The Advantages & Considerations of Dispensing Thermal Interface Materials

Tim Meyer
Systems Design Engineer

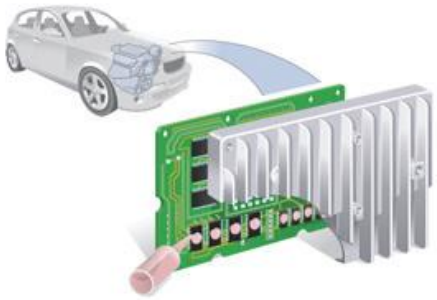


Figure 1: Artwork Courtesy of Parker Chomerics

As powerful electronics shrink in size and increase in variety, thermal interface materials [TIM] for heat dissipation continue to gain importance in the manufacturing industry. A variety of methods exist for aiding this heat transfer. Gap filling pads, adhesive tapes, and dispensable gels are the most common. The primary considerations when selecting a TIM material is the thermal conductivity and dielectric strength. However, there are several considerations that should be weighed to create an efficient assembly process while still achieving optimal product performance; considerations such as assembly tolerance, compression force, cycle time, waste generation, and equipment maintenance are among the determining factors.

Dispensable gels, thermal pads, and tapes all provide a variety of thermal properties but differ significantly in application techniques and mechanical performance. Pads and tapes are cut from flat sheets of raw material. Applying shapes other than square or rectangular patterns to your design often results in waste from the cutting or stamping process (Figure 2). Pads cut with uniform thickness can make it difficult to achieve a TIM bond between components of differing height. Stacked tolerances inside an electronic assembly can create issues with creating contact of the pads or, in the other extreme, excess compression on sensitive electronics.

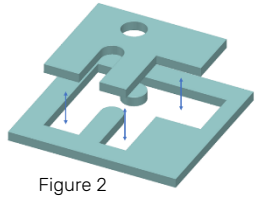
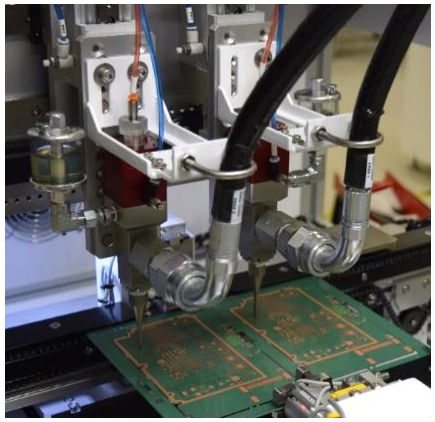


Figure 2

Dispensable gels offer more flexibility in design geometry and tolerancing. A gel will give and flow into cavities while still retaining enough body to hold shape and maintain contact with critical components, while a precut pad, when compressed, can cause continuous stress. The nature of dispensing allows for complex geometries to be applied. Multiple layers of material may also be applied in varying heights for a single TIM section without creating excessive waste. An automated dispensing solution simplifies the application of TIM by eliminating the stamping or cutting process entirely.

One Mustang Drive I Cohoes, NY 12047
tel 518 371 2684 I fax 518 371 2688
rapidplaster.pva.net I med@pva.net

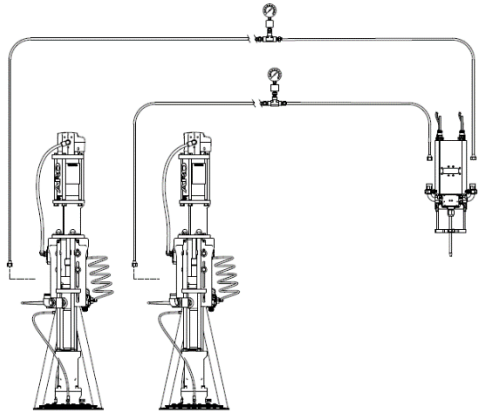


A variety of options are available for dispensable materials besides the obvious variance in dielectric strength and thermal conductivity. Differences in viscosity, filler density, filler particle, curing mechanism, and chemistry are all things that provide for different applications. Pre-cured, single component moisture or heat cure, and two-component materials are all available. Nearly all dispensable options are filled with aluminum oxide, otherwise known as alumina. 〖Al〗_2 O_3 is a relatively good thermal conductor and is electrically insulating. Glass beads are also commonly used for electrical insulation. The overall conductance of the TIM is usually dependent on the density of the 〖Al〗_2 O_3 in the mixture. 〖Al〗_2 O_3 happens to be a particularly hard and abrasive filler, with a Mohs hardness of ~9.0 [Diamond being 10.0]. Because of this, pumping equipment and plumbing must be carefully selected to minimize settling of this filler and to prevent abrasion to seals and moving parts. PVA designs dispensing equipment for handling material with these specific properties in mind. Pumping and dispensing equipment are carefully designed to maximize life. Moving components are constructed of materials selected for their resilience, such as tungsten carbide. Soft seals are limited in quantity and designed in such a way that they can be readily replaced without introducing significant downtime. Fluid routing and plumbing is designed to minimize back pressure to the system and reduce dead space. For example, instead of using a 90-degree fitting, which completely changes flow velocity, a sweep or bent tube fitting would be used to prevent packing of fillers.

Curing & Handling Properties

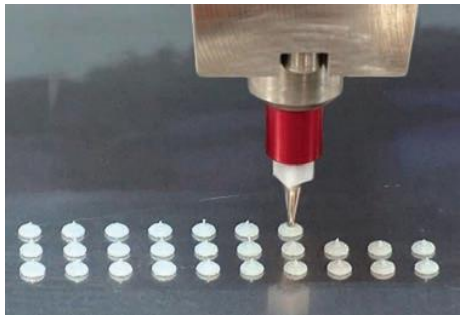
Pre-cured gels remove the need for mixing or post-application curing operations. Once the material has been dispensed onto the component, it is then ready for assembly. Pre-cured materials are packaged in the same form as they will be dispensed on the product. The consistency must be flowable enough to be dispensed, but thick enough to maintain its shape on the electrical component. PVA has designed equipment for extruding the precured material at high pressure through a flexible hose to the point of dispense with a single moving ram. The 1-Gallon Pail Unloader (1GPU) uses a hydraulically driven ram to extrude the material at pressures up to 800 psi. The design takes advantage of the original packaging of the TIM gel and is also available in a 5-Gallon configuration. The ram's only wearable component is a gasket which can be easily replaced between pails. Alternative methods for pumping pre-cured gels usually include piston pumps which are notorious for frequent labor intensive rebuilds. Single component materials are the most straight forward to apply. Flow rate and cycle time are much less of an issue because the material is dispensed in a thinner, more flowable form, which is later cured to its final hardness. Another important consideration is that fillers are more likely to settle and pack up inside fluid lines when the material is lower in viscosity.

Two-component materials pose a unique challenge, but depending on their cure rate, can eliminate the need for inline curing systems while still achieving swift cycle time and curing to a permanent solid. Mix ratio is critical to material performance so equipment must be precise enough to ensure repeatable curing of the material. Fortunately, most 2K TIM chemistries are provided in a convenient 1:1 ratio that provides for good mixing in a static nozzle. Given the challenge of abrasive thermal materials, PVA has developed several solutions designed for highly filled and abrasive material. Production volume and frequency of refilling material containers is often the determining factor for selecting the best dispensing package.



For lower production volume, cartridges are often a more economical solution for manufacturers. The SCTP provides for metering directly out of cartridges. Using a precision linear actuator to drive material out of the cartridge, a precise proportioning of material can be achieved while eliminating wearable components. This principal is frequently used with single component thermal greases as well. When higher production throughput is required, pails of material may be more desirable. Specially designed pail pumps are used for transferring this material to the metering dispense head. These pumps have a special hard coating applied to increase abrasion resistance combined with minimal friction points to allow smooth flow and maintain fluid consistency. For accurate, variable ratio, point of dispense metering; PVA has developed the MR2. This technology uses metering pistons coupled with carbide sleeves and diaphragm style valves to offer a resilient and accurate dosing platform for nearly any 2K material.

In many applications a high level of precision is required. For small volume dosing, progressive cavity pumps deliver precision metering with low shear and no reciprocating parts. As electronic components continue to shrink in size PVA's PCP technology matches small scale with precision. You can dose fluid down to a µL scale with +/- 1% accuracy. This technology is applicable to both one and two component materials. The diverse nature of dispensing requires a wide variety of solutions for every application. PVA is dedicated to being a leading provider of precision dispensing equipment for manufacturing. As new dispensing applications emerge, PVA seeks to develop new and innovative technology that makes manufacturing more efficient for an ever-evolving future.



PVA offers a wide variety of solutions for dispensing Thermal Interface Materials. Contact us for more information on equipment selection and options.

Contact Us