Imagine:
Enhanced performance and reliability of your electronics design

Thermally conductive materials selection guide
Why choose Dow Performance Silicones?

Dow Performance Silicones has been a global leader in silicone-based technology for more than 70 years. Headquartered in Michigan, USA, we maintain manufacturing sites, sales and customer service offices, and research and development labs in every major geographic market worldwide to ensure you receive fast, reliable support for your processing and application development needs.

Unique product technology
To describe Dow Performance Silicones is to describe the history and evolution of silicone technology, which generated a legacy of innovative and reliable products under the Dow Corning® label for more than seven decades. Today that legacy continues under the DOWSIL™ brand name, which encompasses more than 7,000 proven silicone products and services. Few companies offer an encapsulant portfolio with comparable breadth and proven performance, and none match our history in silicone technology.

Extensive know-how
Dow Performance Silicones multiplies the value of its products with deep in-house expertise and an extended network of industry resources.

Collaborative culture
Dow Performance Silicones works closely with you to help reduce time and cost at every stage of your new-product development.

Stability
For more than seven decades, Dow Performance Silicones has been a global leader who invests in manufacturing and quality to help fuel customer innovation through a consistent supply of proven silicone products.
Why heat is the enemy of devices

The reasons may vary from application to application. Yet, improved thermal management is increasingly critical to maintaining the long-term performance and reliability of PCB system assemblies in virtually every industry.

Transportation: From rail to road, vehicles are increasingly reliant on PCB system assemblies for everything from optimized fuel consumption and safety to propulsion and braking. As this trend accelerates, it will drive demand for higher performance and more cost-effective thermal management solutions.

Heat management: The trend toward smaller devices with more densely packed PCB system components is converging with expanded use of flip chip and stacked die architectures. As a result, new thermal management solutions are needed to effectively dissipate heat and deliver greater device reliability.

Solid-state lighting: Unlike conventional light sources, the ability to manage the temperature of an LED module has a direct impact on the reliability, output quality, lifetime and system cost of the device. Moreover, thermal management is becoming an increasingly important performance metric for the entire LED value chain, as solid-state lighting competes with conventional illumination for high-intensity and high-temperature applications.

Power devices: Power supplies and controls for industry, computer servers, and solar and wind energy are all managing higher electrical loads and, with them, increasing temperatures. The trend is creating a need for improved thermal management to dissipate heat in these devices, as this translates into improved performance, reliability and lifetime. Improved thermal management also offers needed design flexibility.

Consumer devices and telecommunications: Form factor optimization is one of the challenges facing this industry. Thin is in for consumer devices, requiring compact, multifunctional thermal management solutions.

Why silicone thermal solutions from Dow?

The inherent versatility of silicone chemistry can help expand your design freedom, increase your processing options, and enhance the performance and reliability of your device. As a class of materials, silicones generally offer demonstrable benefits over organic-based urethane and epoxy solutions, including:

• Superior stability and reliability across temperatures from -45°C to 200°C
• More physically robust under mechanical stress caused by thermal cycling or mismatched coefficient of thermal expansion
• Higher elongation and compression for extraordinary protection against shock and vibration
• Greater hydrostability and stronger resistance to chemicals
• None of the toxicity issues of organics, helping to reduce or eliminate special handling precautions
• Simpler processing without the need for oven-drying or concerns about exotherms
• Stable pot life and ease of reworkability

Dow builds on silicone’s inherent potential by combining it with industry-leading materials knowledge, application expertise, customer collaboration and a global footprint. The value we add is further evident in the unmatched breadth of our industry-leading product portfolio, which encompasses a broad selection of thermally conductive adhesives, compounds, encapsulants and dispensable pads – all available in a wide range of delivery formats, viscosities, cure chemistries, and thermal and mechanical profiles.

There likely is a specific category or grade that delivers the optimal processing and performance advantages for your device design, and we’ve designed this guide to help you quickly narrow your search for a thermal management solution that meets your design goals for heat dissipation, processability and low cost of ownership.

Next-generation thermal management materials ... today!

Dow listens closely to its customers and continuously innovates across product technologies to deliver next-generation thermal solutions when you need them – today.

Available in a broad range of viscosities and cure chemistries, our thermally conductive materials come in various delivery formats.
Thermally conductive materials selection guide

Thermal conductivity vs. viscosity

Legend:
- Encapsulants and gels
- Room temperature cure adhesives
- Heat cure adhesives

1. DOWSIL™ TC-2035 Thermally Conductive Adhesive
2. DOWSIL™ TC-2030 Thermally Conductive Adhesive
3. DOWSIL™ 1-4174 Thermally Conductive Adhesive
4. DOWSIL™ 1-4173 Thermally Conductive Adhesive
5. DOWSIL™ 3-6752 Thermally Conductive Adhesive
6. DOWSIL™ 3-6751 Thermally Conductive Adhesive
7. DOWSIL™ Q1-9226 Thermally Conductive Adhesive
8. DOWSIL™ SE 4485 Thermally Conductive Adhesive
9. DOWSIL™ SE 4486 Thermally Conductive Adhesive
10. DOWSIL™ TC-2022 Thermally Conductive Adhesive
11. DOWSIL™ EA-9189 H RTV Adhesive
12. DOWSIL™ TC-6020 Thermally Conductive Encapsulant
13. DOWSIL™ SE4445 CV Thermally Conductive Gel
14. DOWSIL™ 3-6651 Thermally Conductive Elastomer
15. DOWSIL™ TC-4605 HLV Thermally Conductive Encapsulant
16. DOWSIL™ TC-6011 Thermally Conductive Encapsulant
17. SYLGARD™ 3-6605 Thermal Conductive Elastomer
Thermally conductive materials selection guide

Thermal conductivity vs. hardness

<table>
<thead>
<tr>
<th>DOWSIL™ TC-6020 Thermally Conductive Encapsulant</th>
<th>Encapsulants</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOWSIL™ TC-4025 Dispensable Thermal Pad</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-3015 Reworkable Thermal Gel</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 3-6651 Thermally Conductive Elastomer</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4605 HLV Thermally Conductive Encapsulant</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-6011 Thermally Conductive Encapsulant</td>
<td></td>
</tr>
<tr>
<td>SYLGARD™ 3-6605 Thermal Conductive Elastomer</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4535 CV Thermally Conductive Gap Filler</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4525 Thermally Conductive Gap Filler</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4525 CV Thermally Conductive Gap Filler</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ SE 4448 CV</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4515 Thermally Conductive Gap Filler</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4515 CV Thermally Conductive Gap Filler</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ SE 4485 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 1-4173 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 1-4174 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 3-6752 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-2022 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ SE 4486 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ EA-9189 H RTV Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-2035 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-2030 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 3-6751 Thermally Conductive Adhesive</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ Q1-9226 Thermally Conductive Adhesive</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Encapsulants
- Gap fillers
- One-part adhesives
- Two-part adhesives

(1) Some hardness data estimated from Shore OO data.
**Choose your thermally conductive adhesive**

DOWSIL™ thermally conductive silicone adhesives are suitable for bonding and sealing hybrid circuit substrates; semiconductor components; heat spreaders; and other applications that demand broad design, flexible processing options and excellent thermal management.

The high-performance materials in our portfolio encompass moisture-cure grades for simple, room-temperature processing as well as heat-cure solutions for speeding productivity and time to market. Options range from low-viscosity liquids that fill oddly shaped gaps and ensure large contact areas for maximal heat transfer to nonslump formulations to hold vertical position prior to cure completion.

### Thermally conductive adhesives

<table>
<thead>
<tr>
<th></th>
<th>Cure type (chemistry)</th>
<th>Unique features</th>
<th>Key features/advantages</th>
<th>Appearance</th>
<th>Thermal conductivity, W/mK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>@ 25°C/50% RH, min</td>
<td>@ 25°C/55% RH, min</td>
<td>@ 20°C/55% RH, min</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heat</td>
<td>Short tack-free time</td>
<td>Flowable</td>
<td>Thixotropic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>@ 10 s⁻¹</td>
<td>@ 20 rpm, RVF 7(4)</td>
<td>@ 10 s⁻¹</td>
<td>@ 20 rpm, RVF 7(4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density @ 25°C, g/cm³</td>
<td>Viscosity, Pa-s:</td>
<td>@ 10 s⁻¹</td>
<td>@ 20 rpm, RVF 7(4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Room temperature cure</td>
<td>Thermal expansion, ppm/°C</td>
<td>25°C</td>
<td>25°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bond line thickness above 180 µm</td>
<td>Shelf life</td>
<td>25°C</td>
<td>25°C</td>
</tr>
</tbody>
</table>

**One-part adhesives**

- **DOWSIL™ SE 4485 Thermally Conductive Adhesive**
  - Alkoxy moisture
  - Moisture cure
  - Semi
  - White
  - 2.8 W/mK

- **DOWSIL™ 1-4173 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Fast cure at moderate temperature
  - Gray
  - 1.8 W/mK

- **DOWSIL™ 1-4174 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Gray
  - 1.8 W/mK

- **DOWSIL™ 3-6752 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Gray
  - 1.7 W/mK

- **DOWSIL™ SE 4486 Thermally Conductive Adhesive**
  - Alkoxy moisture
  - White
  - 1.6 W/mK

- **DOWSIL™ TC-2022 Thermally Conductive Adhesive**
  - Thermal radical cure
  - Gray
  - 1.6 W/mK

- **DOWSIL™ EA-9189 H RTV Adhesive**
  - Alkoxy moisture
  - White
  - 0.9 W/mK

**Two-part 1:1 mix ratio adhesives**

- **DOWSIL™ TC-2035 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Low bond line thickness of 80 µm; optimized wetting on typical electronics substrates
  - Part A: White
  - Part B: Pink
  - Mixed: Pink
  - 3.3 W/mK

- **DOWSIL™ TC-2030 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Bond line thickness above 130 µm
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - 2.7 W/mK

- **DOWSIL™ 3-6751 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Low viscosity; low elastomeric modulus
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - 1.0 W/mK

- **DOWSIL™ O1-9226 Thermally Conductive Adhesive**
  - Addition by hydrosilylation
  - Moderate flow; long pot life; good resilience due to high elongation; low elastomeric modulus
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - 0.8 W/mK

NA – test data not available.

Specification writers: These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
<table>
<thead>
<tr>
<th>Viscosity, Part:</th>
<th>Cure conditions</th>
<th>Density @ 25°C, g/cm³</th>
<th>Durometer: Shore A&lt;sup&gt;[11]&lt;/sup&gt;</th>
<th>Linear coefficient of thermal expansion, ppm/°C</th>
<th>Tensile strength, MPa</th>
<th>Elongation at break, %</th>
<th>Lap shear adhesion, MPa (substrate)</th>
<th>Dielectric strength, kV/mm</th>
<th>Shelf life</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTM 1094&lt;sup&gt;[2]&lt;/sup&gt;</td>
<td>20°C 55% RH, min</td>
<td>2.9&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>90&lt;sup&gt;[11]&lt;/sup&gt;</td>
<td>80</td>
<td>3.4</td>
<td>25</td>
<td>2.3 (Al) 1.2 (GL)</td>
<td>19</td>
<td>9 months @ 25°C</td>
</tr>
<tr>
<td>61.3&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>NA</td>
<td>2.7&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>92&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>125</td>
<td>6.2</td>
<td>22</td>
<td>4.5 (Al)</td>
<td>18</td>
<td>6 months @ 5°C cold storage</td>
</tr>
<tr>
<td>62.3&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>NA</td>
<td>2.7&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>92&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>125</td>
<td>5.2</td>
<td>NA</td>
<td>4.4 (Al)</td>
<td>16</td>
<td>6 months @ 5°C cold storage</td>
</tr>
<tr>
<td>88.3&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>NA</td>
<td>2.6&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>87&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>138</td>
<td>3.8</td>
<td>15</td>
<td>3.6 (Al)</td>
<td>16</td>
<td>6 months @ 5°C cold storage</td>
</tr>
<tr>
<td>19.6&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>3 hr</td>
<td>2.6&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>81&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>140</td>
<td>3.9</td>
<td>43</td>
<td>0.7 (Al) 1.6 (GL)</td>
<td>20</td>
<td>12 months @ 25°C</td>
</tr>
<tr>
<td>190&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>NA</td>
<td>2.7&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>90&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>125</td>
<td>4.7</td>
<td>100</td>
<td>4.1 (Al)</td>
<td>16</td>
<td>12 months @ -5°C cold storage</td>
</tr>
<tr>
<td>139&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>2 hr</td>
<td>1.7&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>80&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>189</td>
<td>3.9</td>
<td>31</td>
<td>2.2 (Al) 2.3 (Cu) 2.4 (FR4)</td>
<td>28</td>
<td>9 months @ 25°C</td>
</tr>
</tbody>
</table>

**Part A:** 130<sup>[5]</sup>  
**Part B:** 118<sup>[5]</sup>  
**Mixed:** 125<sup>[5]</sup>  
<table>
<thead>
<tr>
<th>Viscosity, Part:</th>
<th>Cure conditions</th>
<th>Density @ 25°C, g/cm³</th>
<th>Durometer: Shore A&lt;sup&gt;[11]&lt;/sup&gt;</th>
<th>Linear coefficient of thermal expansion, ppm/°C</th>
<th>Tensile strength, MPa</th>
<th>Elongation at break, %</th>
<th>Lap shear adhesion, MPa (substrate)</th>
<th>Dielectric strength, kV/mm</th>
<th>Shelf life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A: 250&lt;sup&gt;[5]&lt;/sup&gt;</td>
<td>3 hr</td>
<td>2.9&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>92&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>60</td>
<td>4.7</td>
<td>50</td>
<td>3.3 (Al)</td>
<td>21</td>
<td>12 months @ 25°C</td>
</tr>
<tr>
<td>Part B: 200&lt;sup&gt;[5]&lt;/sup&gt;</td>
<td>5 min</td>
<td>2.3&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>68&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>180</td>
<td>2.8</td>
<td>36</td>
<td>3.5 (Al)</td>
<td>18</td>
<td>12 months @ 25°C</td>
</tr>
<tr>
<td>Mixed: 20.2&lt;sup&gt;[6]&lt;/sup&gt;</td>
<td>60 min @ 100°C 45 min @ 125°C 10 min @ 150°C&lt;sup&gt;[5]&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;[8]&lt;/sup&gt;</td>
<td>67&lt;sup&gt;[12]&lt;/sup&gt;</td>
<td>168</td>
<td>4.1</td>
<td>124</td>
<td>2.6 (Al)</td>
<td>25</td>
<td>12 months @ 25°C</td>
</tr>
</tbody>
</table>
Choose your thermally conductive encapsulant, gel or dispensible thermal pad

Dow’s selection of DOWSIL™ and SYLGARD™ thermally conductive silicone elastomers and gels presents flexible options for protecting sensitive components from harsh environmental conditions as well as from heat. Offering low viscosity before cure, these products process easily and fully embed tall components, delicate wires and solder joints to enhance thermal management — even for the most complex structures. Additionally, DOWSIL™ thermal pads enable you to quickly and precisely print a thermally conductive silicone compound in controllable thicknesses on complex substrates.

The silicone products in this versatile portfolio include:
- **Encapsulants**, which come in a variety of viscosities and cure chemistries and cure into rubbery elastomers that provide reliable protection from harsh environmental conditions
- **Gels** that offer remarkably low modulus to protect the most sensitive and delicate components against mechanical stress and the effects of thermal cycling
- **Dispensable thermal pads** that offer a versatile, cost-effective alternative to prefabricated thermal pads

### Thermally conductive encapsulants, gels and dispensible thermal pads

<table>
<thead>
<tr>
<th></th>
<th>Mix ratio</th>
<th>Cure type (chemistry)</th>
<th>Key features/advantages</th>
<th>Thermal conductivity, W/mK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CTM 1163/ JIS R 2618-1992(7) CTM 1388/ ASTM D5334(6)</td>
</tr>
<tr>
<td>DOWSIL™ TC-6020 Thermally Conductive Encapsulant</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>High thermal conductivity with good flowability ✓ ✓ ✓ Part A: White Part B: Gray Mixed: Gray 2.7(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4025 Dispensable Thermal Pad</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>DOWSIL™ TC-4026 Dispensable Thermal Pad provides 180 µm glass bead ✓ ✓ ✓ Part A: White Part B: Blue Mixed: Blue 2.7(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-3015 Reworkable Thermal Gel</td>
<td>One-part</td>
<td>Addition by hydrosilylation</td>
<td>✓ ✓ ✓ ✓ Pink 2.0(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ SE4445 CV Thermally Conductive Gel</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>✓ ✓ ✓ Part A: White Part B: Black Mixed: Gray 1.3(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ 3-6651 Thermally Conductive Elastomer</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>Low viscosity; low modulus; excellent wetting of surfaces ✓ ✓ ✓ Part A: White Part B: Gray Mixed Gray 1.1(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-4605 HLV Thermally Conductive Encapsulant</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>Low viscosity ✓ ✓ ✓ Part A: White Part B: Gray Mixed: Gray 1.0(7)</td>
<td></td>
</tr>
<tr>
<td>DOWSIL™ TC-6011 Thermally Conductive Encapsulant</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>✓ ✓ ✓ ✓ Part A: White Part B: Gray Mixed: Gray 1.0(7)</td>
<td></td>
</tr>
<tr>
<td>SYLGARD™ 3-6605 Thermal Conductive Elastomer</td>
<td>Two-part 1:1</td>
<td>Addition by hydrosilylation</td>
<td>High tensile strength; long working time ✓ ✓ ✓ ✓ Part A: White Part B: Gray Mixed: Gray 0.8(7)</td>
<td></td>
</tr>
</tbody>
</table>

NA – test data not available.

Specification writers: These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
### Thermally Conductive Materials Selection Guide

#### Key Features/Advantages
- **DowSIL™ TC-6020 Thermally Conductive Encapsulant**: Two-part, 1:1 mix ratio, addition by hydrosilylation. High thermal conductivity with good flowability. 
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 2.7(2)
  - Viscosity, Pa-s: 2.7(2)
  - Cure conditions: 23 min @ 60°C(8), 13 min @ 80°C(8), 5 min @ 100°C(8), 30 min @ 80°C(10)
  - Tensile strength, MPa: 1.0
  - Elongation, %: 21
  - Lap shear adhesion, MPa (substrate): 0.3 (Al)
  - Dielectric strength, kV/mm: 24
  - Volume resistivity, Ω•cm: 8.22E+15
  - Shelf life: 9 months @ 25°C

#### DOWSIL™ TC-4025 Dispensable Thermal Pad**: Two-part, 1:1 mix ratio, addition by hydrosilylation. DOWSIL™ TC-4026 Dispensable Thermal Pad provides 180 µm glass bead. 
  - Part A: White
  - Part B: Blue
  - Mixed: Blue
  - Density @ 25°C, g/cm³: 2.7(1)
  - Viscosity, Pa-s: 2.7(1)
  - Cure conditions: 24 hr @ 25°C(10), 30 min @ 100°C(10)
  - Tensile strength, MPa: 2.8(12)
  - Elongation, %: 50 Shore OO(16)
  - Lap shear adhesion, MPa (substrate): NA
  - Dielectric strength, kV/mm: 18
  - Volume resistivity, Ω•cm: 3.90E+12
  - Shelf life: 6 months @ 25°C

#### DOWSIL™ TC-3015 Reworkable Thermal Gel**: One-part, addition by hydrosilylation. 
  - Pink
  - Density @ 25°C, g/cm³: 2.0(2)
  - Viscosity, Pa-s: 220(7)
  - Cure conditions: 7 hr @ 60°C(10), 30 min @ 100°C(10)
  - Tensile strength, MPa: 2.8(12)
  - Elongation, %: 66 Shore OO(16)
  - Lap shear adhesion, MPa (substrate): NA
  - Dielectric strength, kV/mm: 15
  - Volume resistivity, Ω•cm: 5.90E+14
  - Shelf life: 6 months @ -25°C cold storage

#### DOWSIL™ SE4445 CV Thermally Conductive Gel**: Two-part, 1:1 mix ratio, addition by hydrosilylation. 
  - Part A: White
  - Part B: Black
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 1.3(1)
  - Viscosity, Pa-s: Mixed: 15.0(3)
  - Cure conditions: 30 min @ 120°C(10), 15 min @ 130°C(9)
  - Tensile strength, MPa: 2.4(12)
  - Elongation, %: 51 Shore A(17)
  - Lap shear adhesion, MPa (substrate): 0.1
  - Dielectric strength, kV/mm: 350
  - Volume resistivity, Ω•cm: NA
  - Shelf life: 6 months @ 25°C

#### DOWSIL™ 3-6651 Thermally Conductive Elastomer**: Two-part, 1:1 mix ratio, addition by hydrosilylation. Low viscosity; low modulus; excellent wetting of surfaces. 
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 1.1(1)
  - Viscosity, Pa-s: Mixed: 20.4(6)
  - Cure conditions: 60 min @ 120°C(10), 24 hr @ 60°C(10), 30 min @ 100°C(10)
  - Tensile strength, MPa: 2.4(13)
  - Elongation, %: 50 Shore OO(16)
  - Lap shear adhesion, MPa (substrate): 2.6
  - Dielectric strength, kV/mm: 95
  - Volume resistivity, Ω•cm: 1.5 (Al)
  - Shelf life: 12 months @ 25°C

#### DOWSIL™ TC-4605 HLV Thermally Conductive Encapsulant**: Two-part, 1:1 mix ratio, addition by hydrosilylation. Low viscosity. 
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 1.0(1)
  - Viscosity, Pa-s: Mixed: 1.6(5)
  - Cure conditions: 60 min @ 120°C(10), 24 hr @ 60°C(10), 30 min @ 100°C(10)
  - Tensile strength, MPa: 1.7(13)
  - Elongation, %: 60 Shore A(15)
  - Lap shear adhesion, MPa (substrate): 2.6
  - Dielectric strength, kV/mm: 95
  - Volume resistivity, Ω•cm: 1.5 (Al)
  - Shelf life: 6 months @ 25°C

#### DOWSIL™ TC-6011 Thermally Conductive Encapsulant**: Two-part, 1:1 mix ratio, addition by hydrosilylation. 
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 1.0(1)
  - Viscosity, Pa-s: Mixed: 3.2(5)
  - Cure conditions: 60 min @ 120°C(10), 24 hr @ 60°C(10), 30 min @ 100°C(10)
  - Tensile strength, MPa: 1.6(13)
  - Elongation, %: 30 Shore A(15)
  - Lap shear adhesion, MPa (substrate): 0.8
  - Dielectric strength, kV/mm: 100
  - Volume resistivity, Ω•cm: 0.8 (Al)
  - Shelf life: 9 months @ 25°C

#### SYLGARD™ 3-6605 Thermal Conductive Elastomer**: Two-part, 1:1 mix ratio, addition by hydrosilylation. High tensile strength; long working time. 
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - Density @ 25°C, g/cm³: 0.8(1)
  - Viscosity, Pa-s: Mixed: 48.8(3)
  - Cure conditions: 90 min @ 100°C(10), 45 min @ 125°C(10), 15 min @ 150°C(10)
  - Tensile strength, MPa: 2.1(12)
  - Elongation, %: 79 Shore A(15)
  - Lap shear adhesion, MPa (substrate): 5.6
  - Dielectric strength, kV/mm: 83
  - Volume resistivity, Ω•cm: 2.7 (Al)
  - Shelf life: 12 months @ 25°C

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**Note:** NA – test data not available. Specification writers: These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
**Choose your thermally conductive compound**

DOWSIL™ thermally conductive silicone compounds deliver high bulk conductivity and low thermal resistance to efficiently draw heat away from sensitive PCB components and dissipate it into the ambient environment. Applied via screen or print processes or by standard dispensing equipment, our thermal compounds flow easily to fully cover and fill surface irregularities for maximum coverage. Select grades from this family of products offer thermal conductivity as high as 4.3 W/mK.

### Thermally conductive compounds

<table>
<thead>
<tr>
<th>Compound Description</th>
<th>Unique features</th>
<th>Thixotropic</th>
<th>Thin bond line</th>
<th>UL 94 V-0</th>
<th>Flowable</th>
<th>Nonflowable</th>
<th>Controlled volatility</th>
<th>Appearance</th>
<th>Thermal conductivity W/mK</th>
<th>Viscosity Pa·s: @ 10 s(^{-1})</th>
<th>Dilatant strain, 10 rad/s @ 1 rpm CPE 52</th>
<th>1 rpm BS #7</th>
<th>10 rpm BS #7</th>
<th>Shelf Life</th>
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<td>Gray</td>
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<td>540(^{5})</td>
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NA – test data not available.

Specification writers: These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
<table>
<thead>
<tr>
<th>Density @ 25°C, g/cm³</th>
<th>Volatile content:</th>
<th>Thermal conductivity, W/mK</th>
<th>Thermal resistance @ 2.75 kPa, °C cm²/W</th>
<th>Minimum BLT @ 2.75 kPa, mm</th>
<th>Dielctric strength, kV/mm</th>
<th>Volume resistivity, Ω•cm</th>
<th>Dielectric constant @ frequency</th>
<th>Dissipation factor @ frequency</th>
<th>Shelf life</th>
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<td>0.02%⁸</td>
<td>0.05</td>
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<td>NA</td>
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<td>NA</td>
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<tr>
<td>2.53⁷</td>
<td>0.08%⁸</td>
<td>0.06</td>
<td>20</td>
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<td>NA</td>
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<tr>
<td>3.47⁹</td>
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<td>NA</td>
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<td>3.70E+11</td>
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<td>6E-02 @ 1 kHz⁹³</td>
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<td>3.12⁹</td>
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<td>1.89³⁹⁴</td>
<td>1.2 E+12</td>
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<td>7E-02 @ 1 kHz³⁹⁴</td>
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<td>2.78⁷</td>
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<td>253⁹</td>
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<td>4.8 @ 50 Hz³⁹⁶</td>
<td>1E-03 @ 50 Hz³⁹⁶</td>
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<td>2.1³</td>
<td>0.14%⁸</td>
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<td>20</td>
<td>8.7³⁹⁶</td>
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<td>NA</td>
<td>12 months @ 25°C</td>
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<tr>
<td>2.45⁷</td>
<td>0.4%⁹</td>
<td>0.62</td>
<td>50</td>
<td>2.1³⁹⁶</td>
<td>2.0 E+16</td>
<td>4.0 @ 50 Hz³⁹⁶</td>
<td>2E-02 @ 50 Hz³⁹⁶</td>
<td>24 months @ 25°C</td>
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<tr>
<td>2.11⁸</td>
<td>0.38%⁸</td>
<td>0.162</td>
<td>55</td>
<td>8.2³⁹⁶</td>
<td>2.0E+15</td>
<td>5.0 @ 100 kHz³⁹⁶</td>
<td>2E-02 @ 100 kHz³⁹⁶</td>
<td>5 years @ 25°C</td>
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</tr>
</tbody>
</table>

**Dow Sil TC-5888 Thermally Conductive Compound**
- Excellent resistance to pump-out in high-stress MCP architecture;
- Low volatile content.

**Dow Sil TC-5622 Thermally Conductive Compound**
- Gray 5.2⁷ 100⁴
- Viscosity 2.6³ 0.02%⁷ 0.05 20 NA NA NA NA 12 months @ 25°C

**Dow Sil TC-5021 Thermally Conductive Compound**
- Gray 3.3¹ 83⁵ 3.47³ 0.0%⁷ 0.2 NA 5.0³¹ 3.70E+11 8.1 @ 1 MHz³¹ 6E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil TC-5351 Thermally Conductive Compound**
- Gray 3.3¹ 300⁶ 3.12³ 0.24 3.53³ 0.0%⁷ 0.032 7 8.9³¹ 5.90E+11 8.1 @ 1 MHz³¹ 6E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil TC-5026 Thermally Conductive Compound**
- Gray 2.9² 102⁵ 3.53³ 0.0%⁷ 0.3 7 8.9³¹ 5.90E+11 8.1 @ 1 MHz³¹ 6E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil TC-5121 Thermally Conductive Compound**
- Gray 2.5² 86⁵ 4.18³ 0.0%⁷ 0.096 20 1.89³¹ 1.2 E+12 19.3 @ 1 kHz³¹ 7E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil SC 4476 CV Thermally Conductive Compound**
- Gray 3.1¹ 310⁶ 3.04³ 0.0%⁷ 0.24 6.2³¹ 3.10E+11 8.1 @ 1 MHz³¹ 6E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil TC-5080 Thermal Grease**
- Stable high-temperature performance

**Dow Sil SC 102 Compound**
- White 0.8¹ 290³ 2.45³ 0.4%⁷ 0.62 50 2.1³¹ 2.0 E+16 4.0 @ 50 Hz³¹ 2E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil SC 4471 CV**
- White 2.0¹ 116³ 2.76³ 0.1%⁷ 0.24 50 2.1³¹ 2.0 E+16 4.0 @ 50 Hz³¹ 2E-02 @ 1 kHz³¹ 12 months @ 25°C

**Dow Sil SE 4490 CV Thermally Conductive Compound**
- White 1.9¹ 520³ 2.63³ 0.1%⁷ 0.32 7 8.9³¹ 5.90E+11 8.1 @ 1 MHz³¹ 6E-02 @ 1 kHz³¹ 24 months @ 25°C

**Dow Sil 340 Heat Sink Compound**
- MIL-DTL-47113 compliant

**Specification writers:** These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
**Choose your thermally conductive gap filler**

DOWSIL™ thermally conductive silicone gap fillers are soft, compressible solutions specifically formulated to process easily from the original packaging with minimal to no additional process preparation. They avoid slumping on vertical surfaces during assembly and maintain their vertical stability after cure, even after long use. These highly advanced silicone formulations dissipate heat away from sensitive PCB components by efficiently conducting it to a heat sink. Able to withstand peak exposure at 200°C, these materials perform reliably at operating temperatures up to 150°C. Our gap fillers also offer effective vibration-damping.

### Thermally conductive gap fillers

<table>
<thead>
<tr>
<th>Part A:</th>
<th>Part B:</th>
<th>Mixed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Blue</td>
<td>Blue</td>
</tr>
</tbody>
</table>

| Specification writers: These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products. |

<table>
<thead>
<tr>
<th>Key features/advantages</th>
<th>Appearance</th>
<th>Thermal conductivity, W/mK</th>
<th>Viscosity, Pa s: @ 10 s⁻¹(3)</th>
<th>@ 10rpm KK #6(4)</th>
<th>Thixotropic index (mixed)</th>
<th>Room temperature cure time</th>
<th>Heat cure time</th>
<th>Density @ 25°C, g/cm³</th>
<th>Durometer, Shore OO</th>
<th>Low-molecular-weight siloxane (D₄-D₁₀), ppm</th>
<th>Dielectric strength, kV/mm</th>
<th>Volume resistivity, Ω•cm</th>
<th>Dielectric constant @ 1 MHz</th>
<th>Shelf life</th>
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<tbody>
<tr>
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<td>Mixed: Blue</td>
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<td>Part A: 207°C</td>
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<td>Mixed: 217°C</td>
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NA – test data not available.
## Thermally Conductive Materials Selection Guide

<table>
<thead>
<tr>
<th>Thixotropic Index (mixed)</th>
<th>Room Temperature Cure Time</th>
<th>Heat Cure Time</th>
<th>Density @ 25°C, g/cm³</th>
<th>Durometer, Shore OO</th>
<th>Low-Molecular-Weight Siloxane Content (D4-D10), ppm</th>
<th>Dielectric Strength, kV/mm</th>
<th>Volume Resistivity, Ω•cm</th>
<th>Dielectric Constant @ 1 MHz</th>
<th>Shelf Life</th>
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<td>CTM 0099/ASTM D2240(6)</td>
<td>CTM 0099/ASTM D2240(6)</td>
<td>CTM 0099/ASTM D2240(6)</td>
<td>CTM 0099/ASTM D2240(6)</td>
<td>CTM 00839B</td>
<td>CTM 0114/ASTM D149(10)</td>
<td>CTM 0249/ASTM D257(13)</td>
<td>CTM 0112/ASTM D150(17)</td>
<td>6 months @ 25°C (target 12 months)</td>
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<td>3.6(5)</td>
<td>120 min @ 25°C</td>
<td>10 min @ 80°C(8)</td>
<td>3.1(12)</td>
<td>52</td>
<td>8</td>
<td>22(14)</td>
<td>3.00 E+13(18)</td>
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<td>300</td>
<td>11(14)</td>
<td>2.00 E+15(17)</td>
<td>5.9(18)</td>
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<td>5.0(5)</td>
<td>150 min @ 25°C</td>
<td>30 min @ 80°C(9)</td>
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<td>16(13)</td>
<td>8.13 E+14(14)</td>
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<td>8</td>
<td>19(14)</td>
<td>1.00 E+12(16)</td>
<td>5.4(18)</td>
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**Thermally Conductive Gap Fillers**

- DOWSIL™ TC-4535 CV Thermally Conductive Gap Filler
  - Addition by hydrosilylation
  - Two-part 1:1
  - Part A: White
  - Part B: Blue
  - Mixed: Blue
  - 3.4(1)
  - Part A: 200(3)
  - Part B: 230(3)
  - Mixed: 205(3)
  - 3.6(5) 120 min @ 25°C 10 min @ 80°C(9) 3.1(12) 52 8 22(14) 3.00 E+13(18) 6.5 E-3(18) 6 months @ 25°C (target 12 months)

- DOWSIL™ TC-4525 CV Thermally Conductive Gap Filler
  - Addition by hydrosilylation
  - Two-part 1:1
  - Part A: White
  - Part B: Blue
  - Mixed: Blue
  - 2.6(1)
  - Part A: 207(3)
  - Part B: 193(3)
  - Mixed: 217(3)
  - 4.3(5) 120 min @ 25°C(7) 10 min @ 80°C(9) 2.9(12) 55 NA 18(13) 2.40E+14(16) 6.6(18) 12 months @ 25°C

- DOWSIL™ SE 4448 CV
  - Addition by hydrosilylation
  - Two-part 1:1
  - Part A: White
  - Part B: Gray
  - Mixed: Gray
  - 2.2(1)
  - Part A: 52.8(4)
  - Part B: 50.3(4)
  - Mixed: 51.5(4)
  - Not measured 300 min @ 25°C(6) 30 min @ 120°C(8) 2.9(11) 59 300 11(14) 2.00 E+15(15) 5.9(19) 12 months @ 25°C

- DOWSIL™ TC-4515 CV Thermally Conductive Gap Filler
  - Addition by hydrosilylation
  - Two-part 1:1
  - Part A: White
  - Part B: Blue
  - Mixed: Blue
  - >1.8(2)
  - Part A: 215(3)
  - Part B: 227(3)
  - Mixed: 240(3)
  - 5.0(5) 150 min @ 25°C(6) 30 min @ 80°C(8) 2.7(10) 50 NA 16(13) 8.13 E+14(15) 4.27 @ 1 KHz(17) 9 months @ 25°C (target 12 months)

- DOWSIL™ TC-4515 CV Thermally Conductive Gap Filler
  - Addition by hydrosilylation
  - Two-part 1:1
  - Part A: White
  - Part B: Blue
  - Mixed: Blue
  - >1.8(1)
  - Part A: 155(3)
  - Part B: 153(3)
  - Mixed: 151(3)
  - 5.6(5) 120 min @ 25°C(7) 10 min @ 80°C(9) 2.8(12) 44 8 19(14) 1.00 E+12(16) 5.4(18) 12 months @ 25°C

**Note:** NA – test data not available.

**Specification Writers:** These values are not intended for use in preparing specifications. Please contact your local Dow representative or sales office before writing specifications on these products.
# Thermally conductive materials selection guide

## Corporate Test Methods and equivalents

<table>
<thead>
<tr>
<th>Corporate Test Method (CTM)</th>
<th>CTM description</th>
<th>Reference/equivalent standard method</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTM 0022</td>
<td>Specific gravity – wet/dry or Jolly balance technique: A solid sample is weighed in air and in water.</td>
<td>ASTM D792</td>
</tr>
<tr>
<td>CTM 0050</td>
<td>Viscosity by rotational viscometer such as a Brookfield Synchro-Lectric viscometer or a Wells-Brookfield cone/plate viscometer. Since materials measured are non-Newtonian, no correlation should be expected between results obtained using different spindles (cones) or speeds.</td>
<td>ASTM D1084 (spindle) ASTM D4287 (cone/plate)</td>
</tr>
<tr>
<td>CTM 0095</td>
<td>The skin-over time, a measure of cure rate, is defined as the time in minutes required for a curing material to form a nontacky surface film. This method uses polyethylene film contact to determine the nontacky characteristic.</td>
<td>ASTM D2377</td>
</tr>
<tr>
<td>CTM 0097</td>
<td>Specific gravity of liquid or semiliquid materials by weighing the amount of material contained in a calibrated weighing cup. Specific gravity is the ratio of the mass of a given volume of material at a given temperature to the mass of an equal volume of water at a reference temperature.</td>
<td>ASTM D1475</td>
</tr>
<tr>
<td>CTM 0099</td>
<td>Durometer – a measure of hardness on the Shore A or OO scale.</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>CTM 0112 (CTM 1139)</td>
<td>Dielectric constant and dissipation factor for solid insulating materials at frequencies to 107 hertz by the air gap method. The dielectric constant and dissipation factor of solid materials at specified frequencies to 107 hertz are determined by the direct measurement of voltage and phase across a capacitor made from the material in an appropriate test fixture. The measurement is made using a digital impedance analyzer.</td>
<td>ASTM D150 ASTM D618</td>
</tr>
<tr>
<td>CTM 0114</td>
<td>Dielectric strength and breakdown voltage – solid and semisolid insulating materials in transformer oil.</td>
<td>ASTM D149</td>
</tr>
<tr>
<td>CTM 0137</td>
<td>Determination of tensile strength, elongation, set and modulus of elastomeric materials. Samples are pulled at a constant rate to the point of rupture and the appropriate values calculated.</td>
<td>ASTM D412 JIS K 6301</td>
</tr>
<tr>
<td>CTM 0155</td>
<td>Penetration – gel-like materials with modified penetrometer. This method is used to determine the firmness of soft gels. A lightweight blunt-head shaft is used. The results are not correlated with either quarter- or full-scale penetration results. The results are reported in tenths of a millimeter.</td>
<td>JIS K 2207 ASTM D217</td>
</tr>
<tr>
<td>CTM 0176</td>
<td>Appearance – visual examination covering a wide variety of physical characteristics. The characteristics of importance are specified. Any unusual appearance is noted. Material uniformity is the major factor.</td>
<td>ASTM E284</td>
</tr>
<tr>
<td>CTM 0243</td>
<td>Adhesion – lap shear.</td>
<td>ASTM D816</td>
</tr>
<tr>
<td>CTM 0249</td>
<td>Volume resistivity, surface resistivity and insulation resistance of solid insulating materials are measured using a commercial ohmmeter equipped with circular electrodes as described in ASTM D257.</td>
<td>ASTM D257</td>
</tr>
<tr>
<td>CTM 540</td>
<td>Specific gravity by water displacement. It is the ratio of the mass of material to an equal volume of water at 25 ±0.2°C.</td>
<td>ASTM D70</td>
</tr>
<tr>
<td>CTM 0585</td>
<td>Linear thermal coefficient of expansion by TMA is determined over a specified temperature range between -100 to 500°C by positioning a dilatometer probe upon the solid.</td>
<td>ASTM E831</td>
</tr>
<tr>
<td>CTM 0663</td>
<td>Cure in depth determined by measuring how far below the surface a curing material has hardened in a specified time.</td>
<td></td>
</tr>
<tr>
<td>CTM 0768</td>
<td>Density by measuring the period of vibration for a hollow oscillator when filled with different fluids at a constant temperature. The period is measured for fluids with known density at the operating temperature. Air and water are most commonly used as reference fluids.</td>
<td>ASTM D4052</td>
</tr>
<tr>
<td>CTM 839</td>
<td>Gas-liquid chromatographic method used for separation, detection and quantitation of specified components where the flame ionization detector provides the most suitable means of detection, and where it is either not desirable or not possible to determine all the components present. The quantitative measurement is based on rationing the adjusted peak area of the specified component to the adjusted peak area of the added internal standard. The results are reported as weight percent.</td>
<td></td>
</tr>
<tr>
<td>(CTM 1094)</td>
<td>Rheological properties of viscoelastic materials are characterized using a dynamic mechanical spectrometer. Several modes of operation may be selected. Typically, an oscillating strain is imposed on the sample and the resulting stress measured over the sweep range. Values for the energy stored (elastic or storage modulus, G') and the energy lost (viscous or loss modulus, G&quot;) are obtained. Values for torque, complex viscosity, tangent delta and other attributes are measured or computed from G' and G&quot; results.</td>
<td>ASTM D4440 ASTM D4065</td>
</tr>
<tr>
<td>CTM 1098</td>
<td>The dielectric constant using air as the comparative dielectric. The dielectric constant and dissipation factor of solid materials at specified frequencies to 107 hertz are determined by the direct measurement of voltage and phase across a capacitor made from the material in an appropriate test fixture. The measurement is made using a digital impedance analyzer.</td>
<td>ASTM D150 ASTM D618</td>
</tr>
<tr>
<td>CTM 1139 (CTM 112)</td>
<td>The dielectric constant constant and dissipation factor of solid materials at specified frequencies to 107 hertz are determined by the direct measurement of voltage and phase across a capacitor made from the material in an appropriate test fixture. The measurement is made using a digital impedance analyzer.</td>
<td></td>
</tr>
<tr>
<td>CTM 1163</td>
<td>Thermal conductivity of any solid form in 60 seconds. Measure the amount of heat transferred through the material from a heated wire to a thermocouple.</td>
<td>JIS R 2618-1992</td>
</tr>
<tr>
<td>CTM 1388</td>
<td>Thermal conductivity of solids and viscous liquids using the ThermTest-TT-TK04 instrument. The equipment uses the transient line source (needle probe method) with an accuracy of ±2% and a measuring range of 0.1-10.0 W/mK.</td>
<td>ASTM D5334</td>
</tr>
</tbody>
</table>

(CTM 1094) and (CTM 112) are reference methods adopted from JIS K 2207 and JIS K 6301, respectively.
Learn more

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