



## NS 33-510 Front Contact Silver for SiN<sub>x</sub> Passivated Solar Cells

**Description:** NS 33-510 silver conductor paste is designed for contacting p/n<sup>+</sup> type crystalline silicon solar cells passivated with SiN<sub>x</sub> coatings with thicknesses between 750–900 Å and high sheet resistivity/shallow emitters. The rheology of NS 33-510 is suitable for fast printing and high aspect ratio lines. When fired, this screen printable ink yields very low bulk and contact resistivity, which results in high a fill factor and energy conversion efficiency. During the firing process the glasses and additives contained in the inks react with silicon nitride to form a low

resistance contact while providing good adhesion to the wafer. The reaction zone between the silver paste and the Si wafer is carefully controlled through the paste chemistry to maintain high diode quality even while contacting shallow emitters. The ink provides very good electrical contact to n+ surfaces passivated with SiN<sub>x</sub>. NS 33-510 is able to contact emitters from 55–70 Ω/square. The conductor is compatible with all Ferro rear silver pastes as well as lead free and low bow aluminum pastes.

### Typical Properties

	NS 33-510
Viscosity (Pa·s) <sup>1</sup> :	80–120
Solids Content:	86.5–89.5%
Fineness of Grind:	< 14/11 μm
Dried Thickness:	20–25 μm
Fired Thickness:	12–15 μm
Line Resolution:	100–150 μm
Resistivity <sup>2</sup> (milliohms/square):	< 2.0
Drying Profile <sup>3</sup> :	250–300°C, <60 seconds
Firing <sup>3</sup> :	810–940°C, < 1–3 seconds
Recommended Thinner	0800

All properties are target values and are not meant to represent product specifications

#### Notes:

<sup>1</sup>Viscosity as measured on Brookfield model HBT cone/plate viscometer; 9.6 reciprocal seconds, 1.565° cone, 25°C.

<sup>2</sup>Milliohms/sq. at 25μm.

<sup>3</sup>Recommended set points °C in infrared firing furnace.

### Product Advantages:

- RoHS compliant<sup>4</sup>
- Cadmium free<sup>5</sup>
- Forms excellent contact on 55–70 Ω/square high sheet resistivity/shallow emitters
- Reduced contact resistance & higher aspect ratio yield greater power output
- Wide processing window, fires through SiN<sub>x</sub> ARCs
- Hot Melt & conventional printing versions available

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#### Processing Recommendations

**Printing:** It is recommended that the paste temperature be between 20–25°C prior to printing, and it is advisable to control the ambient room temperature within ± 2° to insure consistent printing results. The printing area should be clean and well-ventilated.

**Screen:** 280–325 mesh screen with a 20–25 μm emulsion thickness is recommended. Wire diameter is 20–25 μm with a mesh orientation of 45°.

**Drying:** The ink can be dried in an Infrared or conventional dryer under a wide range of conditions. Inks are typically dried in an IR dryer with set points of 250–300°C in less than 60 seconds.

**Soldering:** Recommended soldering conditions (ribbons) are 290°C for 96.5Sn/3.5Ag; and 220°C for 62Sn/36Pb/2Ag.

**Firing:** An Infrared fast process furnace with three or more firing zones and belt speeds of > 200 inches per minute is highly recommended, although the product may be fired in a variety of furnaces with belt speeds > 120 inches per minute. Optimum firing conditions must be established by the customer based on the cell configuration, thickness, and manufacturing process. Peak set point temperatures between 810–940°C with a dwell time above 700°C ranging from > 1 to 3 seconds is typical.

**Compatibility:** Ferro has tested this material according to the recommended processing conditions described here, however, it is imperative that customers evaluate the material in their manufacturing process and conditions to insure suitability for their intended use. Ferro technical personnel can help facilitate testing, and can assist with integration into customer manufacturing processes.

**Thinning:** Thinning is not recommended, since the paste is supplied at the correct viscosity for application. Contact your local Ferro Representative for appropriate solvent details, should thinning become necessary to replace solvent lost through evaporation.

**Paste Storage & Shelf Life:** The paste should be stored in tightly capped containers in a cool (5–30°C) dry place away from direct sunlight. When properly stored, unopened material will have a shelf life of up to 6 months.

#### Notes:

<sup>4</sup>Complies with EU Directives on Restriction of the use of Hazardous Substances (RoHS; 2002/95/EC) and Waste from Electrical and Electronic Equipment (WEEE; 2002/96/EC). Current exemptions allow lead contained in the glass system of thick film materials used in electronic components. In anticipation of future amendments and more stringent environmental regulations, Ferro continues to expand its range of Lead Free<sup>5</sup> materials.

<sup>5</sup>Initial product composition was certified by SGS laboratories to be below the detection level for cadmium. This conductor paste is not routinely analyzed for cadmium content and is not the basis for product specification or warranty.

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