

XoPHASE 45

High Performance Phase Change Thermal Film

45°C / 113°F Phase-Change Temperature

Designed for Electrically Isolated Component Use

XoPhase 45 is a free standing 45C phase change thermal film designed to provide high performance heat transfer for a variety of electronic device applications including power modules and heat sink/microprocessor cooling. Available standard as either a 4 mil, 8 mil or 12 mil thick free standing phase change film, XoPhase 45 is available in master rolls, sheets or die cut in it's proprietary frame pad transfer system which allows for quick, clean and easy transfer of the thermal pad down to the application surface.

Upon initial phase change, XoPhase 45 begins its controlled flow from its original pre-formed die cut size adjusting for surface irregularities and flatness conditions leading to improved thermal performance. This also includes a reduction of the bond line thickness as mounting pressures are increased.

- High performance thermal transfer
- Low thermal impedance
- Easy to apply—die cut frame transfer system
- Die cut design prevents direct handling of film
- Excellent replacement for thermal greases
- Cost effective thermal pad solution
- Re-workable after phase change
- Metal foil substrate coating options



Typical Device Applications
<ul style="list-style-type: none"> • Power Modules (IGBT) • Power Electronics • LED • Transistors • Diodes / Relays • Microprocessor • Power Semiconductor • RF Components • Heat Sink/Case Sink/Cold Plate • Large Surface Area Transfer

XoPhase 45 Phase Change Film

- * Phase Change Temp.....45°C / 113°F
- * Compound Flow Design.....Thixotropic
- * Volumetric Expansion.....15%

XoPhase 45 is a solvent free / silicon free compound design

Standard XoPhase 45 Film Thicknesses

- * X45-4.....0.004" (0.10mm) film thickness
- * X45-8.....0.008" (0.020mm) film thickness
- * X45-12.....0.012" (0.30mm) film thickness

Contact us for custom XoPhase 45 Film thickness options

XoPhase 45 Thermal Impedance

Thermal impedance testing performed per ASTM D5470

4 mil (0.10mm) XoPhase 45 Film

- * 10 PSI.....0.0138 °C-in² / W | 0.089 °C-cm² / W
- * 20 PSI.....0.0114 °C-in² / W | 0.074 °C-cm² / W
- * 40 PSI.....0.0087 °C-in² / W | 0.056 °C-cm² / W
- * 80 PSI.....0.0070 °C-in² / W | 0.045 °C-cm² / W
- * 100 PSI.....0.0064 °C-in² / W | 0.041 °C-cm² / W

8 mil (0.20mm) XoPhase 45 Film

- * 10 PSI.....0.0148 °C-in² / W | 0.095 °C-cm² / W
- * 20 PSI.....0.0118 °C-in² / W | 0.076 °C-cm² / W
- * 40 PSI.....0.0093 °C-in² / W | 0.060 °C-cm² / W
- * 80 PSI.....0.0076 °C-in² / W | 0.049 °C-cm² / W
- * 100 PSI.....0.0069 °C-in² / W | 0.045 °C-cm² / W

12 mil (0.30mm) XoPhase 45 Film

- * 10 PSI.....0.0158 °C-in² / W | 0.102 °C-cm² / W
- * 20 PSI.....0.0124 °C-in² / W | 0.080 °C-cm² / W
- * 40 PSI.....0.0100 °C-in² / W | 0.065 °C-cm² / W
- * 80 PSI.....0.0082 °C-in² / W | 0.053 °C-cm² / W
- * 100 PSI.....0.0076 °C-in² / W | 0.049 °C-cm² / W

Other Information

- * Manufactured to ISO 9001:2008 Standards
- * RoHs Compliant / Halogen Free Compliant

Die Cut Frame Thermal Pad Transfer System

When designing XoPhase 45 to achieve excellent thermal transfer results, the thermal performance was not the only target. An additional key advantage in using XoPhase 45 is the offering of the TIMTEL Die Cut Thermal Pad Transfer System. The purpose of this die cut design was to avoid common issues typically experienced by similar phase change thermal pad application systems available in market place today.

These common issues typically include:

- ⇒ Having to directly handle the phase change thermal film.
- ⇒ Thermal film breaking when releasing from protective liners.
- ⇒ Inconsistent placement of thermal pad on module or heat sink surface.
- ⇒ Inconsistent transfer of thermal pad from release liner onto module or heat sink surface. Thermal film gets released back up with liner leading to a partially placed torn pad causing re-work or re-application of new pad.



The XoPhase 45 Die Cut Frame Thermal Pad Transfer System was designed to eliminate issues with handling, storage as well as placement of the thermal pad on either a power module or heat sink surface. Through design of special release liners as well as new die cutting process techniques, the XoPhase 45 Die Cut can be handled without direct handling contact with the soft phase change thermal film and fluently transferred down to a range of metal or anodized surfaces using a few different techniques within nominal pressure methods.

XoPhase 45 Thermal Pad Application Methods

The following methods of applying the XoPhase 45 have been developed to fit a range of low, mid and high volume thermal pad application requirements as well as allowable times permitted from the time the thermal pad is placed to the time when device mounting occurs.

Visit www.timtelthermal.com/xovideo.html to watch the XoPhase 45 Video outlining these methods:

- **Pad Mating:** place pad, transfer the thermal film under its own weight before removal of final liner. Transfer Time: 30 to 60 minutes
- **Nominal Finger Pressure:** place pad, apply nominal finger pressure to perimeter and interior of pad before removal of final liner. Transfer Time: 1 to 2 minutes
- **Roll and Release:** place pad, use a hand held roller with nominal pressure going back and forth a minimum of 4 times before removing final liner. Transfer Time: Immediate
- **Pneumatic Press:** place pad, use a press with a medium to soft durometer pad as an interface (2 to 5 PSI) (1 to 5 seconds) before removal of final liner. Transfer Time: Immediate

XoPhase 45 Typical Die Cut Frame Typical Designs

The XoPhase Die Cut Frame Thermal Pad is a fully adaptable installation system for a wide range of pre-formed pad requirements. All pre-formed pad designs utilize the same overall cross section relationship of XoPhase Pad to release liners and require the same steps needed for thermal pad transfer down to the application surface. Within all die cut designs, the liner frame width beyond XoPhase 45 pad size can be specified for specific application requirements. Below is a general overview of some common die cut pad geometries, interior cut features and discrete pad placement capabilities.

Rectangles and Squares



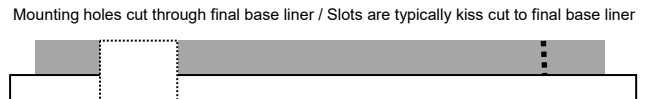
Cross section shown has top frame already removed. Pad is at a stage to be placed down on application surface with final liner to complete thermal pad transfer



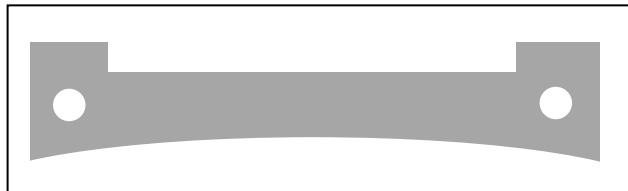
Interior Mounting Holes or Slots



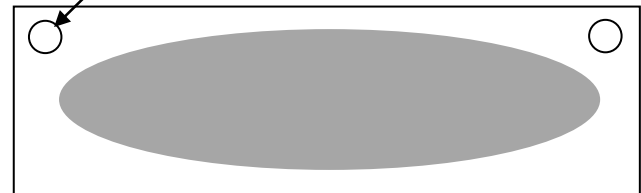
Cross section shown has top frame already removed. Pad is at a stage to be placed down on application surface with final liner to complete thermal pad transfer



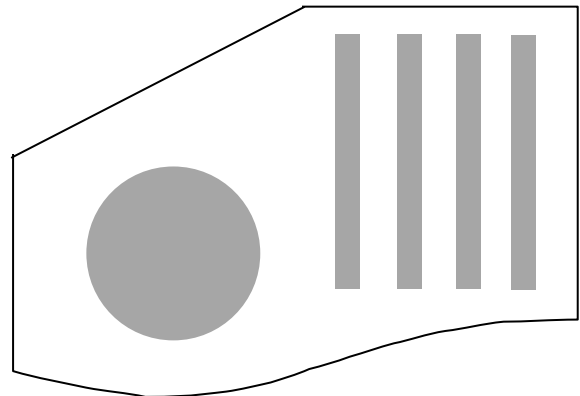
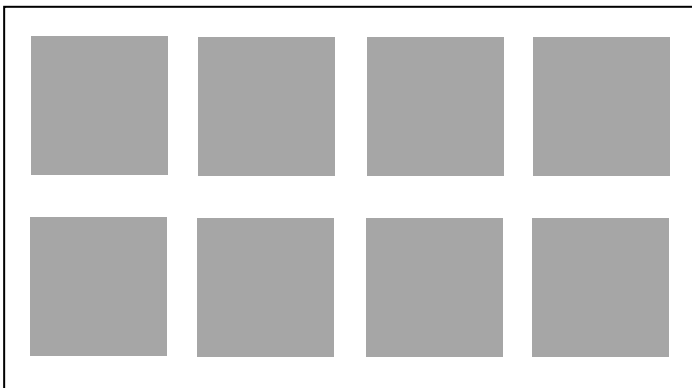
Customer Defined Outlines



Final base liner can contain holes or other cut out features to assist with pad alignment during installation



Discrete Pad Placement on Single Liner (for multiple discrete pad placements on same application surface or pad placements on multiple components within a fixtured setup)



XoPhase 45 Cut Prototypes For Testing: Thermal material evaluation is always critical when designing in a new material or developing a new product. Bulk sheet samples of XoPhase 45 as well as razor plotter cut prototypes are available for preliminary testing in order to optimize the best XoPhase Die Cut Pre-Form within the scope of your application. Contact us for details on how to receive bulk sample sheets as well as razor cut prototypes for testing.

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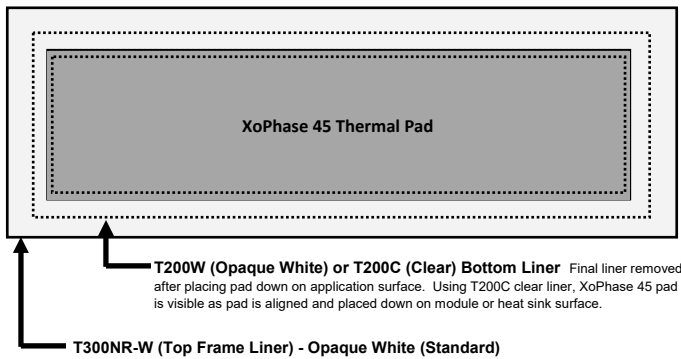
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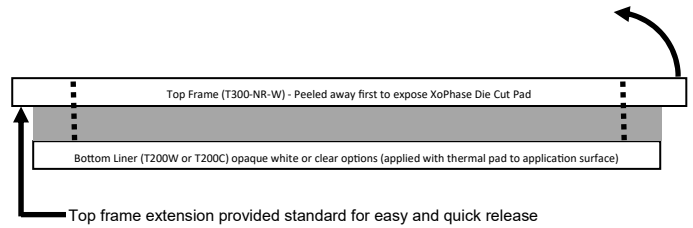
XoPhase 45 Die Cut Frame Thermal Pad General Overview

Below is a general overview of the XoPhase 45 Die Cut Frame Thermal Pad Transfer System as well as base liner options (white versus clear). Watch the XoPhase 45 Demonstration Video by visiting www.timtelthermal.com

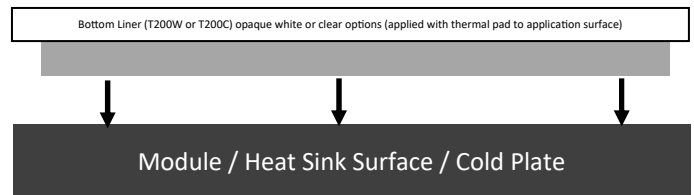
1) Pad Top View (shown with top frame)



2) Pad Cross Section (shown with top frame)

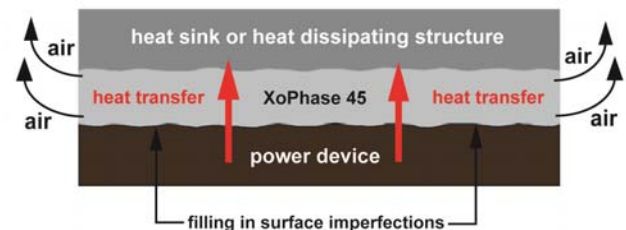


3) Pad Application View (shown with top frame removed)



Watch the XoPhase 45 Die Cut Demonstration Video by visiting www.timtelthermal.com/xovideo.html

A primary advantage of utilizing the XoPhase 45 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.



NO Re-Torque Versus Re-Torque After Initial Phase Change

Re-torque after initial phase change is not required. However, applying re-torque back to your initial torque setting during the first full phase change will thin the material bond line down further leading to increased thermal performance. It is recommended if no re-torque will be applied, to understand what the loss in pressure will be after initial phase-change to determine the corresponding thermal impedance performance figure for what that stabilized pressure will be after the XoPhase has performed its first phase change cycle.

Pad Sizing for Clip Mount Systems

As a general guideline, for traditional microprocessor or memory module applications within a heat sink clip mount scenario, nominal pad *oversizing* of the processor lid or chip size should be considered since lighter pressures are typically involved.

Electrical Isolation Properties

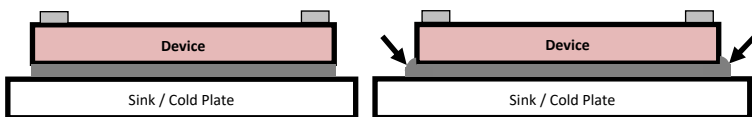
The XoPhase is a specially formulated compound base with a distribution of conductive particles. Even though the overall compound is not designed to be electrically conductive, it should not be considered for use in non-isolated electronic packages where the thermal interface material is being 100% depended upon to provide a dielectric barrier for isolation requirements. Please refer to our DiaPhase or EcoPhase product lines for more information regarding our dielectric thermal interface solutions for non-insulated electronic device packages.

Thinner vs. Thicker XoPhase 45 Thermal Film

XoPhase 45 is manufactured standard within 3 free standing film thicknesses of 4 mil (0.10mm), 8 mil (0.20mm) and 10 mil (0.30mm) in order to meet various types of flatness conditions, overall interface sizes and/or nominal gap filling requirements. It is typically recommended that for overall surface finish areas exceeding flatness conditions of 0.002" (0.051mm) or more, 8 mil (0.20mm) or 12 mil (0.30mm) thick film should be considered. This is to allow the XoPhase 45 phase change material to adjust for those flatness or surface imperfection conditions that may exist within the interface allowing the air to be driven out from within the interface.

Pad Sizing for Screw Mount Systems

The XoPhase 45 Pad's overall X and Y dimensions should be evaluated depending on device type, initial torque applied, if re-torque after phase change will be applied and device operating temperatures (ie: power modules or other screw mount devices). Two scenarios depending on the requirement: 100% surface coverage only (no interface exit) or a nominal external bead of the compound is acceptable outside the interface. When XoPhase is allowed to exit the interface forming a bead around the perimeter of the interface, it makes contact with ambient air changing back to its non-liquid state below its phase change temperature of 45C.



Material flowed to perimeter without exiting interface. Determining optimal pad sizing is more critical in this scenario if requirement is no perimeter bead allowed.

Material allowed to exit the interface and form a perimeter bead where it makes contact with ambient air. Bead only on outside of the interface moves back into its solid state.

The example below is a 4 mil thick film pad which follows the outer contour of the interface and mounting holes since spread will not be as significant upon initial phase change.

The example below is a 12 mil thick film pad which is significantly under sized from the perimeter due to the increased thickness of the film and flow will be more significant upon initial phase change.



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XoPhase 45 Substrate Coating Options

The flexibility and compound design of the XoPhase 45 phase change material provides TIMTEL the capability to coat the XoPhase on one side of thin metal foil substrate for customers who require one side of an interface to be compound free for re-work or component design purposes.

Below is a list of typical metal foil substrates within either a **100% surface coating** or **discrete XoPhase 45 placement** on a metal foil substrate. One side coating only.

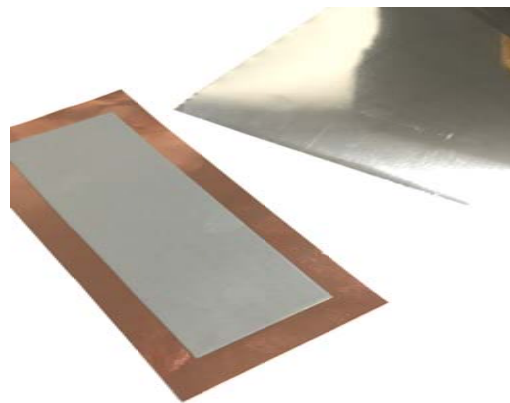
Aluminum Foil (1100 Series)

0.001" (0.025mm), 0.002" (0.051mm), 0.003" (0.08mm), 0.005" (0.127mm)

Copper Foil (110 series)

0.001" (0.025mm), 0.002" (0.051mm), 0.003" (0.076mm), 0.004" (0.102mm), 0.005" (0.127mm)

Contact us for more information about XoPhase Substrate Coating Options. Pressure sensitive adhesive foil backing options available.



XoPhase 45 Physical Properties / Form Characteristics (free standing thermal film)

Characteristic	XoPhase 45
Base Formulation (Compound) / Thermal Conductivity	Proprietary / ~ 3.5 W/m-K
Phase Change Temperature	45°C (+/- 6C)
Viscosity @ Phase Change	Thixotropic
Overall Film Thickness Tolerance Contact us for custom XoPhase 45 Film Thicknesses	4 mil (0.10mm) +/- 20% 8 Mil (0.20mm) +/- 15% 12 Mil (0.30mm) +/- 10%
XoPhase 45 Color	Gray
Available Formats	Master Rolls / Slit Rolls / Die Cut Frame System
Master Roll Width Customer must specify T200W or T200C liner required	XoPhase 45 Material Width = 14.00" (35.6cm) T300-12 (Top Liner) - 0.003" (0.076mm) Clear—16" (40.6cm) T200W (white) or T200C (clear) - 0.002" (0.051mm) - 16" (40.6cm)
Standard Master Roll Lengths	25ft / 50ft / 100ft / 250ft / 500ft or custom lengths
Standard Sheet Sizes Customer must specify T200W or T200C liner required	Sheet Size = 14.00" x 12.00" (35.6cm x 30.5cm) T300-12 (Top Liner) - 0.003" (0.076mm) Clear—16" (40.6cm) T200W (white) or T200 (clear) - 0.002" (0.051mm) - 16" (40.6cm)
Custom Sheet Sizes Available	Yes (customer defined)
XoPhase Die Cut Frame Dimensional Tolerance	+/- 0.020" (0.51mm) XoPhase 45 Final Pad Only

XoPhase 45 Storage & Shelf Life	Guidelines
Storage Condition and Storage Temperature	Cool Dry Location at or below 80°F / 27°C
Shelf Life	2 years from the date of manufacture if stored per storage conditions listed above. Recommended to leave in original package until use.
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)

Disassembly / Re-Work / Clean Up

Reworking your application with XoPhase 45 is simple. Simply detach your device from its heat sink or case sink. Remove any excess Xophase compound off the surfaces using a solvent (ex: mineral spirits) or bio-solvent. Gently wipe away excess compound with a soft cloth. Allow solvent to fully flash off surfaces before applying a new XoPhase Pad. **For best results, make sure all application surfaces are clean and free of debris before applying the XoPhase 45 Pad.**