



SPI Supplies  
206 Garfield Avenue,  
West Chester, PA 19380, USA

# PROPERTIES AND TECHNICAL NOTES

## SPI Supplies Silver Paste Plus 05063-AB

### Typical Properties

Sheet Resistivity (25 um [0.001"] film thickness):

Specification: <100 milli  $\Omega$ /square

Typical: 12 milli  $\Omega$ /square

### Adhesion Strength:

#### Tensile:

Specification: >700 N/cm<sup>2</sup> (1000 lb/in<sup>2</sup>)

Typical: 1000 N/cm<sup>2</sup> (1500 lb/in<sup>2</sup>)

Lap Shear: ~1400 N/cm<sup>2</sup> (2000 lb/in<sup>2</sup>)

Bulk Resistivity:  $3 \times 10^{-5}$   $\Omega$ -cm

Specific Heat: 0.30 J/g°C (0.07 cal/g°C)

Thermal Conductivity: 0.04J/cm-s°C (0.01 cal/cm-s°C)

Coefficient of Expansion:  $3 \times 10^{-5}$  m/m/°C

Modulus of Elasticity (tensile):  $4 \times 10^{+10}$  Pa (6x10<sup>6</sup> lb/in<sup>2</sup>)

Poisson's Ratio: 0.35

VOC %: 21

VOC (g/L): 570

Specific Gravity: 2.78

% Silver Solids in paste: 70%

**Viscosity at 25 °C:**

|                   |              |
|-------------------|--------------|
| <b>Pa.S</b>       | <b>38-54</b> |
| <b>Brookfield</b> | <b>HBF</b>   |
| <b>Spindle</b>    | <b>4</b>     |
| <b>RPM</b>        | <b>10</b>    |

**Thinner: n-butyl acetate**

**Cure: Room temperature or 1 hour at 100 °C / 212 °F**

**Sheet resistivity: < 0.05 ohms/square (25 µm film thickness)**

**Coverage: 72 cm<sup>2</sup>/gram (When wet film thickness is 50µm)**

The properties of the most interest are density and resistivity, and both of these are highly dependent on application technique. All of the properties given here are "typical", but we offer no guarantee that you will obtain similar results in your application. You will have to do your own testing to be sure.

**Safety and handling:**

This product contains organic solvents and materials. It should be handled using the following precautions:

- Use with adequate ventilation
- Avoid prolonged contact with skin
- Avoid prolonged breathing of vapor
- Keep away from sparks and open flame

**Thinner:** We suggest the use of n-butyl acetate or [SPI #05004-DA](#) Thinner for SPI Silver Colloidal Suspensions, as described on to thin SPI Silver Paste Plus. Larger sizes are described on the same page, but they require much higher shipping charges. For cleanup you can use acetone, but if you try to use acetone as a thinner you will probably "break" the suspension, destroying the intimate bond between the flake-like silver colloid particles and the polymer binder of Silver Paste Plus.

## **Additional Information about SPI Supplies Silver Paste Plus**

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SPI Silver Paste Plus is a suspension of a specially prepared silver powder combined with a proprietary organic binder system. The product is designed to produce electrically conductive paths, patterns, or films over nonconductive surfaces. The product is designed for either air drying or low temperature curing for applications on substrates which will not generally tolerate high-temperature firing. The product can be used to produce electrically conductive paths on paper, plastic, rubber, cloth, wood, etc. and may be applied by dip, spray, brush, stylus, syringe or even screen printing.

The selection of an air drying composition, such as SPI Silver Paste Plus is dependent on the application and the performance of any other silver composition should not necessarily be used as an extrapolation of what to expect from Silver Paste Plus. The final properties of the end product, after application can themselves depend to some degree on the method of application.

Generally speaking, higher metal contents result in maximum conductivity and load carrying capabilities, and are more easily soldered. The paste can be diluted somewhat with SPI # 5004-AB [Silver Paint Thinner](#)

### **Bonding Substrates to Heater Heads**

SPI Silver Paste "Plus" was developed to provide optimum adhesion of substrates to heater heads for thin film superconductor research. In order to obtain optimum properties, we suggest the following procedure as a starting point for "fine tuning" your own protocol:

1. Begin at room temperature. In this stage, all volatile organics are beginning to evaporate. The silver particles are beginning to form a uniform network which permits the continuous escape of any trapped vapors.
2. Additional heating from 60 to 150 °C. The organic binder depolymerizes without carbon or graphite formation and is expelled from the system without disruption of the uniform network of silver particles.
3. Final annealing in the range of 150 to 200 °C. At this point the uniform network of silver particles sinters together, producing the superior adhesion properties for which this product was developed.

*Note: Larger substrates may require use of higher temperatures.*

Proper preparation of the bond will provide uniformity in heat transfer characteristics throughout the silver layer along with easy release of the substrate from the heater head using minimum mechanical stress.

## **Storage and shelf life**

Normally speaking, this kind of product can be stored at room temperature. However, there is a thermodynamic phenomenon that tends to cause a separation of the silver solids from the extender in the vicinity of the high radius of curvature near the nozzle. The result of this separation is that when the tube is used, the first to come out is a thinner (extended) rich "squirt" and while this is not going to cause the demise in properties of this product for most uses, the point is that this is a problem and the way to help mitigate the impact of this separation, is to store the tubes upside down on their heads, refrigerated. The refrigeration results in a significantly slowdown of the tendency of the silver colloid to separate out and migrate away from the high radius of curvature end (e.g. the nozzle). And standing the tube on its head makes possible the use of gravity itself to help reduce the rate of colloid separation.

The main point of caution here is that after retrieval from the refrigeration, one must be certain to wait until the product has warmed to room temperature to avoid any moisture condensation into the product.

The SPI Silver Paste Plus will exhibit, in addition to a reasonably fast drying rate, even at room temperature, good adhesion to most substrates and high conductivity. It can be used to produce electrically conductive patterns on surfaces of paper, film, plastic, rubber, or wood as well as on conventional ceramic substrates. The product, when sold in bulk, has found acceptance in the manufacturing of tantalum capacitors to metallize the anode, making it a good electrical contact and solder receptive surface.

The product is one of the highest silver content paste products available anywhere and is free of any glass frit, and is suitable for brush, stylus or machine banding application where its somewhat higher conductivity is desired. It is also widely used in the printed circuit board repair industry where again, the high viscosity, high silver solids and better solderability make it an attractive product.

In order to reduce the viscosity and percent silver solids, the paste product can be thinned down with butyl acetate.

**Revised by:** AWB

**Date:** 7/13/2016