

IntraPHASE 60

Graphite Filled Phase Change Thermal Material

60°C/140°F Phase-Change Temperature

Similar in design to its IntraPhase 50 counterpart, IntraPhase 60 offers all the same performance offerings but designed with a higher phase change temperature of 60C for power devices with higher operating temperatures. IntraPhase 60 is a graphite filled phase change thermal interface material offering efficient heat transfer from device to sink packaged with a clean drop-in-place assembly solution.

IntraPhase 60 not only achieves efficient thermal transfer through its graphite filled compound coating design but by providing optimal phase change at normal device operating temperatures adjusting for any interface flatness concerns, surface imperfections as well as elimination of air from within the interface.

IntraPhase 60 is readily available in multiple material thicknesses targeted towards specific device/cooling application requirements (aluminum substrate and coating thickness adjustments).

- High Performance Thermal Transfer
- Low Thermal Impedance
- 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	• Power Modules (IGBT)	• LED	• Diodes / Relays	• Power Semiconductor	• Heat Sink/Case Sink
	• Power Electronics	• Transistors	• Microprocessor	• RF Components	• Large Surface Area Transfer

IntraPhase 60 Thermal Compound Properties

Phase Change Temp.....60°C / 140°F
 See IntraPhase 50 for lower phase-change temp
 Volumetric Expansion.....15%
 Thermal Impedance...see page 4 for details on specific material construction performance (ASTM D5470)

Standard IntraPhase 60 Coating Thicknesses

G03.....0.00025" (0.006mm) per side
 G05.....0.0005" (0.013mm) per side
 G06.....0.00065" (0.017mm) per side
 G10.....0.00100" (0.025mm) per side
 G13.....0.00125" (0.032mm) per side
 Contact us for custom IntraPhase 60 coating thickness options

Standard Aluminum Substrate Thicknesses

AL1.....0.001" (0.025mm)
 AL2.....0.002" (0.051mm)
 AL3.....0.003" (0.076mm)
 AL5.....0.005" (0.127mm)
 AL10.....0.010" (0.254mm)
 Standard aluminum type is 1145 (O) soft temper
 Custom aluminum types as well as copper substrate options available.

IntraPhase 60 Delivery Formats

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

IntraPhase 60 Pre-Apply Attachment Options

A.....low tack pressure sensitive (repositionable)
 T20.....thermally conductive pressure sensitive

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

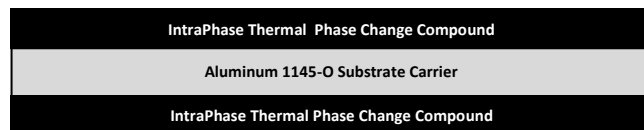
Other Information

RoHs Compliant REACH Compliant Halogen Free

What is IntraPhase 60?

IntraPhase 60 is a graphite filled solvent free 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 IntraPhase 60 in a variety of phase-change thicknesses, aluminum 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. IntraPhase'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.

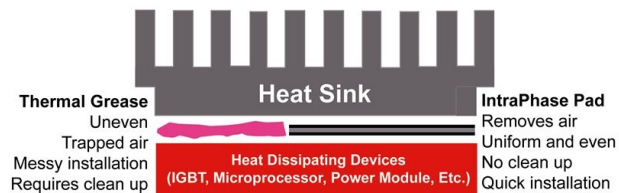
Standard IntraPhase Pad Construction



See page 2 for detailed material construction options and material codes

Superior Alternative to Thermal Grease

IntraPhase 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 its 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 IntraPhase 60 is manufactured with a specific thickness and die cut pattern, it can be placed instantly and immediately ready for component mounting. Due to its thixotropic formulation design, compound is held within the interface with no worries of run-out into unwanted areas during installation or device/component operation. Upon initial phase-change of the IntraPhase 60 compound, IntraPhase begins its 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.

IntraPhase 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.

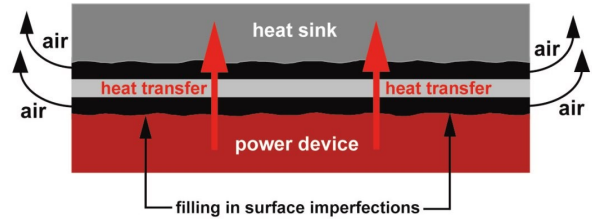
IntraPHASE 60

Graphite Filled Phase Change Thermal Material

60°C/140°F Phase-Change Temperature

Thinner vs. Thicker

IntraPhase 60 is manufactured in a range of compound coating thicknesses as well as aluminum substrate thicknesses in order to meet various surface flatness conditions, 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 IntraPhase 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 IntraPhase 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 IntraPhase 60 Material Constructions

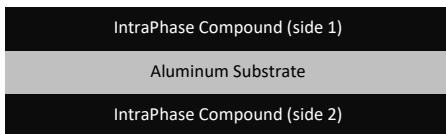
IntraPhase 60 is manufactured standard within a range of phase-change coating thicknesses as well as aluminum 1145-O (soft) aluminum substrate thicknesses allowing us to target standard and custom device / mounting application requirements. Below is a table of standard IntraPhase 60 material constructions to choose from.

Standard IntraPhase Material Constructions	0.001" / 0.025mm Aluminum 1145-O	0.002" / 0.051mm Aluminum 1145-O	0.003" / 0.076mm Aluminum 1145-O	0.005" / 0.127mm AL 1145 Aluminum 1145-O	0.010" / 0.254mm Aluminum 1145-O
G05 (0.00025" / 0.006mm) compound per side		AL2-G03 * 0.0025" / 0.064mm	AL3-G03 0.0035" / 0.089mm	G03 coating is a nominal slight coating method in which a streak type coating is applied.	
G05 (0.0005" / 0.013mm) compound per side	AL1-G05 0.002" / 0.051mm	AL2-G05 * 0.003" / 0.076mm	AL3-G05 0.004" / 0.100mm	AL5-G05 0.006" / 0.152mm	AL10-G05 0.011" / 0.279mm
G06 (0.00065" / 0.017mm) compound per side	AL1-G06 0.0023" / 0.058mm	AL2-G06 * 0.0033" / 0.084mm	AL3-G06 0.0043" / 0.109mm	AL5-G06 0.0063" / 0.160mm	AL10-G06 0.0113" / 0.287mm
G10 (0.0010" / 0.025mm) compound per side	AL1-G10 0.003" / 0.076mm	AL2-G10 * 0.004" / 0.102mm	AL3-G10 0.005" / 0.127mm	AL5-G10 0.007" / 0.177mm	
G13 (0.00125" / 0.032mm) compound per side	AL1-G13 0.0035" / 0.089mm	AL2-G13 * 0.0045" / 0.114mm	AL3-G13 0.0055" / 0.139mm		

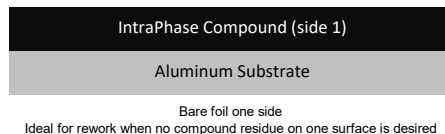
IntraPhase 60 Standard and Custom Material Constructions

* Popular IntraPhase Material Constructions

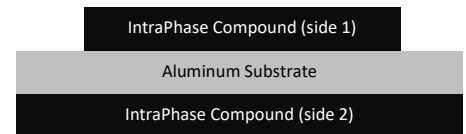
Standard Double Coated Construction



Single Side Coated



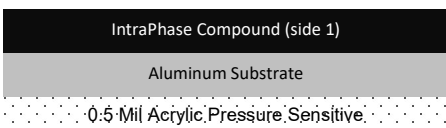
Discrete Coating Placement



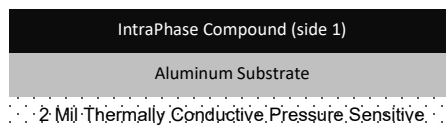
IntraPhase 60 Pre-Apply Attachment Options (100% surface backed)

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

Low Tack Repositionable (Type: A)



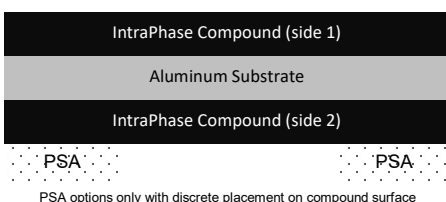
Thermally Conductive (Type: T20)



IntraPhase 60 Pre-Apply Attachment Options (Discrete PSA Placement)

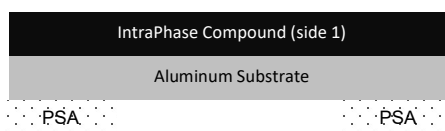
Note: Discrete placement designed for applying PSA outside of primary thermal via so thermal performance will not be impacted.

Discrete PSA Placement on Compound



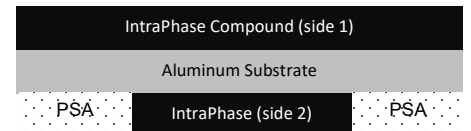
PSA options only with discrete placement on compound surface

Discrete PSA Placement on Uncoated Side



PSA options with discrete placement on bare aluminum surface

Discrete PSA with Discrete Coating Placement



PSA options with discrete placement on bare aluminum surface

IntraPhase 60 Physical Properties / Form Characteristics

Characteristic	IntraPhase 60
Base Formulation (Compound)	Proprietary
Phase Change Temperature	60°C / 140°F
Viscosity @ Phase Change	Thixotropic
Overall Thickness Tolerance	Target Thickness +/- 10% (typical)
IntraPhase 60 Color	Black
Separator Liner / Color	Paper / White
Available Formats	Master Rolls / Slit Rolls / Die Cuts (piece or reels)
Maximum Master Roll Width	11.500" (29.2cm) or 17.500" (44.5cm)
Standard Master Roll Lengths	25ft / 50ft / 100ft / 250ft / 500ft
Custom Roll Lengths and Widths Available	Yes (customer defined)
Standard Sheet Sizes	12.0" x 24.0" (30.5cm x 61.0cm) or 18" x 24" (45.7cm x 61.0cm)
Custom Sheet Lengths and Widths Available	Yes (customer defined)
TIMTEL Die Cutting Capabilities	Steel Rule Die / Flexible Die / Rotary Die / Laser Cutting
Typical TIMTEL 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 design review)

Thermal Outgassing (IntraPhase 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, IntraPhase 60 is suitable for aerospace application.

IntraPhase 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 the 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 IntraPhase 60 by customer)

Due to the flexibility of technology and capability, not always does our **standard** IntraPhase 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 IntraPhase 60 is simple. Simply detach your device from its heat sink or case sink and remove the pad. Depending on the amount of Intra-Phase compound left on your application surface, introduction of new IntraPhase 60 material may be required when re-assembling. IntraPhase 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 adhesive. **For best results, make sure all application surfaces are clean and free of debris before applying the IntraPhase Pad.**

Flexibility Across Markets and Application Requirements

Due to IntraPhase 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. IntraPhase 60 is available in a variety of delivery formats including master rolls, slit rolls, die cut individuals or die cuts on a continuous reel

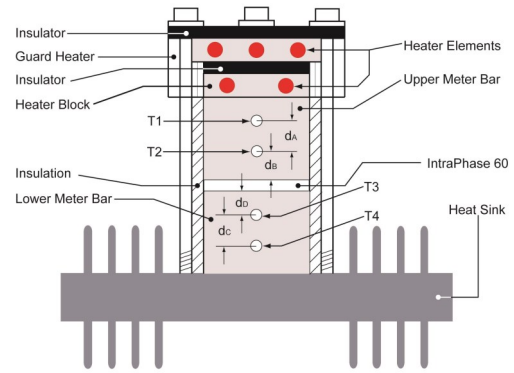
Thermal Performance Testing and Characteristics

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-in²/watt (°C-cm²/watt)

General Test Setup / Overview for Measuring Thermal Impedance



$$T_A = T_2 - d_B / d_A (T_1 - T_2) = \text{Temperature of upper meter bar surface in contact with IntraPhase 60 Pad}$$

$$T_B = T_3 + d_D / d_C (T_3 - T_4) = \text{Temperature of lower meter bar surface in contact with IntraPhase 60 Pad}$$

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 standard versions of IntraPhase 60

Type	@ 10 PSI	@ 20 PSI	@ 40 PSI	@ 80 PSI
AL2-G03	0.020 °C-in ² / Watt	0.014 °C-in ² / Watt	0.010 °C-in ² / Watt	0.007 °C-in ² / Watt
AL2-G05	0.022 °C-in ² / Watt	0.015 °C-in ² / Watt	0.011 °C-in ² / Watt	0.008 °C-in ² / Watt
AL2-G06	0.028 °C-in ² / Watt	0.020 °C-in ² / Watt	0.014 °C-in ² / Watt	0.010 °C-in ² / Watt
AL3-G10	0.055 °C-in ² / Watt	0.041 °C-in ² / Watt	0.028 °C-in ² / Watt	0.027 °C-in ² / Watt

Note: Thermal Impedance Testing is available upon request for customers who require IntraPhase 60 material constructions not listed above, custom constructions, revised substrates or PSA pre-tacking options within pressure ranges of 10 PSI to 80 PSI

IntraPhase 60 Samples

Thermal material evaluation is always critical when designing in a new material or developing a new product. Sheet samples of IntraPhase 60 are available for preliminary testing to determine the optimal IntraPhase 60 thickness as well as overall material construction best suited within the scope of your application requirements.

Want to test samples per your required die cut part? Our razor plotter sampling machine allows us to provide customers IntraPhase 60 material already cut to their required outline for testing. Plotter formed samples provide our customers the ability to test not only the IntraPhase material itself, but their required outline as well without incurring the expense of production tooling.

Contact TIMTEL to request sample sheets or plotter formed samples for testing.

This space intentionally left blank