</tr>
<tr>
<td>Thickness (mm)²</td>
<td>0.5-5</td>
<td>ASTM D374</td>
</tr>
<tr>
<td>Hardness (Shore00)</td>
<td>60</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>3.5</td>
<td>ASTM D792</td>
</tr>
</tbody>
</table>

**Thermal Properties**

| Thermal Conductivity (W/m·K) | 8.0     | ASTM D5470  |
| Thermo Impedance (˚C·in²/W) | 0.20    | ASTM D5470  |

**Electrical Properties**

| Dielectric Strength (V/mm) | 8000    | ASTM D2149  |
| Dielectric Constant @1MHz  | 8.3     | ASTM D150   |
| Volume Resistivity (ohm·cm) | 6.47 x 10¹³ | ASTM D257   |

**Flammability**

| Flammability Rating | V-0   | UL94        |

² Thickness range: 0.5-5.0mm with 0.25mm incremental

Thermal Tolerance: ≥1mm, ≥10%, 0.5-1mm, ≥0.1mm

The low oil-bleeding property protects components from contamination.

Honeywell TGP model gap pads are available in standard sheets and also custom die-cut parts, and in a range of thicknesses.
Honeywell Thermally Conductive Putty Pads provide high thermal performance and solid thermal reliability. The material’s putty-like consistency enables excellent gap-filling capability for applications with large dimensional variances.

**TYPICAL APPLICATIONS**
- EV battery & charging station
- Automotive electronics
- Power devices & modules
- Telecommunications & network servers

**TYPICAL PROPERTIES**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TGP3500PT</th>
<th>TGP6000PT</th>
<th>TGP8000PT</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Green</td>
<td>Grey</td>
<td>Grey</td>
<td>Visual</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>0.5-5</td>
<td>0.5-5</td>
<td>0.5-6</td>
<td>ASTM D374</td>
</tr>
<tr>
<td>Hardness (ShoreA)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>3.2</td>
<td>3.4</td>
<td>3.5</td>
<td>ASTM D792</td>
</tr>
</tbody>
</table>

**Thermal Properties**
- Thermal Conductivity (W/m·K): 3.5, 6.0, 8.0
- Thermal Impedance (˚C·in²/W) @10psi (Typical): 0.45, 0.27, 0.19

**Electrical Properties**
- Dielectric Constant @1MHz: 6.4, 6.5, 8.5
- Volume Resistivity (ohm·cm): 4.0 x 10¹³, 4.0 x 10¹³, 4.0 x 10¹³

**Flammability**
- Flammability Rating: V-0

**Storage & Use**
- Shelf Life: 12 months at 23±2°C

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The TIP series provides low thermal impedance and high insulation for high power and high voltage applications.

**TYPICAL APPLICATIONS**
- Automotive electronics
- Power conversion equipment
- Power supply equipment
- Motor controllers
- Speaker amplifier
- Power switch

**TYPICAL PROPERTIES**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TIP1500</th>
<th>TIP3500</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Pink</td>
<td>Blue</td>
<td>Visual</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>0.19, 0.23</td>
<td>0.25-0.50</td>
<td>ASTM D374</td>
</tr>
<tr>
<td>Hardness (Shore A)</td>
<td>90</td>
<td>80</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.21</td>
<td>2.47</td>
<td>ASTM D792</td>
</tr>
</tbody>
</table>

**Thermal Properties**
- Thermal Conductivity (W/m·K): 1.5, 3.5
- Thermal Impedance (˚C·in²/W) @10psi (Typical): 0.91 x 0.19 mm, 0.93 x 0.23 mm
- Thermal Impedance (˚C·in²/W) @50psi (Typical): 0.54 x 0.19 mm, 0.61 x 0.23 mm

**Electrical Properties**
- Dielectric Breakdown Voltage (V): >6000, >6000
- Dielectric Constant @1MHz: 5.50, 3.30
- Volume Resistivity (ohm·cm): 1 x 10¹¹, 5 x 10¹¹

**Flammability**
- Flammability Rating: V-0

**Storage & Use**
- Shelf Life: 12 months at 23±2°C

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**Configurations Available**
- Sheet form and die-cut parts

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**Additional Information**

1. Thickness range: 0.5-5.0mm with 0.25mm incremental.
2. Thickness Tolerance: ±10%, 0.5-1mm: ±0.1mm, ±0.5mm: ±0.1mm.
Honeywell silicone grease products provide superior thermal performance with ease of use across a multitude of applications. The low viscosity and inherent thixotropy make the technology a good fit for large-scale production with dispensing, screen printing and stencil printing.

**TYPICAL APPLICATIONS**
- CPU, GPU and chipsets
- LED assemblies
- Automotive electronics
- IGBT & power units
- Flipchip BGAs

**HIGH THERMAL CONDUCTIVITY THERMAL GREASE**

Thermal Grease is a common silicone thermal interface material, usually used to increase thermal contact conductance across jointed solid surfaces. Thermal interface materials occupy the space of air (a very poor thermal conductor) and fill in the gaps between two solid surfaces. This establishes an effective thermal path between a heat-generating component and a heat sink attached to it, therefore greatly increasing thermal transfer efficiency.

Silicone thermal grease is a composite containing silicone and inorganic or metal nanomaterials with high thermal conductivity. Compared with thermal pads or liquid gap fillers, grease has the lower viscosity, and it can be used by dispense or screenprint, forming a thinner thermal conductivity layer with high thermal conductivity performance.

Honeywell thermal greases are designed to minimize thermal resistance at interfaces, and maintain excellent performance through reliability testing. TG series products are offered with varying thermal impedance and thermal conductivity properties to complement different power densities in real applications. Products are also available in a range of bondline thicknesses (BLT) to meet variations in interface flatness.

**FEATURES**
- Low viscosity and excellent thixotropy for dispensing or stencil/screen printing
- Range of BLT thicknesses
- Thermal resistance and thermal conductivity options for different power densities
- High stability and reliability
- Stable and homogeneous at room temperature storage

**STORAGE & USE**

Shelf Life: 12 months at 23±2°C

Honeywell thermal grease remains stable under room temperature storage.

**TYPICAL PROPERTIES**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TG2000I</th>
<th>TG2800I</th>
<th>TG3000</th>
<th>TG3000I</th>
<th>TG4000</th>
<th>TG5500</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Blue</td>
<td>Yellow</td>
<td>Grey</td>
<td>White</td>
<td>Grey</td>
<td>Grey</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity (cps @ 25°C)</td>
<td>90,000</td>
<td>100,000</td>
<td>150,000</td>
<td>200,000</td>
<td>200,000</td>
<td>300,000</td>
<td>Brookfield Viscometer</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>3.0</td>
<td>4.2</td>
<td>2.7</td>
<td>3.4</td>
<td>2.7</td>
<td>2.5</td>
<td>ASTM D792</td>
</tr>
<tr>
<td>BLT (µm) (35psi, 50°C)</td>
<td>30</td>
<td>25</td>
<td>25</td>
<td>10</td>
<td>23</td>
<td>23</td>
<td>HON Internal</td>
</tr>
<tr>
<td>Thermal Conductivity (W/m·K)</td>
<td>2.0</td>
<td>2.8</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>5.5</td>
<td>Hot Disk</td>
</tr>
<tr>
<td>Thermal Impedance (°C·in²/W) (35psi, 50°C)</td>
<td>0.020</td>
<td>0.009</td>
<td>0.009</td>
<td>0.003</td>
<td>0.005</td>
<td>0.010</td>
<td>ASTM D5470</td>
</tr>
<tr>
<td>Electrical Properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric Constant @ 1MHz</td>
<td>&gt;6</td>
<td>&gt;14</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>ASTM D150</td>
</tr>
<tr>
<td>Volume Resistivity (ohm·cm)</td>
<td>1.0 x 10¹⁰</td>
<td>1.3 x 10¹⁰</td>
<td>1.0 x 10¹⁰</td>
<td>2.0 x 10¹⁰</td>
<td>1.0 x 10¹⁰</td>
<td>1.0 x 10¹⁰</td>
<td>ASTM D257</td>
</tr>
<tr>
<td>Flammability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flammability Rating</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>UL94</td>
</tr>
<tr>
<td>Working Temperature (°C)</td>
<td>-40~150</td>
<td>-40~150</td>
<td>-40~150</td>
<td>-40~150</td>
<td>-40~150</td>
<td>-40~150</td>
<td>-</td>
</tr>
</tbody>
</table>

**THERMAL GREASE**

Low viscosity and excellent thixotropy make thermal grease appropriate for large-scale production.

**PACKAGING AVAILABILITY**
- 0.5kg can
- 1kg can
- 5 gallon pail
THERMAL ONE-PART HYBRID

Thermal conductivity liquid gap fillers not only have the benefits of shape recovery, strong material cohesion, and good long-term thermal stability — they also offer a very low thermal resistance comparable to thermal grease, and can fill gaps at interfaces.

TYPICAL APPLICATIONS
• Consumer electronics
• Telecommunications equipment
• Automotive electronics
• Power supplies & semiconductors
• Memory & power modules
• Power electronics

ONE-PART, DISPENSABLE, VERY LOW COMPRESSION FORCE, THERMAL HYBRID
Hybrid is a substance between liquid and solid, combining the advantages of thermal grease and thermal gap pad, without the potential problems of either. Thermal Hybrid is prepared as a silicone polymer, with low molecular siloxane, and mixed with high thermal conductivity particles (such as alumina, aluminum nitride powder, etc.). Compared with thermal grease, the main difference is that Thermal Hybrid does not present oil separation issues while in storage, and the Hybrid can be torn off and reused. Thermal Hybrid only needs a relatively low working pressure when connected with heat sink and chip, and has a wide working temperature range. The HT series, our one-part Gap Filler, provides effective thermal properties and high conformability along with its high compressibility. It is formulated to deliver high dispense rates for improved productivity, long-term reliability performance and easy re-workability. It is designed to minimize thermal resistance at interfaces, maintain its performance through reliability testing, and provide scalable application at a competitive cost. All HT series products are available in 280cc aluminum cartridge, and 1 and 5-gallon pail.

FEATURES
• High thermal performance and low contact resistance
• Easily dispensable and reworkable
• High compressibility for low stress applications
• Long-term reliability
• No pump-out or cracking risk
• Reduced oil separation
• Requires no mixing, additional curing or low temperature storage

TYPICAL PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>HT3500</th>
<th>HT5000</th>
<th>HT7000*</th>
<th>HT10000*</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature</td>
<td>Silicone-based Pre-cured</td>
<td>Silicone-based Pre-cured</td>
<td>Silicone-based Pre-cured</td>
<td>Silicone-based Pre-cured</td>
<td>-</td>
</tr>
<tr>
<td>Color</td>
<td>Dark Red</td>
<td>Grey</td>
<td>*</td>
<td>*</td>
<td>Visual</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>3.2</td>
<td>3.4</td>
<td>*</td>
<td>*</td>
<td>ASTM D792</td>
</tr>
<tr>
<td>Thermal Conductivity (W/m·K)</td>
<td>3.5</td>
<td>5.0</td>
<td>7.0</td>
<td>10.0</td>
<td>ASTM D5470</td>
</tr>
<tr>
<td>Thermal Impedance (°C·cm²/W)</td>
<td>&lt;0.35</td>
<td>&lt;0.25</td>
<td>*</td>
<td>*</td>
<td>ASTM D5470 at BLT</td>
</tr>
<tr>
<td>Minimum BLT (mm)</td>
<td>0.10</td>
<td>0.05</td>
<td>*</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Dispense Rate (g/min)</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>*</td>
<td>*</td>
<td>90psi, 30cc EFD syringe</td>
</tr>
<tr>
<td>Out Gassing (TML)</td>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
<td>*</td>
<td>*</td>
<td>ASTM E595</td>
</tr>
<tr>
<td>Storage Condition</td>
<td>RT</td>
<td>RT</td>
<td>*</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Shelf Life (months)</td>
<td>12</td>
<td>12</td>
<td>*</td>
<td>*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Contact Honeywell for latest information.

Honeywell’s thermal Hybrid materials provide good surface wetting without slump after dispensing.

A large selection of packaging options is available for our one-part and two-part thermal Hybrid products.
Hybrid thermal interface materials offer a variety of options for dispensing methods, depending on the application. The enhanced bonding force between the polymer base and the filler minimizes oil separation issues in storage.

HLT series products are two-component, dispensable thermally conductive gels, which offer long-term reliability and superior softness. The enhanced bonding force between the polymer base and the filler minimizes oil separation issues in storage.

TYPICAL APPLICATIONS
- Consumer electronics
- Telecommunications equipment
- Automotive electronics
- Memory & power modules

TWO-PART, DISPENSABLE, VERY LOW COMPRESSION FORCE, THERMAL HYBRID
Prior to curing, the material maintains good thixotropic characteristics and low viscosity to be easily dispensed. The product can be cured in a short time after two-component mixing at room temperature. The high compressibility minimizes thermal resistance at interfaces, while maintaining excellent performance during reliability testing.

FEATURES
- Low contact resistance
- Easily to dispense and rework
- High compressibility for low stress applications
- Long-term reliability
- Reduced oil separation
- No pump-out and cracking

The recommended modified viscosity and cure schedule meets large-scale application requirements.

TYPICAL PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>HLT 2000</th>
<th>HLT2000LV</th>
<th>HLT 3500</th>
<th>HLT 7000*</th>
<th>HLT 9000*</th>
<th>HLT 10000*</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity (cps)</td>
<td>200,000– 350,000</td>
<td>200,000– 400,000</td>
<td>300,000– 450,000</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>ASTM D2196**</td>
</tr>
<tr>
<td>Hardness (Shore00)</td>
<td>50</td>
<td>35</td>
<td>50</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.8</td>
<td>2.8</td>
<td>3.2</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>ASTM D792</td>
</tr>
<tr>
<td>Thermal Conductivity (W/m·K)</td>
<td>2.0</td>
<td>2.0</td>
<td>3.5</td>
<td>7.0</td>
<td>9.0</td>
<td>10.0</td>
<td>ASTM D5470</td>
</tr>
<tr>
<td>Thermal Impedance (˚C·in²/W) (1mm@10psi, typical value)</td>
<td>0.66</td>
<td>0.60</td>
<td>0.44</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>ASTM D5470</td>
</tr>
<tr>
<td>Cure Schedule</td>
<td>25 °C (hour)</td>
<td>10</td>
<td>16</td>
<td>12</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>100 °C (minute)</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*Contact Honeywell for latest information. ** Brookfield Viscometer, #7 spindle, 10rpm

Storage & Use
Shelf Life: 6 months at 23±2°C

Availability
Syringes—200+200cc
Jar—1+1gal, 5+5gal
On request

State-of-the-art two-part Hybrid with high thermal conductivity for high power density applications.
DEVELOPMENT AND MANUFACTURING LOCATIONS

United States
- Santa Clara, California
- Sunnyvale, California
- Spokane, Washington
- Chandler, Arizona
- Salt Lake City, Utah
- Bryan, Texas
- Mansfield, Texas
- Fombell, Pennsylvania

Europe
- Seelze, Germany

Asia
- Shanghai, China
- Jincheon, Korea
- Yaita, Japan
- Chonburi, Thailand

GLOBAL SUPPORT

HONEYWELL ADVANTAGES

Quality
- Industry-leading reliability over device lifetime
- More than twenty years specializing in TIM materials R&D and manufacturing
- Proprietary formulations optimized for the needs of specific applications
- Proven, long-standing supplier with multiple worldwide quality certifications

Customer Focused
- Serving diverse range of customers
- TIMs offered in a wide range of thermal conductivity and application forms
- Superior global technical support
- Portfolio of other materials, such as thermal spreaders, electrical interconnect and pure metals
Although all statements and information contained herein are believed to be accurate and reliable, they are presented without guarantee or warranty of any kind, express or implied. Information provided herein does not relieve the user from the responsibility of carrying out its own tests and experiments, and the user assumes all risks and liability for use of the information and results obtained. Statements or suggestions concerning the use of materials and processes are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe any patent. The user should not assume that all toxicity data and safety measures are indicated herein or that other measures may not be required.

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