Journey through the Solder Mask Process, Part 2: Screen Printing

Wikipedia defines screen printing as “a printing technique whereby a mesh is used to transfer ink onto a substrate, except in areas made impermeable to the ink by a blocking stencil. A blade or squeegee is moved across the screen to fill the open mesh apertures with ink, and a reverse stroke then causes the screen to touch the substrate momentarily along a line of contact. This causes the ink to wet the substrate and be pulled out of the mesh apertures as the screen springs back after the blade has passed.” So how did the idea come about? Let us turn to the early Polynesian Islanders for a brief history and, perhaps, simplify the definition a little. Early Polynesians cut designs and patterns into banana leaves and then forced natural dyes through the leaf openings. This process left an image of the cut design on the bark cloth, or “tapa.” Legend—no pun intended—has it that the idea came about while watching insects eat holes through the leaves and then seeing the rain run through the holes. Essentially, screen printing is forcing ink through a porous opening in a stencil, or an outline of an image. Many of us would probably prefer this definition.

Applying solder mask is a critical processing step in the PCB world. It can be done manually or mechanically. Both approaches are in use today. A skilled operator in the arts of screen printing can provide the same quality as an automated coater. However, automation is preferred to achieve speed, reliability, and consistency. The most important consideration in the application of solder mask is the coating thickness. Adequate solder mask coverage is required to protect the circuit board from the solder flowing into undesired areas and from the external elements. A general rule of thumb for most of Taiyo’s PSR-4000 masks is to maintain a coating thickness of 0.4 mil (10 µm) over the edge of a trace, or “knee,” to withstand chemistry such as electroless nickel immersion gold (ENIG). Typically, a blank monofilament polyester screen between 74 and 110 mesh count per inch with a thread diameter between 80 and 120 microns is used to apply the solder mask. Another important consideration in solder mask application is mask in holes. Squeegee hardness, print angle and printing speeds are critical parameters that affect the amount of mask in holes. A squeegee with a durometer of 70, print angle between 27°-30° and a print speed of about 6-7 inches per second are good starting points.

Since automation is prevalent nowadays and many board shops have a Circuit Automation DP Series Coater, the chart below provides guidance to optimizing your screening process.

Screen Mesh	83/120 – 110/80
Screen Tension	26 – 28 Newtons
Screen Bias	22.5°
Squeegee Hardness	60 – 80 Shore
Print Angle	27° – 30°
Flood Speed	Maximum, typically 10 inches/second
Flood Pressure	20 – 25 psi
Print Speed	Maximum without skipping
Print Pressure	65 – 80 psi
Print Cycle	Flood/Print/Print