

What is Area Ratio and How Does it Affect Stencil Design?

IPC-7525B Stencil Design Guidelines details Area Ratio in relation to SMT Stencil Design:

“1.1.2 *Area Ratio The ratio of the area of the aperture opening to the area of the aperture walls”

Both area ratio and aspect ratio are illustrated in Figure 3-5, using the following formulas.

$$\text{Aspect Ratio} = \frac{\text{Width of Aperture}}{\text{Thickness of Stencil}} = \frac{W}{T}$$

$$\text{Area Ratio} = \frac{\text{Area of Aperture}}{\text{Area of Aperture Walls}} = \frac{L \times W}{2 \times (L + W) \times T}$$

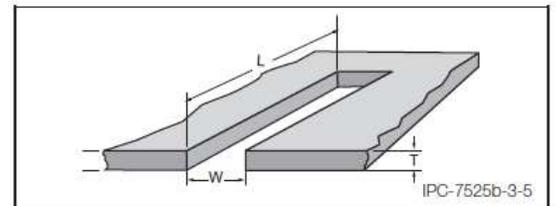


Figure 3-5 Cross-Sectional View of A Stencil

“3.2.1.2 When the stencil separates from the board, paste release encounters a competing process. Solder paste will either transfer to the land on the board or stick to the aperture side walls. When the area ratio is greater than 0.66 of the inside aperture wall area, a complete paste transfer should occur.”

The 0.66 minimum area ratio discussion above refers to stainless steel stencils with no nano-coatings.

How do Nano-Coatings affect Area Ratio?

There are two types of Nano-Coatings used on stencils.

1. **Self-Assembled Monolayer Coatings (Microshield)**, are applied by hand, the coating is clear and typically 2-4 nano-meters thick. These coatings prevent solder paste from sticking to the bottom of the stencil but do not improve solder paste release from the stencil apertures. The IPC recommended 0.66 Area Ratio should be maintained when designing stencils with this type of coating.
2. **Ceramic Nano-Coatings (Nanoslic Gold)**, are sprayed on and cured. They are typically 2-4 microns thick. These coatings prevent solder paste from sticking to the bottom of the stencil and improve solder paste release from the stencil apertures with area ratios lower than the IPC recommended 0.66 Area Ratio. When using Nanoslic Gold, customers can print down to 0.50 area ratio apertures with acceptable solder paste deposits. Testing shows transfer efficiency above 100% can be achieved with Type 4 No-Clean lead-free solder paste. In many cases where the required foil thickness would need to be reduced to remain above 0.66 area ratio on un-coated stencils, the foil thickness does not have to be reduced when applying the Nanoslic Gold coating. This can be critical in mixed technology PCB's where larger components exist with smaller components on the same board and reducing the foil thickness would not provide enough volume for the larger components.

Minimum Area Ratio Recommendations per Foil Type

Material	Minimum Area Ratio (AR)	Minimum Area Ratio (AR)
	No Stencil Coating	Nanoslic Gold
Slic™	0.60	0.50
UltraSlic™	0.55	0.48

*Modern Fiber Laser systems combined with using the best stainless steel in the industry for laser cut stencils allow our customers to print below 0.66 area ratio as recommended by IPC in the IPC 7525 guideline. Lab testing has shown 100% Transfer Efficiency with Type 4, No Clean, Lead Free Solder Paste at these Area Ratios.