

## PRODUCT DATA SHEET

# Liquid Metal TIMs

### Introduction

Indium Corporation offers a number of innovative high-performance metal TIM solutions. With its portfolio of alloys that are liquid at or near room temperature, Indium Corporation's **Liquid Metal TIMs** are designed to offer superior thermal conductivity for both TIM0 and TIM1 applications. **Liquid Metal TIMs** offer:

- High thermal conductivity, enhancing end-product longevity, and reliability
- Low interfacial resistance against most surfaces, ensuring they dissipate heat quickly
- Extraordinary wetting ability to both metallic and non-metallic surfaces

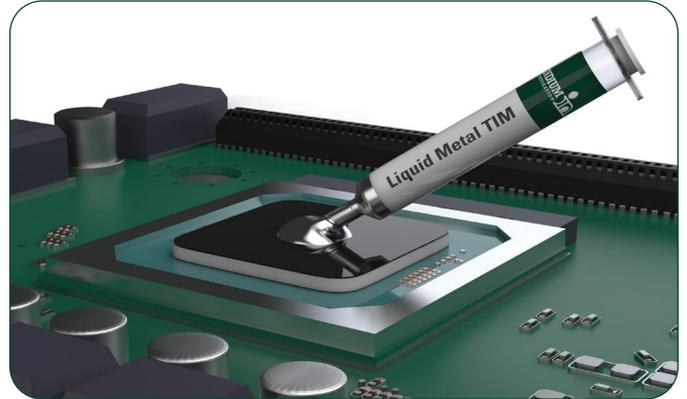
**Liquid Metal TIMs** are available in a variety of alloys, including InGa and InGaSn.

### Excellent Thermal and Electrical Conductivity

Liquid metal is a pure metal or metal alloy that is liquid at or near room temperature and offers far superior thermal performance relative to non-metallic liquids. Our liquid metals for use in TIM0 and TIM1 thermal applications of CPU/GPUs are liquid between 7.6 and 17°C (45.68–62.6°F) and are alloys containing gallium and various other elements, such as indium, tin, or zinc. By alloying gallium with other metals, properties such as liquidus temperature, viscosity, and thermal conductivity can be changed to provide ease of application and long-term reliability. All Indium Corporation liquid metals are RoHS compliant, non-toxic, and transported worldwide in compliance with international and domestic shipping regulations.

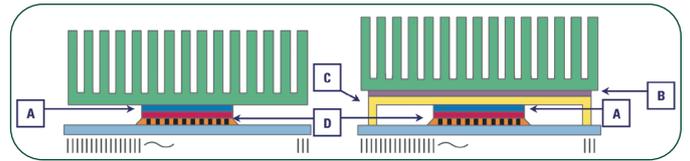
### Wetting to Metallic and Non-Metallic Surfaces

Liquid metals wet to most metallic and non-metallic surfaces through two mechanisms: oxide pinning and reactive wetting. Oxide pinning is a physical bond of an oxide to a relatively smooth surface. Reactive wetting is a metallurgical bond. Copper, nickel, and direct-to-silicon are all common TIM surfaces for use with gallium-based TIMs. For TIM0 and TIM1 application, the silicon die is perfectly safe to use with Ga-containing alloys. However, for the heat-sink and IHS, gallium will diffuse into copper. In static environments, this may not be of concern, but operating in variable temperature environments—such as a CPU/GPU—could lead to early failure. While the Ga/Cu alloy layer never gets more than a few hundred atoms thick, we recommend an electroless nickel plating of 20nm or more if using a Cu IHS or heat-sink.



### Applications

**Liquid Metal TIM** is typically used in TIM0 and TIM1 applications.



### Packaging

Alloys are packaged in polyethylene bottles and 3, 5, 10, 30, and 55cc syringes, and are shipped in accordance with applicable federal regulations.

**Note:** Gallium alloys expand when they solidify. Accordingly, these alloys should not be stored in glassware below the melting temperature.

### Storage and Shelf Life

Unopened bottles and syringes properly stored have a guaranteed shelf life of one year. Gallium-based liquid metals are very stable at and should be stored at room temperature. Syringes should be stored tip down. Due to their corrosive nature, they should not be put in contact with most metals, including aluminum. Care should be taken not to use these materials on or in close proximity with aluminum surfaces.

All shipments of gallium-based alloys are compliant with international shipping regulations. Indium Corporation's packaging of gallium-based alloys is certified UN compliant, and all shipments comply with International Air Transport Association (IATA), DOT, and International Maritime Dangerous Goods (IMDG) regulations.

These materials are pure metals, so there is no phase separation or other physical changes that would happen over time.



**From One Engineer To Another®**



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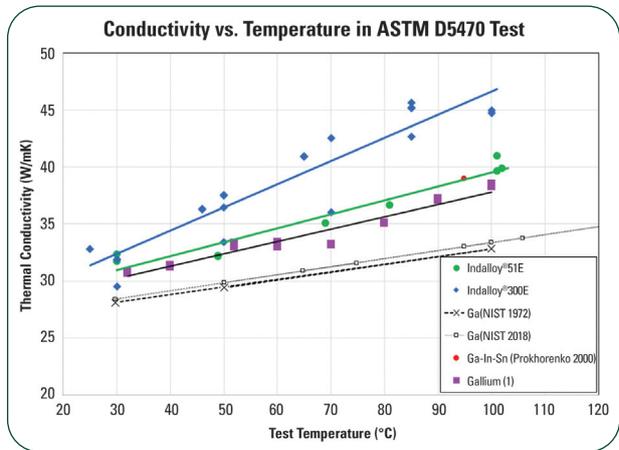
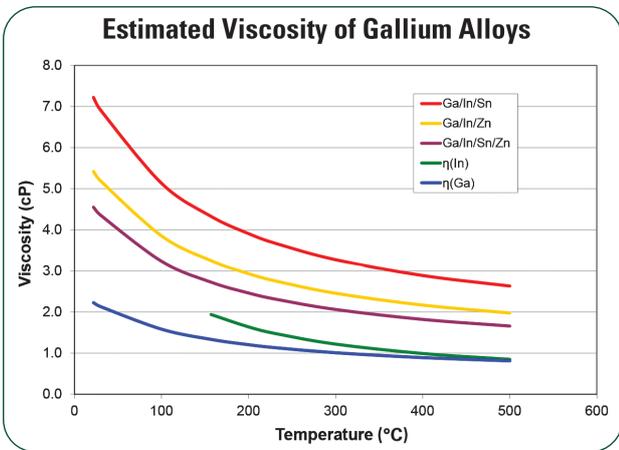
# Liquid Metal TIM

## Liquid Metal Application Comparison

Variable	Deposition Method			Key
	Brushing	Jetting	Dispensing	
Accurate placement of material	Bad	Good	Acceptable	
Consistent volume	Bad	Good	Acceptable	
Minimal wastage	Bad	Good	Acceptable	
Manufacturing Speed (UPH)	Bad	Good	Acceptable	
Minimal leakage during deposition	Bad	Acceptable	Acceptable	
Wetting of material onto bare silicon	Good	Good	Bad	

Quality	Color
Good	Green
Acceptable	Orange
Bad	Red
Material dependent	Blue



## Available Alloys

Indalloy® Number	Composition	When to choose	Liquidus (°C)	Solidus (°C)	Thermal Conductivity (@ 85°C W/mK)	Electrical Resistivity	Density (g/cc)	RoHS Compliant
51E	66.5Ga/20.5In/13Sn	Lower melting point eutectic alloy best used in dispensing and printing applications	11	11	37	28.9	6.32	Yes
300E	78.6Ga/21.4In	Highest thermal conductivity and best for jetting applications	15.7	15.7	44	27	6.16	
306 (AKA)	68.5Ga/21.5In/10Sn	Widely used in high-end gaming platforms	19	10	35*	29*	6.44	

Other Liquid Metal Alloys available upon request. Please contact Indium Corporation to discuss your specific needs.

\*Estimated

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All of Indium Corporation's solder paste and preform manufacturing facilities are IATF 16949:2016 certified. Indium Corporation is an ISO 9001:2015 registered company.

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