The amount of printed paste depends on the thickness of the screen material and the emulsion and the open area of the fabric. It also depends on the printed line width.

The viscous properties are of utmost relevance: when printing, the paste must be fluid enough to fill without voids all the volume allowed by the fabric and the emulsion, but after being printed it must not spread over the surface.

Critical parameters of this process are the pressure applied on the screen, the snap-off distance and the velocity of the squeegee.

4. *Drying*: Solvents are evaporated at 100 to 200°C right after printing so that the wafer can be manipulated without the printed pattern being damaged.

5. *Firing*: Firing of the pastes is usually done as a three-step process in an IR belt furnace. In the first step, when heating up, the organic compounds that bind the powder together are burnt in air. In the next step, the highest temperature between 600 and 800°C is reached and maintained for a few minutes. Higher temperatures are needed if an AR coating must be penetrated; crystal orientation and paste composition must be considered too. In the last step, the wafer is cooled down.

   The phenomena that take place during firing are very complex and not completely understood. The oxides forming the glass frit melt, enabling silver grains to sinter and form a continuous conductor so that the layer can present low sheet resistance. Neither the silver melting point nor the silicon–silver eutectic temperature is reached, sintering consisting of the intimate contact of solid silver crystallites. At the same time, the reactive molten glass etches some silicon and silver grains are allowed to form intimate contact with the substrate. The amount of etched silicon is on the order of 100 nm. When a layer of TiO_2 or SiN is present, the glass frit is able to etch through it. In fact, the quality of the contact improves because of a better homogeneity.

   The picture of the contact after cooling down shows two zones [74]. In the inner one, crystallites of silver are plugged into silicon forming crystalline interfaces and presumably very good electrical contact in a sort of "point contact". These grains are embedded in a compact amorphous glass. The outer zone is more porous and contains silver grains and glass frit: this porosity explains why the resistivity of silver paste is much higher than that of pure silver.

   Besides, the contact resistance of printed contacts is much higher than that of an evaporated contact to n-Si of the same doping. It seems that, although enough silver grains make good contact with silicon, not all them are connected to the grains in the outer layer; many remain isolated by the glass.

   When the paste, in the case of the back metallization, contains aluminum as well as silver, the Al-Si eutectic formed and recrystallized ensures a good contact. With dielectric layers the contact appears to be localized as well, and some beneficial role is attributed to the metal atoms in the frit [75].

6. *Limitations and trends in screen printing of contacts*: As explained in former sections, the high contact resistance and the etching action of the glass frit require the front emitters to be highly doped and not very thin if screen printing is used. Only improved paste formulation and processing can overcome this limitation.

   Narrow but thick fingers with good sheet conductance are also needed. Well-defined lines must be much wider than the pitch of the woven fabric; 60-μm lines seem achievable, with 100-μm ones being standard (see Figure 7.10). Incrementing the amount of transferred paste implies increasing the thickness of the emulsion or the