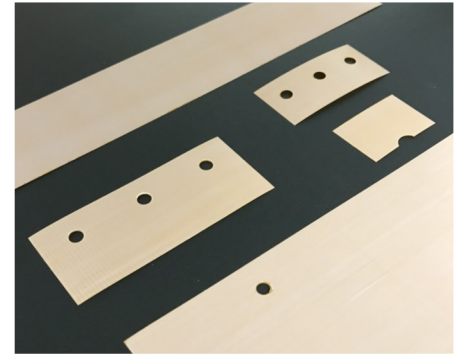


Diaphase 60 is high performance *dielectric* phase-change material which utilizes Kapton® MT polyimide film to act as a thermally conductive carrier in order to deliver a uniform thickness coating of Diaphase 60 phase-change thermal compound on both sides. Through the development of this unique formulation, Diaphase 60 offers efficient thermal transfer by phase-changing during normal device operating temperatures while maintaining a uniform bond line thus driving out the air and adjusting for any surface imperfections or flatness conditions that may exist across the interface.

Being able to manufacture Diaphase 60 in multiple compound thicknesses as well as Kapton MT thicknesses allows us to meet a wide range of electronic cooling applications ranging from transistors, diodes or any type of heat generating *non-isolated* power device requiring efficient and reliable thermal transfer into a heat sink/case sink or heat dissipating structure.



See Page 4 for UL Information



- Low Thermal impedance
- Excellent Mechanical & Dielectric Properties
- Solutions for many types of surfaces
- Excellent replacement for thermal greases
- Rolls, Sheets, Die Cuts
- Thixotropic / Prevents Compound Run-Out
- Multiple Standard Material Constructions
- Cost Effective “Drop in Place” Solution / Reworkable
- Fully Customizable—centered around specific requirements

Typical Device Applications	• Non-isolated packages	• Diodes/Relays	• Power Semiconductor	• Chassis Assembly	• Heat Sink/Case Sink
	• Transistors	• Power Supply / UPS	• RF Components	• Non-isolated modules	• Large Surface Area

### Diaphase 60 Thermal Compound Properties

Phase Change Temp.....60°C / 140°F  
 Volumetric Expansion.....15%  
 Thermal Impedance....see page 4 for details on specific material construction performance (ASTM D5470)

### Standard Diaphase 60 Coating Thicknesses

L05.....0.0005" (0.013mm) per side  
 L10.....0.001" (0.025mm) per side  
 Contact us for custom Diaphase 60 coating thickness options

### Kapton MT Substrate Thickness/Specific Properties

K1.....0.001" (0.025mm)  
 Dielectric Strength.....5500 V/mil (ASTM D149)  
 K1.5.....0.0015" (0.038mm)  
 Dielectric Strength.....5100 V/mil (ASTM D149)  
 K2.....0.002" (0.051mm)  
 Dielectric Strength.....4600 V/mil (ASTM D149)  
 K3.....0.003" (0.076mm)  
 Dielectric Strength.....4100 V/mil (ASTM D149)  
 Standard Diaphase 60 Kapton type is version MT  
 See page 3 for other specific information on Kapton MT Film

### Diaphase 60 Delivery Formats

- Master rolls
- Sheets
- Die cut individuals
- Multiple die cuts per card
- Die cut continuous reels
- Laser Cutting (Tight Tolerance)

### Diaphase 60 Pre-Apply Attachment Options

LT.....low tack pressure sensitive (repositionable)  
 A.....See Diaphase 60A Data Sheet  
 T20.....thermally conductive pressure sensitive

Discrete PSA placement or 100% backed options  
 See page 2 for detailed pre-apply attachment options and configurations

### Other Information

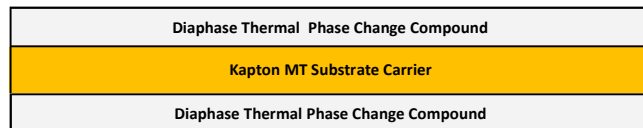
RoHs Compliant REACH Compliant Halogen Free



### What is Diaphase 60?

Diaphase 60 is a solvent free high performance dielectric thermal interface material that is designed to provide efficient thermal transfer by providing precision phase-change and a uniform bond line thickness across a device/component mounting interface. The ability to manufacture Diaphase 60 in a variety of phase-change thicknesses, Kapton MT substrate thicknesses as well as within rolls, sheets and pre-form die-cuts allows us to meet a wide range of requirements within multiple industries. Diaphase’s inherent flexibility from manufacturing to installation makes it an ideal solution for applications ranging from low volume (even prototypes) and/or high volume environments.

### Standard Diaphase Pad Construction



See page 2 for detailed material construction options and material codes

### Superior Alternative to Thermal Grease

Diaphase 60 is designed as a pre-formed thermally conductive “drop in place” pad that offers excellent thermal transfer characteristics not only through design of the compound formulation itself, however, through it’s uniform pad thickness in X, Y, Z dimensions as well. From an installation perspective, thermal greases are difficult to dispense as well as provide inadequate coverage and a uniform thickness across the interface most often leaving trapped air leading to poor thermal transfer. Not to mention the thermal grease clean up required in unwanted areas afterwards.

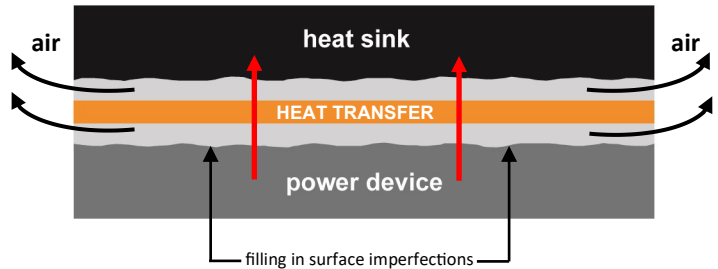


Since Diaphase 60 is manufactured with a specific thickness and die cut pattern, it can be placed instantly and immediately ready for component mounting. Due to it’s thixotropic formulation design, compound is held within the interface with no worries of run-out into unwanted areas during normal device/component operation. Upon initial phase-change of the Diaphase 60 compound, Diaphase begins it’s wetting out process allowing it to fill in any microscopic surface imperfections or uneven surface conditions across the interface as well as drive out any trapped air leading to increased thermal transfer performance keeping the device/component cool and reliable.

Diaphase 60 pre-formed pads are shipped in clean sizable packs or continuous die cut reels instantly ready for cost effective installation and reliable thermal performance.

### Thinner vs. Thicker

Diaphase 60 is manufactured in a range of compound coating thicknesses as well as kapton substrate thicknesses in order to meet various surface flatness condition, overall interface size and/or nominal gap filling requirements. It is typically recommended that for larger surface area conditions with surface finishes exceeding 64 microns and/or flatness conditions exceeding 0.002" or more, thicker compound coating thicknesses should be considered to allow the Diaphase 60 compound to adjust for these features during initial phase change. Filling a nominal gap requirement with smooth interface surfaces can typically be accomplished with thicker substrate options.



### Driving Out the Air

A primary advantage of utilizing the Diaphase 60 phase-change system is the ability to drive out air from within the interface during initial device cycling causing phase change and surface wetting of the thermal compound coating.

### Standard Diaphase 60 Material Constructions

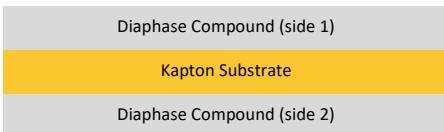
Diaphase 60 is manufactured standard within a range of phase-change coating thicknesses as well as Kapton MT Polyimide Film substrate thicknesses allowing us to target standard and custom device / mounting application requirements. Below is a table of standard Diaphase 60 material constructions to choose from.

Standard Diaphase Material Constructions	0.001" / 0.025mm Kapton MT Film	0.0015" / 0.038mm Kapton MT Film	0.002" / 0.051mm Kapton MT Film	0.003" / 0.076mm Kapton MT Film
<b>L05 (0.0005" / 0.013mm) compound per side</b>	K1-L05 * 0.002" / 0.051mm	K1.5-L05 * 0.0025" / 0.064mm	K2-L05 * 0.003" / 0.076mm	K3-L05 * 0.004" / 0.100mm
<b>L10 (0.001" / 0.03mm) compound per side</b>	K1-L10 0.003" / 0.076mm	K1.5-L10 0.0035" / 0.089mm	K2-L10 * 0.004" / 0.100mm	K3-L10 0.005" / 0.127mm

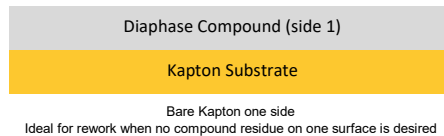
\* Popular Diaphase Material Constructions

### Diaphase 60 Standard and Custom Material Constructions

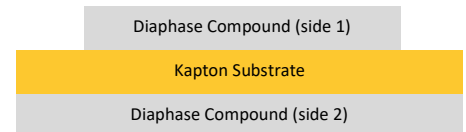
#### Standard Double Coated Construction



#### Single Side Coated



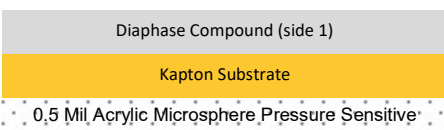
#### Discrete Coating Placement



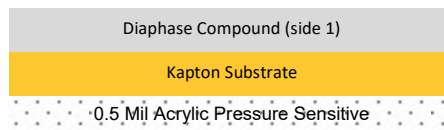
Note: the introduction of an additional tacking layer to 100% one side of Diaphase will impact the overall thermal performance of the material.

### Diaphase 60 Pre-Apply Attachment Options (100% surface backed)

#### Low Tack Repositionable (Type: LT)

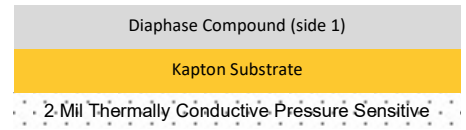


#### High Tack Repositionable (Type: A)



For Type A, Please see DiaPhase 60A Data Sheet

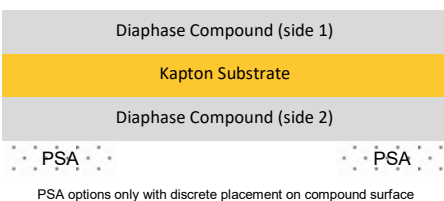
#### Thermally Conductive (Type: T20)



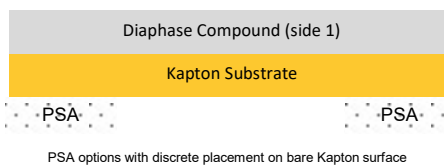
### Diaphase 60 Pre-Apply Attachment Options (Discrete PSA Placement)

Note: Discrete placement designed for applying PSA outside of primary thermal via so thermal performance will not be impacted.

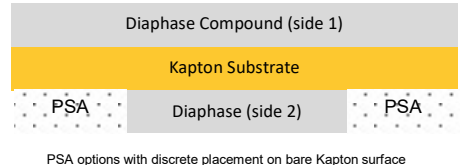
#### Discrete PSA Placement on Compound



#### Discrete PSA Placement on Uncoated Side



#### Discrete PSA with Discrete Coating Placement



#### Diaphase 60 Physical Properties / Form Characteristics

Characteristic	Diaphase 60
Base Formulation (Compound)	Proprietary
Phase Change Temperature	60°C / 140°F
Viscosity @ Phase Change	Thixotropic
Overall Thickness Tolerance	Target Thickness +/- 10% (typical)
Diaphase 60 Color	Orange
Separator Liner / Color	Paper / White
Available Formats	Master Rolls / Slit Rolls / Die Cuts (piece or reels)
Maximum Master Roll Width	15.500" (39.37cm)
Standard Master Roll Lengths	25ft / 50ft / 100ft / 250ft / 500ft
Custom Roll Lengths and Widths Available	Yes (customer defined)
Standard Sheet Sizes	12.0" x 15.5" (30.5cm x 39.4cm) or 24" x 15.5" (61.0cm x 39.4cm)
Custom Sheet Lengths and Widths Available	Yes (customer defined)
TIMTEL Die Cutting Capabilities	Steel Rule Die / Flexible Die / Rotary Die / Laser Cutting
Typical TIMEL Die Cut Delivery Formats	Individuals, Multiples on a card, or Continuous Reel
Typical TIMTEL Die Cut Dimensional Tolerance	0.005" (0.13mm) to 0.010" (0.25mm) (determined at review)

DuPont Kapton MT	100MT	150MT	200MT	300MT
Specific Properties	Timtel Substrate ID K1	Timtel Substrate ID K1.5	Timtel Substrate ID K2	Timtel Substrate ID K3
Tensile Strength	20 kpsi	21 kpsi	22 kpsi	23 kpsi
ASTM D882	(138 MPa)	(145 MPa)	(152 MPa)	(159 MPa)
Modulus	440 kpsi	450 kpsi	475 kpsi	490 kpsi
ASTM D882	(3.0 GPa)	(3.1 GPa)	(3.3 GPa)	(3.4 GPa)
Elongation	80%	85%	87%	100%
ASTM D882				

Figures reported above are per DuPont reported data for Kapton MT Film. Visit DuPont's website at [www.dupont.com](http://www.dupont.com) or contact TIMTEL for more information.

DuPont Kapton MT General Properties	Result
Kapton MT UL Registration	E39505 (DuPont Corporation)
Thermal Conductivity (ASTM D470)	0.46 W / m · K
Tear Strength (ASTM D1004)	1.70 lbf
Cut Through Resistance (per DuPont Method)	40 lbs
Dielectric Constant (25°C) (ASTM D150)	4.2
Volume Resistivity (ASTM D257)	> 10 <sup>16</sup> ohm-cm

Figures reported above are per DuPont reported data for Kapton MT Film. Visit DuPont's website at [www.dupont.com](http://www.dupont.com) or contact TIMTEL for more information.

Thermal Outgassing (Diaphase Compound Only)	Result
Total Mass Loss, % TML	0.138
Collectible Volatile, Condensable Matter, % CVC	0.130
Water Vapor Gain, % WVR	0.021

Note: Thermal outgassing test performed per ASTM E595-93 using thermal compound formulation only. Due to no outgassing, Diaphase 60 is suitable for aerospace application.

Diaphase 60 Storage & Shelf Life	Result
Storage Condition and Temperature	Cool Dry Location at or below 95°F / 35°C
Shelf Life	2 years from date of manufacture
Transit Methods / Conditions	Due to temperature sensitive design of our thermal materials, it is recommended to ship air freight during warmer months to prevent phase-change of thermal compound during long ground transit conditions within elevated temperature environments (May through September)

## Formulation Revisions (post testing of Diaphase 60 by customer)

Due to the flexibility of technology and capability, not always does our **standard** Diaphase 60 formulation or form factors 100% optimize a unique application requirement. This is why at TIMTEL, we can provide our customers with minor to major formulation adjustments to fit better within the scope a specific customer defined requirement/ characteristic. This is accomplished through base compound modification and/or filler particle type, size or structure. These options are available to customers that have tested the standard formulations and can offer feedback from this testing so it can be used as a baseline for further modification/development.

## Application Re-Work / Clean Up

Reworking your application with Diaphase 60 is simple. Simply detach your device from its heat sink or case sink and remove the pad. Depending on the amount of Diaphase compound left on your application surface, introduction of new Diaphase 60 material may be required when re-assembling. Diaphase compound residue on the application surface can be cleaned up using mineral spirits solvent or isopropyl alcohol and a cloth towel. Other clean up methods include slightly heating the compound and gently wiping away softened unwanted compound. **For best results, make sure all application surfaces are clean and free of debris before applying the Diaphase Pad.**

## Flexibility Across Markets and Application Requirements

Due to Diaphase 60's unique formulation and form factor capability allows it to be a viable candidate within various market and application types where a high performing thermally conductive material is required. Diaphase 60 is available in a variety of delivery formats including master rolls, slit rolls, die cut individuals or die cuts on a continuous reel.

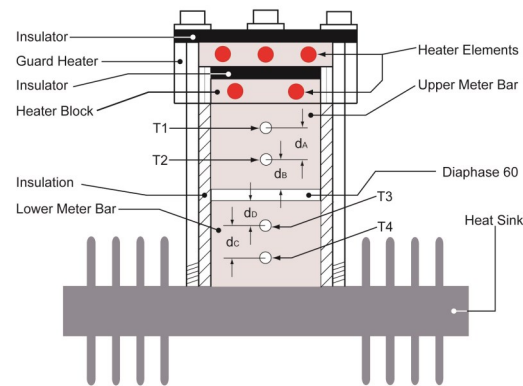
## Thermal Performance Testing and Characteristics

Below is thermal impedance data based upon ASTM D5470, *Standard Test Method for Thermal Transmission Properties of Thermally Conductive Electrical Insulation Materials*.

### What is thermal impedance and why do we measure it?

Thermal impedance allows us to consistently measure the thermal transfer ability of a thermally conductive interface material taking into account a device's power density, interface area as well as bond line thickness (thermal material thickness). By measuring the temperature at 2 points (shown right) in both the upper and lower metering bars, the temperature of the interface surfaces can be determined and thus the thermal impedance can be calculated due to the temperature differential of these 2 surfaces measured in °C-in<sup>2</sup>/watt (°C-cm<sup>2</sup>/watt)

## General Test Setup / Overview for Measuring Thermal Impedance



$T_A = T_2 - d_B / d_A (T_1 - T_2)$  = Temperature of upper meter bar surface in contact with the Diaphase 60 Pad

$T_B = T_3 + d_D / d_C (T_3 - T_4)$  = Temperature of lower meter bar surface in contact with the Diaphase 60 Pad

Thermal Impedance is calculated as follows:  $(T_A - T_B) \times \text{Area} / \text{Power Applied} = \text{°C-in}^2/\text{watt}$

Below are thermal impedance values for versions of Diaphase 60 materials. Contact us for testing of custom thickness compositions of DiaPhase 60.

Type	@ 10 PSI	@ 20 PSI	@ 40 PSI	@ 80 PSI	@ 100 PSI
K1-L05 (0.002")	0.156 °C-in <sup>2</sup> / Watt	0.146 °C-in <sup>2</sup> / Watt	0.130 °C-in <sup>2</sup> / Watt	0.109 °C-in <sup>2</sup> / Watt	0.107 °C-in <sup>2</sup> / Watt
K1.5-L05 (0.0025")	0.201 °C-in <sup>2</sup> / Watt	0.176 °C-in <sup>2</sup> / Watt	0.147 °C-in <sup>2</sup> / Watt	0.127 °C-in <sup>2</sup> / Watt	0.124 °C-in <sup>2</sup> / Watt
K2-L05 (0.003")	0.215 °C-in <sup>2</sup> / Watt	0.188 °C-in <sup>2</sup> / Watt	0.163 °C-in <sup>2</sup> / Watt	0.151 °C-in <sup>2</sup> / Watt	0.147 °C-in <sup>2</sup> / Watt
K2-L10 (0.004")	0.228 °C-in <sup>2</sup> / Watt	0.209 °C-in <sup>2</sup> / Watt	0.186 °C-in <sup>2</sup> / Watt	0.171 °C-in <sup>2</sup> / Watt	0.168 °C-in <sup>2</sup> / Watt
K3-L05 (0.004")	0.329 °C-in <sup>2</sup> / Watt	0.299 °C-in <sup>2</sup> / Watt	0.253 °C-in <sup>2</sup> / Watt	0.223 °C-in <sup>2</sup> / Watt	0.217 °C-in <sup>2</sup> / Watt

**Note:** Thermal Impedance Testing is available upon request for customers who require a non-standard Diaphase 60 material thickness, custom constructions, revised substrates or PSA pre-tacking options within pressure ranges of 10 PSI to 100 PSI

## DiaPhase 60 UL Registration

The following DiaPhase 60 material types are certified and meet UL Flammability Rating UL94-VO (FILE: E478724)

- K1-L05 (0.002" / 0.051mm)
- K1-L10 (0.003" / 0.076mm)
- K1.5-L05 (0.0025" / 0.064mm)
- K2-L05 (0.003" / 0.076mm)
- K2-L10 (0.004" / 0.102mm)
- K3-L05 (0.004" / 0.102mm)
- K3-L10 (0.005" / 0.127mm)



For more information regarding DiaPhase 60 UL Registration or Documentation, contact us toll free at 1-888-989-3832 or e-mail [info@timtelthermal.com](mailto:info@timtelthermal.com)