Pitel Paste AZ-01

Pitel Paste AZ-01 is Magna-Power's signature thermal paste formula, designed to satisfy the majority of semiconductor thermal interface requirements for power electronics manufacturers. AZ-01 finds the perfect balance among long-term thermal resistance, viscosity and cost.

Pitel Paste AZ-01 uses a high-density mixture of powderized aluminum and zinc oxide suspended in non-conducting silicon oil. This thermal paste formulation was designed specifically for power electronics applications, filling microscopic voids between semiconductors and heatsinks, resulting in a better thermal transfer and ultimately, improved performance capabilities. AZ-01, refined and validated over 8 years by Magna-Power, has a proven track record for delivering superior thermal performance in some of the most demanding power electronics applications.

A wide range of deposition methods are supported for a variety of production needs, including direct deposition, spaulta spreading, pneumatic dispensing, and stencil printing.

Pitel Paste is manufactured in the USA at Magna-Power's manufacturing facility and is compliant with both REACH and RoHS directives.

Part Number Specification

AZ-01-A-236

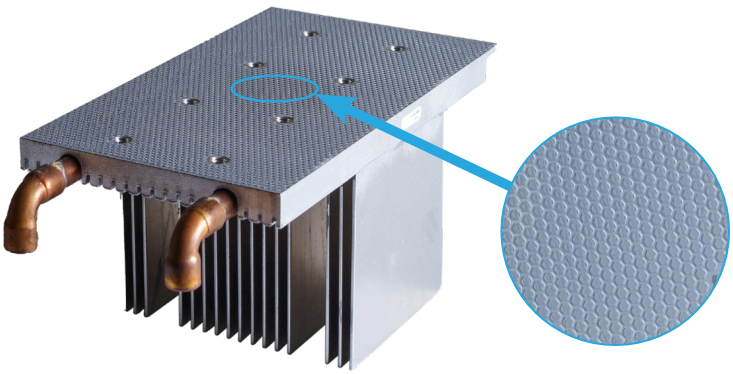
- AZ — Formula
- 01 — Variation
- A — Package Type
- 236 — Volume (ml)

Available Packages

Package Type	Package Description	Volume
A	Resealable Container	236 ml (8 oz)
C	Luer Lock Syringe (Sample Size)	1 ml (0.03 oz)

Specifications

Specification	Value	Testing Method
Color	Silver Gray	N/A
Density	2.32 g/mL	ATM D70
Viscosity at 10 RPM (T-SP-2)	80,000 - 110,000 mPa·s	ASTM D2196
Shearing Tendency	Shear thinning	ASTM D2196
Service Temperature	-20°C to +200°C	N/A
Storage Temperature (Long-term)	-25°C to +30°C	N/A
Dispersion Stability	Slight oil separation may occur	ISO/TR 13097:2013
Thermal Conductivity	2.7 W/m·K	ASTM D7984
Thermal Contact Resistance (40 psi, 25°C)	6.5 x 10-6 K·m²/W	ASTM D5470
Absolute Thermal Resistance (40 psi, 25°C)	0.008 K/W	ASTM D5470
Breakdown Voltage	2.0 kV/mm	ASTM D149
Minimum Bond Line Thickness (40 psi)	25 µm	N/A
Volatile Content	0.008%	ASTM D2369
Volume Resistivity	1.2 x 10^{14} Ohm·cm	ASTM D257
Dielectric Constant	24.08 @ 1 kHz 23.87 @ 10 kHz	ASTM D150
Dissipative Factor	0.01237 @ 1 kHz 0.00390 @ 10 kHz	ASTM D150



Surface finished Magna-Power production heatsink with Pitel Paste Formula AZ-01 deposited by stencil.

> When I was looking to improve my thermal design with IGBT modules, where temperature rise can be the limiting factor, I wanted something better than the thermal grease normally used for these applications. Magna-Power offered its internally developed "Pitel Paste" TIM, which did indeed yield lower device temperatures and had an easy application. I talked Magna-Power into supplying me with the Pitel Paste I needed for my manufacturing and I've been using it ever since.
>
> **William Peterson**
> Co-Founder, E&M Power

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PITEL PASTE

The ultimate thermal interfaces for power electronics

Pitel Paste Introduction

Created by Magna-Power to solve some of the most demanding thermal transfer challenges in power electronics, Pitel Paste thermal compound is now being offered as a commercial product.

With internal capabilities that include metal and heatsink fabrication, CNC machined surface finishing, and power module assembly, Magna-Power is uniquely positioned to address power semiconductor heat extraction with a vertically integrated approach. Over a period of 8 years, Magna-Power iterated on its own thermal compound formulation, evaluating it through the lens of power electronics applications and today playing a critical role in the company's ability to deliver among the most power dense programmable power supplies on the market.

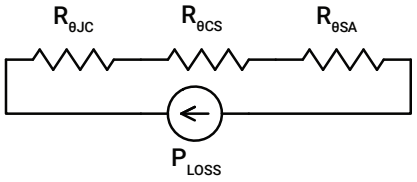
A thermal interface material between two metals can offer up to two orders of magnitude drop in thermal resistance. A high-performing thermal paste can help achieve the highest-performing thermal bond on a production-scale.

Thermal Resistivity for Power Semiconductors

While thermal interface manufacturers often emphasize thermal conductivity as their key performance metric, this specification does not quantify the device-to-surface realities found in power electronic assemblies.

The applied metric for engineers is thermal resistivity, which benchmarks void-filling thermal paste performance for power semiconductors, measuring how easily heat can be conducted between two surfaces. In power electronics, thermal resistance between power semiconductors and heatsinks plays a critical role in product performance, with lower thermal resistance allowing product designers to achieve greater power densities.

Temperatures of heatsink mounted power semiconductors are commonly modeled using a thermal equivalent circuit with thermal resistances (R_θ), where the power dissipated in a device (P_{LOSS}) is converted directly into heat:



- $R_{\theta JC}$: Thermal resistance of semiconductor junction to case; native to the semiconductor fabrication.
- $R_{\theta CS}$: Thermal resistance of the case to heat sink surface; describes the thermal interface material and surface contact and conditions.
- $R_{\theta SA}$: Heatsink to ambient environment surrounding the package; provides a sink for heat.

In addition to using conventional thermal conductivity measurement devices, test apparatuses were developed to evaluate thermal resistance ($R_{\theta CS}$) in power electronics applications using various thermal compounds, as shown in Figure 2. The results of Magna-Power's thermal resistivity measurements using this apparatus are shown in Figure 1.

Thermal Paste Application and Other Considerations

Having produced power supplies for over 40 years, with power density as a critical design criterion, Magna-Power has evaluated numerous thermal interface materials. Beyond just the thermal resistance, there are practical considerations, such as:

- Breakdown Voltage: Many pastes are formulated for low voltage integrated circuit cooling, allowing much higher thermal conductivity but with a much lower breakdown voltage; often times this specification is not even provided. For non-conducting power electronics applications, a high breakdown voltage is required; a testing standard is provided by ASTM D149 for this specification.
- Viscosity: Many high-performing pastes were thick and difficult to dispense and spread evenly.
- Separation: Thinner pastes were easy to apply, but separate over time in the dispensing containers, requiring a secondary operation for mixing before application.
- Cost: Paste that utilized exotic materials achieved only marginal performance gain with a significant price premium.
- Test Standards: Low cost thermal pastes with extreme performance claims did not reference any applicable standards to validate their performance claims. Many of these claims could not be reproduced by certified third party testings facilities using relevant ASTM standards.

Countless iterations of Pitel Paste were formulated to find the right balance of performance with practicality for medium-to-high volume production needs. Pitel Paste Formula AZ-01 achieves excellent thermal performance in power electronics applications, with minimal separation and a long shelf-life, all while supporting a variety of dispensing mechanisms, such as: syringes, stencils, and volumetric dispensing.

Today, with over 150 megawatts of Magna-Power DC power supplies in the field utilizing Pitel Paste, Magna-Power is pleased to offer power electronics manufacturers the same benefits it has achieved with a well-balanced high-performing thermal compound: **Pitel Paste Formula AZ-01**.

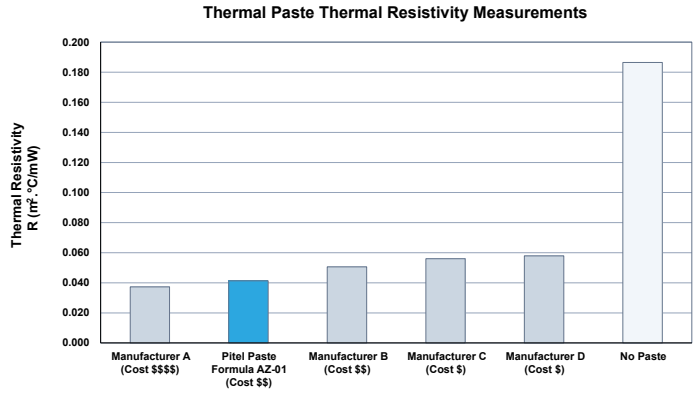


Fig 1. Measured thermal resistivity for common commercial thermal compounds, using Magna-Power's thermal resitivity apparatus.

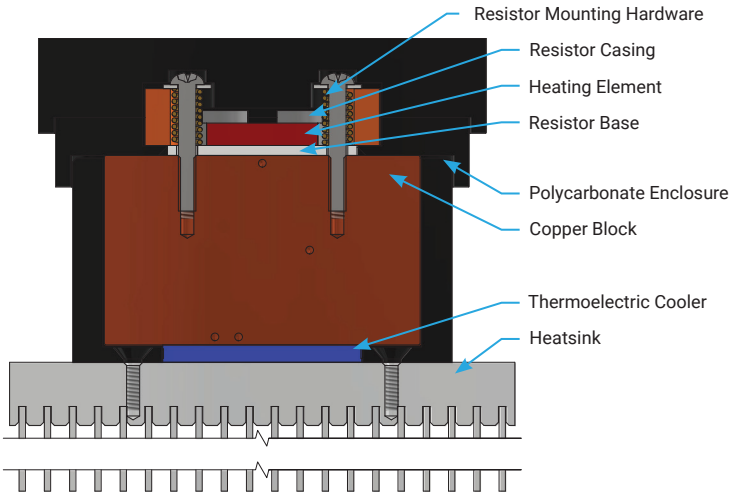


Fig 2. Magna-Power developed thermal resistivity measurement appartus, measuring between device package and heatsink.

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