



LairdTM

**PERFORMANCE
MATERIALS**

**AUTOMATING THERMAL
INTERFACE MATERIAL (TIM)
APPLICATION PROCESSES**

TIM AUTOMATION ANSWERS — TODAY

We offer automation solutions for all forms of **Thermal Interface Materials** (TIMs): dispensable gap fillers, printed thin gap TIMs (**TIM Print™**), “robotic motion control” placed thick-gap TIMs (**TIM Pick™**). Where dispensable gap fillers cannot meet your needs, we can now automate Laird Performance Materials’ (LPM’s) thermal pad product offerings at competitive or even lower costs to that of dispensable TIMs.

We are a leader in TIMs. Now we are a leader in TIM automation solutions: One of the only firms offering an automated solution for all forms of TIMs.

Laird Performance Materials (LPM) can assist in automating your TIM needs — whether it’s a dispensable product or a die-cut TIM pad

Learn more here. Better yet, call or write. We can help you apply automation, significantly improve pad TIM application, experience less aggravation and lower your Total Cost of Ownership.

An EV manufacturer is looking to design and optimize the dispensing pattern of dispensable gap filler onto various size chips, ensuring accurate coverage with minimal cycle time.

SOLUTION: LPM’s Dispensing Application Center

A global GPU manufacturer starts producing its flagship graphics card, yet experiences excessive scrap and low yields when applying the ultra-thin, free standing thermal pad manually via “peel and stick.”

SOLUTION: LPM’s TIM Print™

A global optical interconnect ODM seeks to improve the cycle times and placement accuracy experienced with placing multiple small, thin pads into its device.

SOLUTION: LPM’s TIM Pick™

DISPENSING APPLICATION EXPERTISE

People with talents helping you find your Automated TIM Solution

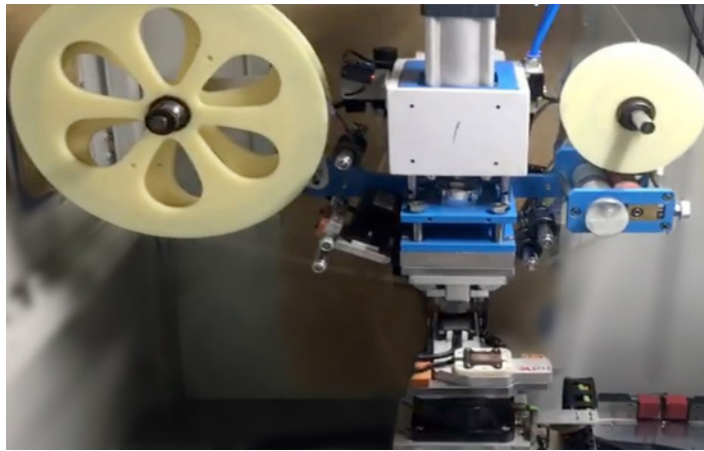
At our global Dispensing Application Centers, we partner with major OEMs/ODMs to solve their TIM dispense problems. We simulate different dispense scenarios and apply root cause analyses. Testing can lead to money and time-saving ideas via optimal dispensing parameters. Work focuses on various product mixing processes, different dispense patterns, volumes, quantities, dimensions as well as material placement accuracy. The Application Centers also help speed new product development. Ask about how our experts can help you.



TIM PRINT™

A cost effective, automated application process for die-cut TIMs

TIM Print™, a novel method of applying LPMs' thermal management die-cut pads, reduces your total cost of ownership. It creates a more robust, reproducible and reliable application process compared to traditional "peel and stick" and dispensing methods. **TIM Print™** uses an automated (or semi-automated) press and die to transfer thermal pad materials from a carrier liner to a substrate (e.g., heat sink, lid, board level shield). This method scales well from individual parts to fully automated, roll to roll processing with integrated substrate feed and in-line inspection. Besides lowering costs and improving speeds, **TIM Print™** can be used to apply materials your team finds difficult to apply by hand. You reduce scrap. You can also use pad materials with improved properties.



TIM Print™ features and benefits reduce Total Cost of Ownership

- Reduced TIM pad/material cost per assembly
- Increased throughput and yields
- Reduced scrap and rework
- Reduced release liner and tab disposal costs
- Simplified supply chain, reduced number of SKUs, lowered logistics costs
- Enables the supply and application of ultra-thin, free-standing pads (as thin as 75 microns)
- Enables an easier application of traditionally difficult-to-apply materials by hand

TIM Print™ Markets/Applications

- Applications using thin pad Tpcm™ and Tflex™ TIMs (< 1.0 mm)
- Proven for IceKap™
- Proven for Tpcm™ 580, 780
- Proven for Slim TIM™ costs (reduces partial SKUs and inventory)
- Demonstrated for Tpcm™ 750

Robotic motion control for pick-and-place automated application of die-cut TIMs

TIM Pick™ offers similar time- and cost-saving solutions as **TIM Print™** for automating the application of thermal management die-cut pads yet incorporates robotic motion control with an innovative “pick head.” You apply TIMs using a single process.

The head used for **TIM Pick™** enables the cutting, removal from an uncut TIM sheet and placement of a “cut to dimension” pad onto an electronic component in a single process step.

TIM Pick™ scales well to a fully integrated assembly process including automated feed, shuttle and in-line inspection systems. You will reduce costs and improve speed. **TIM Pick™** can be used to apply materials your team finds difficult to apply by hand. You reduce scrap.



TIM Pick™ features and benefits reduce Total Cost of Ownership

- Increased throughput and yields through robotics
- Reduced scrap and rework
- Reduced, simplified supply chain/lower logistics
- Enables an easier application of traditionally difficult-to-hand-apply materials
- Enables the supply and application of extremely soft, highly compliant, dimensionally stable pad materials

TIM Pick™ Markets/Applications

- Applications using thick pad Tflex™ TIMs (> 0.5 mm)
- Applications that desire the material properties of a dispensable gap filler with the dimensional stability of a die-cut gap filler
- Applications that desire the processability of a dispensable gap filler with the dimensional stability of a die-cut gap filler

THERMAL DISPENSABLE GAP FILLERS

MATERIAL	FUNCTION	THERMAL CONDUCTIVITY (W/mK)	BENEFITS / APPLICATIONS
Tputty™ 403	Economical one part dispensable gap filler	2.3	Soft and Compliant, low abrasion
Tputty™ 508	One part dispensable gap filler	3.5	Dispensing Consistency, Vertical Reliability
Tputty™ 607	High performing one part dispensable gap filler	6.4	High Performance, Vertical Reliability
Tflex™ CR200	Economical two part dispensable gap filler	2.0	Soft and Compliant, low abrasion
Tflex™ CR350	Two part dispensable gap filler	3.5	Large Tolerance applications, minimal stress on components
Tflex™ CR607	High performing two part dispensable gap filler	6.4	High Performance, large tolerance applications, minimal stress on components

THERMAL GREASES

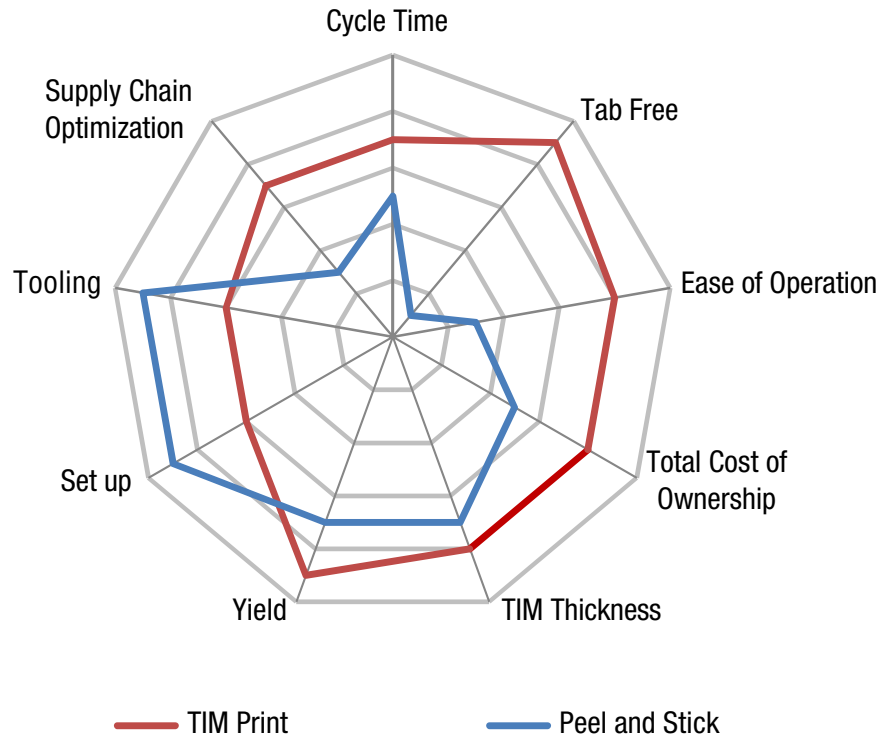
MATERIAL	FUNCTION	THERMAL CONDUCTIVITY (W/mK)	BENEFITS / APPLICATIONS
Tgrease™ 1500	Economical, moderate thermal performance	1.2	For use in most everyday applications
Tgrease™ 880	Economical, high thermal performance	3.0	For use in applications requiring slightly better thermal performance
Tgrease™ 300X	High thermal performance, excellent dispensability, excellent off gas characteristics	3.0	For use in applications requiring more consistent, robust dispensability; For use in some high performing optical applications (e.g. LED headlamps)
Tgrease™ 2500	Silicone free, excellent thermal performance, excellent sag resistance	3.8	For use in applications concerned with silicone off gas or silicone migration For use in vertical applications

THERMAL PHASE CHANGE MATERIALS

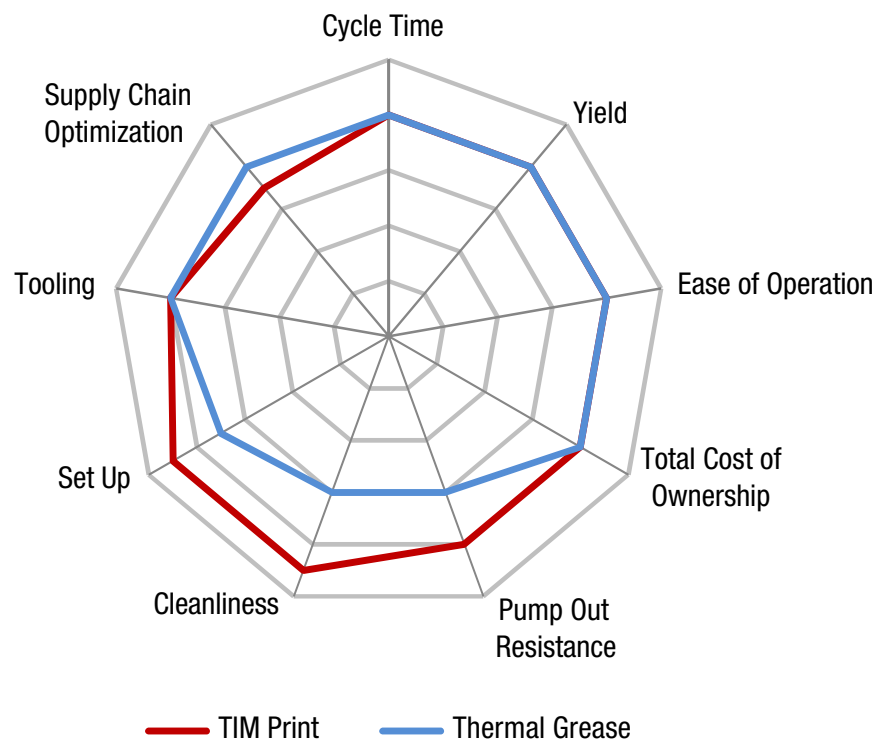
MATERIAL	FUNCTION	THERMAL CONDUCTIVITY (W/mK)	BENEFITS / APPLICATIONS
Tpcm™ 200SP	Silicone free, moderate thermal performance, screen printable	1.5	For use in applications desiring the performance of a die cut phase change with the applicability of a dispensable
Tpcm™ 580SP	Silicone free, high thermal performance, screen printable	3.8	For use in applications desiring the performance of a die cut phase change with the applicability of a dispensable
Tpcm™ 780SP	Silicone free, very high thermal performance, screen printable	5.4	For use in applications desiring the performance of a die cut phase change with the applicability of a dispensable

TIM Print™ features and benefits translate into more than lower material costs. Using **TIM Print™** helps you realize an overall reduction in the Total Cost of Ownership. Improved yields, faster cycle times, and reduced rework all can net significant cost savings in the life of the program.

VALUE PROPOSITION TIM PRINT™ VS “PEEL & STICK”



VALUE PROPOSITION TIM PRINT™ VS THERMAL GREASE



The study below compares the operating costs of **TIM Print™** to those of “Peel and Stick”. **TIM Print™** delivered an additional USD 375k program savings annually. Over the life of a typical program, this can account for total process savings of USD 1 to 1.5 million.

In many cases, **TIM Print™** will also deliver reductions in TIM material costs per assembly, as manufacturing costs are more streamlined for **TIM Print™** as opposed to die-cut TIMs.

TOTAL COST OF OWNERSHIP: PROCESS COMPARISON

	TIM PRINT™ (AUTOMATED)	TABBED PARTS (MANUAL APPLICATION)
Annual Part Volumes	5 M pcs	5 M pcs
TIM Material Cost / Assembly	USD 0.30	USD 0.30
Yields	97%	87%
Cycle Times	~15 secs	~40 secs
Operators Required (Assume Two Shifts)	4 per shift (8 total)	11+ per shift (22+ total)
Miscellaneous	Reduced QC Personnel	Additional release liner & tab disposal maintenance
Investment	4 machines for 5M EAU (~ \$12k each)	

TOTAL COST OF OWNERSHIP: CASE STUDY SUMMARY (TIM Printed Part vs Tabled Parts)

	PROCESS IMPROVEMENT	SAVINGS (USD / Yr)
TIM Material Costs / Assembly	No Change	--
Yield Improvement	+ 11.5%	~ USD 175k
Cycle Time Improvement	14 less operators	~ USD 200k
CapEx	One time investment of 3 TIM Print Machines	~ USD 48k



PERFORMANCE MATERIALS

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