

3

Thermally Conductive Phase Change Material 5500T

Preliminary Technical Data

June 2002

→ Product Note: 5500T is under restricted test market release and material performance properties and/or formulation is subject to change.

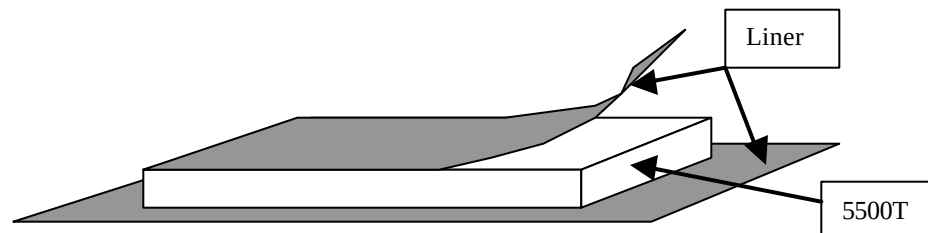
Product Description

3M™ Thermally Conductive Phase Change Material (PCM) 5500T is designed to provide a preferential heat-transfer path between heat-generating components and heat sinks, heat spreaders or other cooling devices (e.g., fans, heat pipes).

- The 5500T PCM is a specially designed PCM that has a “Phase Change” that occurs at approximately 50C. The phase change that occurs takes the 5500T from a modestly firm film at below 50C and allows the 5500T to soften above 50C so that the 5500T can flow and fill voids and cavities uniformly. The removal of air spaces greatly improves the thermal flow of energy between a hot and cool side of a heat dissipating system.
- The 5500T has excellent room temperature handling performance. The 5500T will not easily crack or fall apart during handling or assembly.
- Due to the integrity of the 5500T’s polymer system, the 5500T will resist scratching and thus improve application of the 5500T to a substrate and subsequent handling. Preventing scratches improves yields and ultimate thermal performance as more material is available for uniform space filling.
- The specialized organic chemistry of the 5500T provides for good thermal stability of the base polymer.
- The 5500T offers good thermal conductivity. 5500T is not intended to be an electrical insulator as the melt temperature is approximately 50C. If electrical insulation is needed, the 5500T can be used with an electrically insulating film layer that will not melt at the range of temperatures that the 5500T could be exposed to in the intended application.
- The 5500T has slight tack to allow pre-assembly. The product does not have high adhesion performance so that a mechanical means to support the assembly is required.

Product Constructions

	5500T
Color	White
Tape Type	Filled Polyolefin Polymer
Tape Thickness	0.15mm (5.9mils) and 0.25 mm (9.8mils)
Filler Type	Ceramic
Liner Type	2 liners: Silicone Coated Polyester Liner
Liner Thickness	< 0.15mm



Phase Change Material

5500T

Typical Properties and Performance Characteristics

Note: The following technical information for 3M™ Phase Change Material 5500T should be considered representative or typical only, and should not be used for specification purposes.

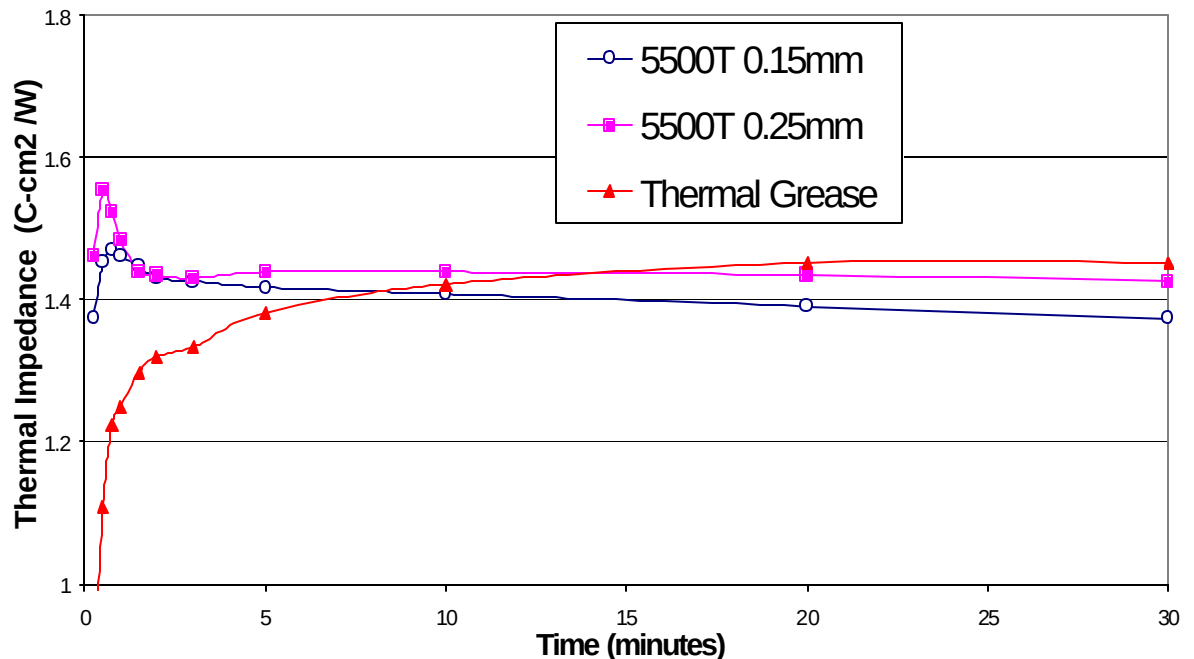
➔ **Product Note:** 5500T is under restricted test market release and material performance properties and/or formulation is subject to change.

Property	Value	Method
Product Number	5500T	
Thermal Impedance (C-cm ² /W)	See Graphs	3M TM
Thermal Conductivity (W/m-K)	2.5	3M TM
Melting Temperature	Approximately 50C	3M TM-DSC
Operating Temperature Range	-30 to 100C	-----
Shelf Life	12 months from date of manufacture when stored at 25C and 50% relative humidity in it's original packaging	-----
Preferred Storage Conditions	Less than 35C, No direct sunlight	-----
Dielectric Strength (Volts/mil)	500 (Estimate)*	ASTM-D149
Peel Strength	Low. 5500T is not to be used as the primary attachment means between two surfaces	-----
Adhesion	Slight tack at room temperature	-----

* 5500T is not intended to be an electrical insulator as the product has a melting temperature of approximately 50C. If the product melts, the 5500T's application thickness could change leading to a change in the application electrical insulation performance. If electrical insulation is needed, the 5500T can be used with an insulating layer that will not melt at the application temperatures. Films such as polyester or polyimide have melting temperatures above the 5500T.

Thermal Impedance Change with Time:

Using the 3M thermal impedance test set-up, 30W of power is applied to a test plate for 30 minutes that is under 40N/cm² pressure. The test data shows that with time the 3M PCM 5500T will perform similarly to a 1.6 W/m-K thermal conductivity grease



Phase Change Material

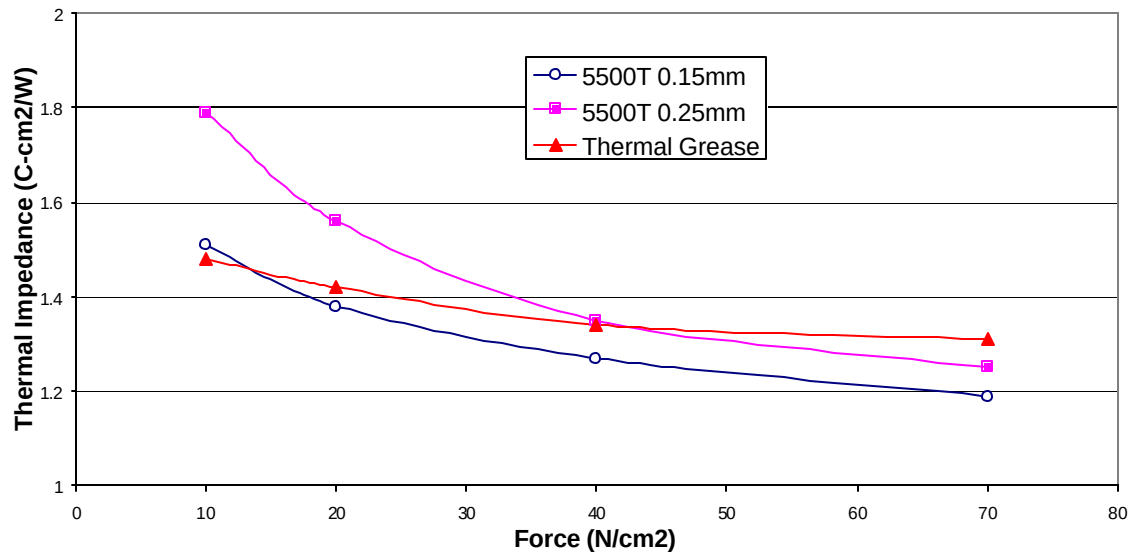
5500T

Note: The following technical information for 3M™ Phase Change Material 5500T should be considered representative or typical only, and should not be used for specification purposes.

Typical Properties and Performance Characteristics

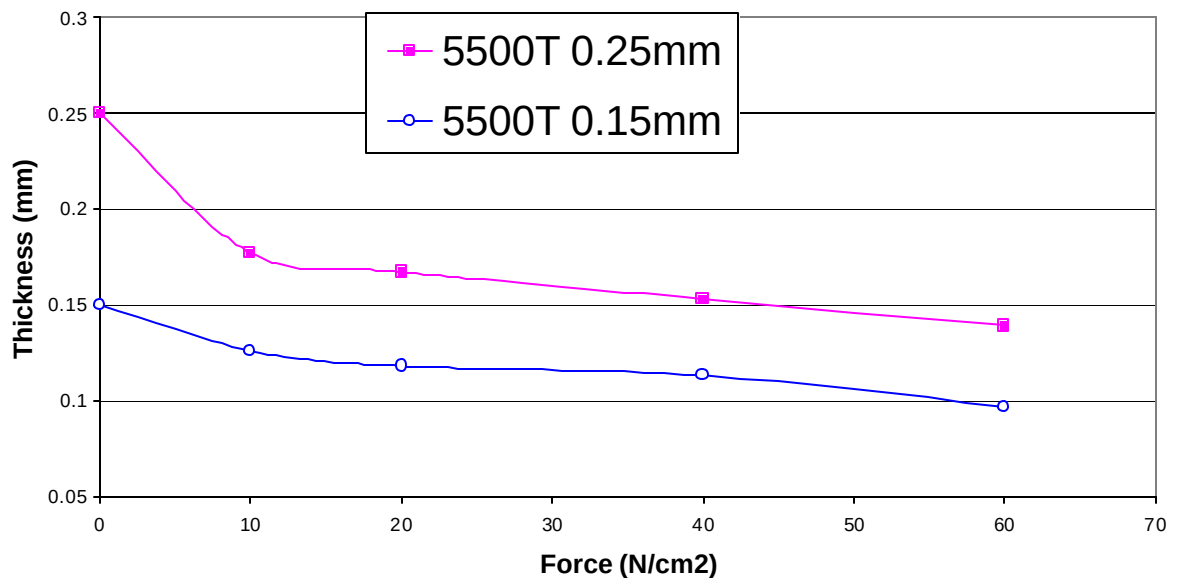
Thermal Impedance versus Force:

Using the 3M thermal impedance test set-up, 20W of power is applied for 30 minutes to a test plate that is under a varying pressure. The test data shows that with time the 3M PCM 5500T will perform similarly to a 1.6 W/m-K thermal conductivity grease



Thickness versus Force:

Using the 3M thermal impedance test set-up, 20W of power is applied for 30 minutes to a test plate that is under a varying pressure. The test data shows that with force the 3M Phase Change Materials 5500T will relax as noted.



Phase Change Material

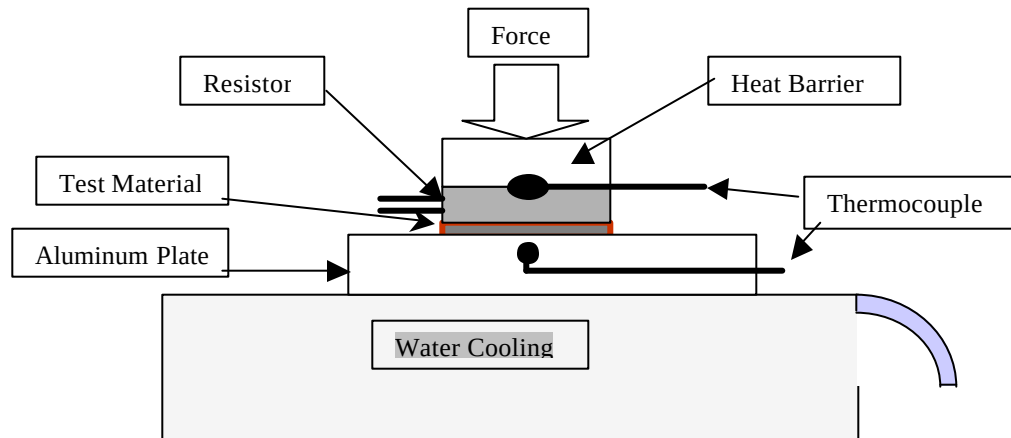
5500T

Note: The following technical information for 3M™ Phase Change Material 5500T should be considered representative or typical only, and should not be used for specification purposes

Typical Properties and Performance Characteristics

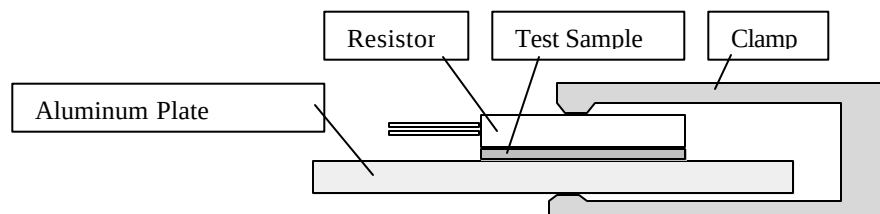
Basic Test Set-up for Thermal Impedance and Force Measurements:

Test data was collected after 30 minutes of time in a given test set-up. Typical sample size was 10mm x 11mm. Typical power applied was 20W.



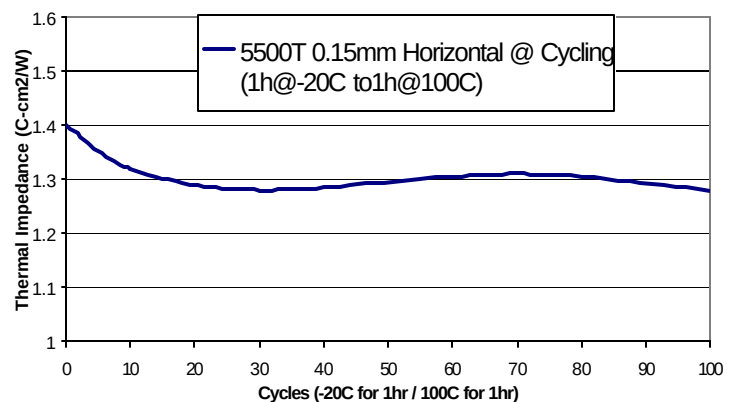
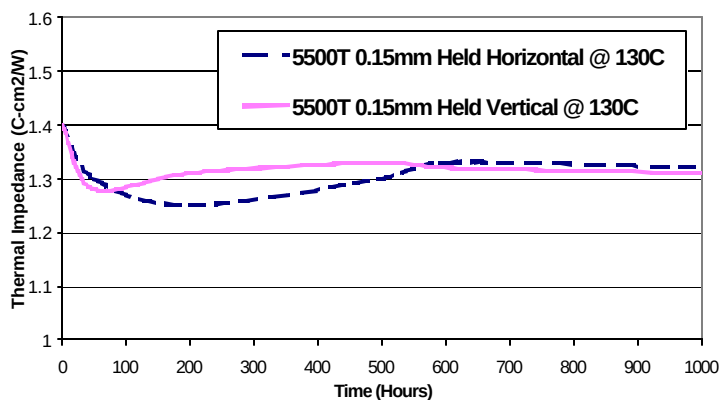
Thermal Test Holder:

Resistor with a test sample and an aluminum plate were placed into an thermal chamber using a test clamp. Assembly was heat aged as required. Sample was then removed from the chamber and the clamp removed. Assembly then tested in the “**Basic Test Set-up for Thermal Impedance and Force Measurements**” configuration at 40N/cm² and 20W.



Thermal Testing:

Test data was collected periodically after a portion of the thermal test cycle was complete. Samples held in thermal test holder in vertical or horizontal position. Power applied was 20W. Clamping pressure was 40N/cm².



Phase Change Material

5500T

Note: The following technical information for 3M™ Phase Change Material 5500T should be considered representative or typical only, and should not be used for specification purposes

Typical Properties and Performance Characteristics

Outgassing:

A sample of the 5500T was placed into a test chamber and heated at 100C for 10minutes. The outgassed components were analyzed using Dynamic Head Space GC/MS with a pentadecane reference standard.

Outgassing 5500T

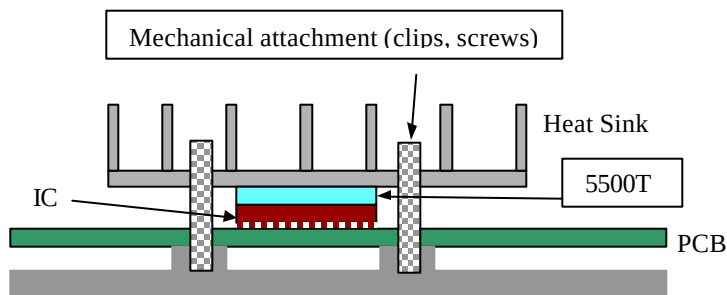
Outgass Component	Amount (ppm)
Hydrocarbon	700
Other	-----
Total	700

Typical Application Configuration

Typical Application Configuration Suggestions:

→ User to Verify Specific End Use Application Requirements

The 5500T is used as the thermal interface material between a hot surface and a cooling surface to aid in the transfer of heat by creating an interface with minimal air gaps. The assembly using the 5500T must be under a degree of pressure or force to ensure good contact between the 5500T and the hot and cool surfaces. The force can be applied by some mechanical means such as clips, screws or other fastening or closure method.



Suggested application assembly configurations should provide for a flexible force application means so that upon heating the assembly force retention upon the 5500T will be greater than approximately 20 N/cm² and less than approximately 40N/cm². The 5500T will stress relax and melt upon heating. The melting temperature of the 5500T is approximately 50C. The melting and softening of the polymer allows for a degree of flow and reduced modulus to provide for enhanced gap filling and intimate contact at surfaces. Upon heating above the melting temperature of the 5500T, the 5500T could be reduced in thickness by 10-40% or more depending on the application force applied.

Requirements for a successful application using the 5500T include:

- Flexible and constant application force after the 5500T experiences thermal cycles above the melting temperature that hold a force in the approximate 20-40N/cm² range.
- Correct thickness of the 5500T to provide sufficient material to fill all available voids or non-uniformities or non-flatness conditions between desired surfaces.

Phase Change Material

5500T

Available Sizes

Width: -----

Length: -----

Custom Sizes: Contact your local 3M sales representative for information and availability of standard and custom sizes (width and length) or die cut parts of the PCM 5500T.

Application Guidelines

1.) Substrate surfaces should be clean and dry prior to the 5500T application. Isopropyl alcohol (isopropanol) applied with a lint-free wipe or swab should be adequate for removing surface contamination such as dust or finger prints. Do not use "denatured alcohol" or glass cleaners, which often contain oily components. Allow the surface to dry for several minutes before applying the 5500T. More aggressive solvents (such as acetone, methyl ethyl ketone (MEK) or toluene) may be required to remove heavier contamination (grease, machine oils, solder flux, etc.) but should be followed by a final isopropanol wipe as described above.

Note: Be sure to read and follow the manufacturers' precautions and directions when using solvents.

2.) Apply the 5500T to one substrate at a modest angle with the use of a squeegee, rubber roller or finger pressure to help reduce the potential for air entrapment under the 5500T during its application. The liner can be removed after positioning the tape onto the first substrate.

3.) Assemble the part by applying compression to the substrates to ensure a good wetting of the substrate surfaces with the 5500T. Rigid substrates are more difficult to assemble without air entrapment as most rigid parts are not flat. Use of a thicker 5500T may result in increased wetting and reduced air entrapment of rigid substrates. Flexible substrates can be assembled to rigid or flexible parts with much less concern about air entrapment because one of the flexible substrate can conform to the other substrates during application.

4.) Upon assembly of the 5500T to a substrate, the 5500T/Substrate are assembled to another component that creates the "Hot Side-5500T-Cold Side" configuration.

- The 5500T assembly (with mechanical force system in place) can be heated past the 5500T melting temperature to provide for maximum wet-out and reduced air entrapment.

5.) Rework Tips:

- Rework requires separation of the two substrates. Separation can be accomplished by any practical means: prying, torquing or peeling. The tape will be destroyed upon separation and must be replaced. The surfaces should be re-cleaned according to the recommendations in this data page.
- Heating up the substrates can reduce the adhesion level and make removal easier.
- Part separation can be aided by immersion in warm water. This should eventually reduce the adhesion and make prying, torquing or peeling apart the substrates easier.

Phase Change Material

5500T

General Information

Product selection table for 3M™ Thermally Conductive Materials

Product	Thickness (mm)	Bulk Thermal Conductivity (W/m-K)	Typical applications
3M™ Thermally Conductive Tapes			
8805 8810 8815	0.127 0.25 0.375	0.6	Applications requiring thin bonding with good thermal transfer; CPU, flex circuit and power transformer bonding to heat sinks and other cooling devices. Superior tack and wetting properties
9894FR	1.0	0.6	Applications requiring gap filling and bonding with good thermal transfer; IC packages and PCB bonding to heat sinks, metal cases and other cooling devices.
3M™ Thermally Conductive Adhesives			
TC-2707	-----	0.7	Applications requiring high adhesive strength, good surface wetting, gap filling and good thermal transfer. IC package and PCB thermal interfacing with heat sinks or other cooling devices.
DP-190 Grey	-----	0.4	
3M™ Thermally Conductive Pads			
5506 / 5507	0.5 to 2.5	2.3 / 2.5	Applications requiring gap filling and superior thermal performance without bonding. IC package and PCB thermal interfacing with heat sinks or other cooling devices and metal cases.
5509	0.5 to 2.5	5.0	

Application Ideas

3M™ Thermally Conductive 5500T PCM is designed to provide a preferential heat-transfer path between heat-generating and cooling devices (e.g., fans, heat pipes and heat sinks).

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-362-3550. Address correspondence to 3M Engineered Adhesives Division, 3M Center, Building 220-7E-01, St. Paul, MN 55144-1000. Our fax number is 651-733-9175. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone: 1-809-750-3000. In Mexico, phone 5-728-2180. www.3m.com/conductives

Certification/Recognition

MSDS: 3M has not prepared a MSDS for this product which is not subject to the MSDS requirements of the Occupational Safety and Health Administration's Hazard Communication Standard, 29 C.F.R. 1910.1200(b)(6)(v). When used under reasonable conditions or in accordance with the 3M directions for use, the product should not present a health and safety hazard. However, use or processing of the product in a manner not in accordance with the directions for use may affect its performance and present potential health and safety hazards.

TSCA: This product is defined as an article under the Toxic Substances Control Act and therefore, it is exempt from inventory listing requirements.

UL: This product has not been recognized by Underwriters Laboratories Inc

Important Notice

3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of application. Please remember that many factors can affect the use and performance of a 3M product in a particular application. The materials to be bonded with the product, the surface preparation of those materials, the product selected for use, the conditions in which the product is used, and the time and environmental conditions in which the product is expected to perform are among the many factors that can affect the use and performance of a 3M product. Given the variety of factors that can affect the use and performance of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

Limitation of Remedies and Liability

If the 3M product is proved to be defective, THE EXCLUSIVE REMEDY, AT 3M'S OPTION, SHALL BE TO REFUND THE PURCHASE PRICE OF OR TO REPAIR OR REPLACE THE DEFECTIVE 3M PRODUCT. 3M shall not otherwise be liable for loss or damages, whether direct, indirect, special, incidental, or consequential, regardless of the legal theory asserted, including negligence, warranty or strict liability.