

## Technical Information

DF28

Performance Coatings

### Silver Pastes for Inductive Heating of Porcelain

Vibrantz offers a wide range of silver pastes mainly for automotive glass.

One special application of our silver pastes is the printing of conductive layers on porcelain. The silver pastes are used to print decals which then form the backside of plates for induction cookers (fig. 1).

The induction cooker induces a current in the silver layer. The electric resistance of the silver layer then causes heat. These plates are used e.g. in canteen kitchens for hospitals or nursing homes.

#### Silver Paste

The thickness of the fired silver layer is determined by the silver content of the paste, the printed wet film thickness as well as the number of printed silver layers. It will have direct influence on the electric resistance. Our standard silver pastes for this application are **SP 1919** with a silver content of 76% and **SP 37** with a silver content of 68%.

#### Thinning

Every addition of solvents reduces the silver content and the thickness of the fired silver layer. This leads to an increased electric resistance.

Our silver pastes are ready to use. The maximum addition of thinner should be <1%. If too much thinner is added, it may cause bleeding effects during printing.

Although the pastes are delivered in printing viscosity, and thinning is normally not recommended, sometimes slight viscosity adaptations might be desired. Then we recommend the products **80 033** for **SP 1919** and **80 063** for **SP 37**. Customer specific viscosities and methods of measurement are possible as well.

## Homogeneity of the Paste

Silver particles have a tendency to settle. Therefore the paste has to be stirred carefully before printing, with a pneumatic or electric stirrer. Insufficient stirring of the paste after thinning causes inhomogeneous pastes as well. As a result, the electric resistance will differ from print to print.

## Operating Time of the Paste

During the printing process solvents are evaporating, which increases the silver content of the paste and decreases the electric resistance. Furthermore a changing viscosity will influence the printing behaviour of the paste.

To avoid significant changes in viscosity it is recommended to use only smaller quantities on the screen and add fresh paste regularly.

## Screen Printing

The application of the silver paste is similar to the application of a gold paste, but a coarser screen (68 – 100 mesh/cm) has to be used. The screens can be stainless steel, polyester or nylon.

The hardness and angle of the squeegee as well as snap off distance and type of screen mesh have an impact on the thickness of the printed layer and the electric resistance. It is important to have constant printing conditions.

Attention: A too high printing speed, as it is easily reached by rotary machines, could cause bubbles in the layer. Therefore, a flat bed press is the more appropriate unit, for this application. **Drying (23 – 120°C)**

The drying process influences the sinter behaviour of the silver layer. Insufficient drying of the silver paste or the top coating will have a negative impact on the sintering process. An increasing porosity will cause an increasing electric resistance. Furthermore, a high porosity will change the chemical resistance for the worse. In this case the silver layer becomes vulnerable to aggressive cleaners. We recommend to dry the silver paste for several hours at room temperature or at least 20 min. in a convection dryer at 50 °C. Alternatively, it can be dried for 5-10 min. at 120 – 150 °C in an infrared or convection dryer.

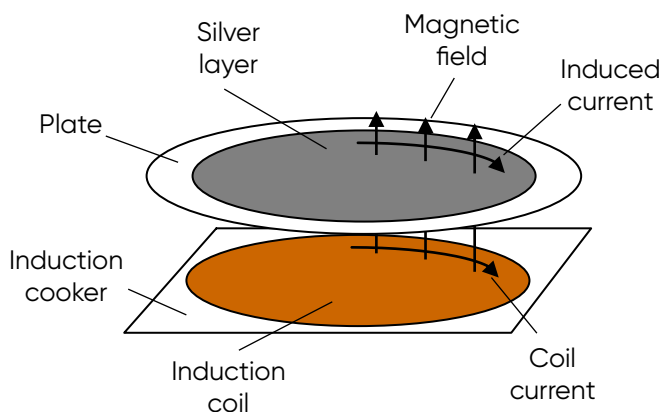
## Cover Flux or Color

To avoid tarnishing and to improve the scratch resistance of the silverlayer, it is recommended to overprint it by a flux or an onglaze color. This top coating has to be applied in a thin layer (120 mesh/cm polyester).

The cover flux or the covering color will have an impact on the sintering behaviour of the silver layer and the electric resistance. Furthermore, this protective flux or color has to be suitable to the body to avoid mechanical stress and should fire without pinholes to avoid corrosion problems.

### Firing (830 – 900°C)

Firing temperature and cycle have an impact on the sintering process and the electric resistance. A normal firing process (5 – 24 h) is less critical than a fast firing process (1 h).



### Paste Consumption

The paste consumption is approximately 100 g/m<sup>2</sup> (screen mesh: 68 T/cm = 175 mesh/inch)

### Tolerances

Usually tolerances of not more than +/-5% regarding the electric resistance are required for the different applications and can be easily fulfilled if the silver pastes are properly applied.

### Shelf life and storage conditions

The shelf life of original closed containers is one year, if they are stored at a temperature between ca. 4 – 25°C.

**Table 1: Silver Pastes**

Product	SP 1919	SP 37
Description	Conductive paste (leadfree) for metallisation of glass and ceramic	
Silver content [%]	76,00 ± 0,3	68,00 ± 0,3
Firing residue [%]	80,5 ± 0,5	72,6 ± 0,5
Viscosity	7 - 10 Pas at a shear rate of $D = 20 \text{ s}^{-1}$ measured by the plate cone system of PHYSICA MC10 at 20°C	app. 5 Pas at a shear rate of $D = 350 \text{ s}^{-1}$ measured by the plate cone system of PHYSICA MC10 at 20°C

**Please Note:** For other than the described applications, for example cooking with ceramic vessels, the user should clarify in preliminary tests, whether body and glaze are suitable for this application.

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