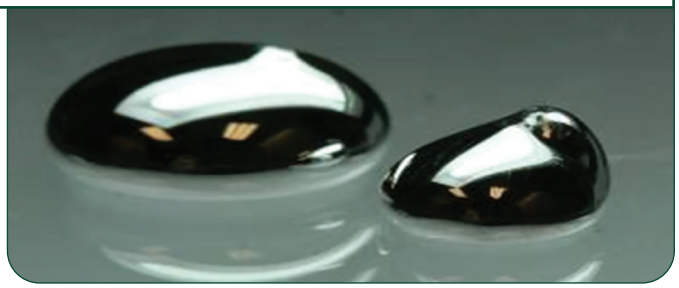
PRODUCT DATA SHEET

m2TIM™ and Liquid Metal Thermal Interface Materials

Introduction

Metal thermal interface materials (TIM) are known to have higher isotropic thermal conductivity than any non-metals. Metals conduct heat and electricity with their valence electrons. This very effective conduction mechanism is a property of liquid as well as solid metals and alloys. In addition to the high thermal conductivity of all metals, those in the liquid form will also exhibit low interfacial resistance ensuring that they can dissipate heat quickly. Liquid metals are used in TIM0, TIM1 and TIM2 applications.

The key parameter in heat dissipation between two surfaces is low thermal resistance. The ASTM D5470 test method describes the metrology of evaluating thermal resistance. In the case of solder TIMs and liquid metal TIMs, very low thermal resistance is achieved. The high thermal conductivity of the metal TIM makes it less sensitive to the TIM thickness. Additionally, the wetting of the molten metals to the surfaces results in an extremely low interfacial resistance at the surfaces.



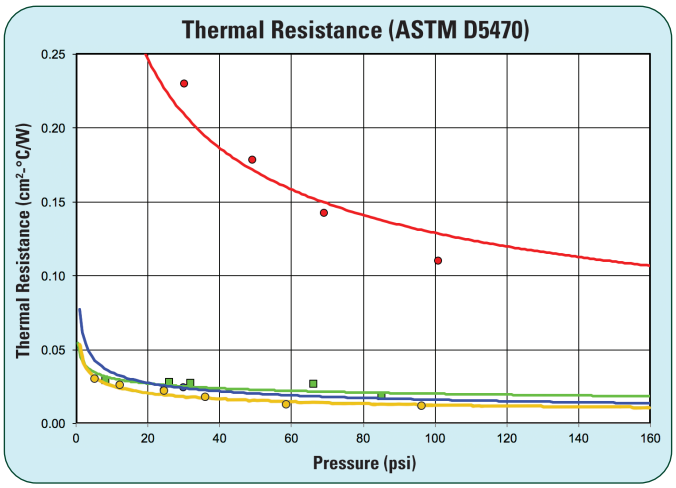


Chart compares thermal resistance of solid metals (red line) vs. metals in liquid or molten state (green, blue, and yellow lines).

m2TIM™ is a unique solid/liquid hybrid approach that combines liquid metal with a solid indium preform to provide very reliable thermal conductivity while eliminating the need for a solderable surface.

InGa and InGaSn alloys are liquid at room temperature. Using one of these alloys alone would provide superior thermal conductivity, but would also require containment of the liquid. Introducing a solid solder preform into the process provides a material that absorbs the liquid and provides the necessary containment without compromising the thermal conductivity.

This hybrid approach provides excellent surface wetting and low interfacial resistance, as well as eliminating the risk of pump-out of the liquid alloy.

Application Limitations

Please note that gallium is not compatible with aluminum, but anodizing the aluminum can overcome this. Other surface treatments can also be effective.

Packaging and Storage

As mentioned before, m2TIMs are a combination of a metal (indium) preform and liquid metal. These materials are delivered separately to the customer; m2TIMs will be formed during the assembly process.

Indium preforms come in a variety of packaging options, including tape & reel. To minimize excessive handling, and exposure to air and subsequent oxidation, indium performs should be packaged according to the quantity used during a typical work shift. Store in the original container, closed securely, at or below room temperature (~70°F/21°C). Indium preforms can also be stored in an inert atmosphere, such as a nitrogen-dry box.

Liquid metal alloys are packaged in polyethylene bottles and 3, 5, 10, 30, and 55cc syringes, and are shipped in accordance with applicable federal regulations. Gallium-based liquid metals should be stored at room temperature where they will remain stable. Accordingly, these alloys should not be stored in glassware below the melting temperature.

From One Engineer To Another®

INDIUM CORPORATION®

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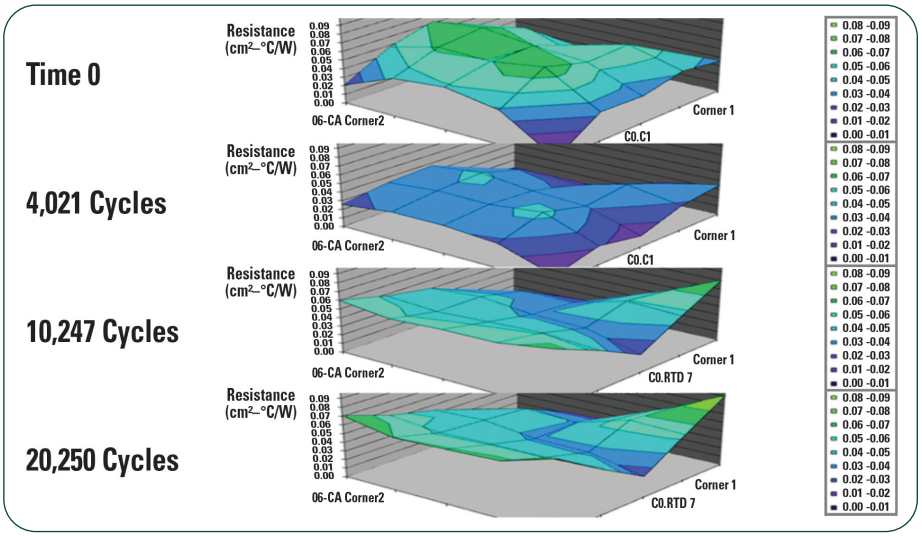
Power Cycling of m2TIM™

When running over 20,000 cycles from 0–80 watts (105°C maximum junction temperature), the thermal resistance of the system remains extremely low.



Options for Liquid 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	68.5Ga/21.5In/10Sn	Widely used in high-end gaming platforms	19	10	37	28.9	6.44	

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

Shelf Life

Indium preforms have a shelf life of 1 year from the date of manufacture (DOM).

Unopened liquid metal alloy 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.

Technical Support

Indium Corporation sets the industry standard in providing rapid response, onsite technical support for our customers worldwide. Indium Corporation's team of Technical Support Engineers can provide expertise in all aspects of materials science.

Safety Data Sheets

Please refer to the SDS document within the product shipment, or contact our local team to receive a copy.

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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