

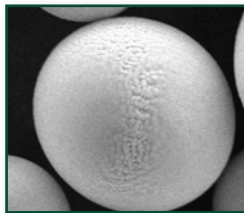
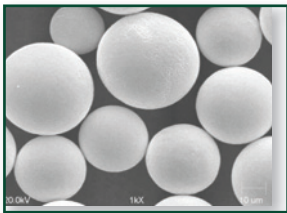
# Powder Choice Stencil Design Guidelines

## Powder Choice Guidelines

Selection of the appropriate powder size for a specific solder paste application is an elemental step that will ultimately affect the printability of the solder paste with regard to the stencil design. The stencil design plays an even more crucial role in solder paste printability and should be given considerable thought with the Area Ratio as a major focus.

Indium Corporation manufactures low-oxide spherical powder composed of a variety of Pb-Free alloys that cover a broad range of melting temperatures. Type 3 and Type 4 powder are standard offerings with most available alloys. Two SEM photographs of typical powder at 500x and 2000x magnification can be seen below.

Area Ratio is an essential component to the printing process and powder size choice. Calculating the Area Ratio and choosing the correct powder size can assist in proper stencil release. The Area Ratio is the ratio between the area of the aperture opening and the area of the aperture walls. [Area Ratio  $\geq$  0.66 (Area of the opening/Area of the walls  $\geq$  0.66)] Once the proper aperture size has been determined, using the Area Ratio, the appropriate powder size can then be chosen. For all apertures, it is important to choose the correct powder size so that a minimum of 4-5 solder particles (the large particle size of the range) can be maintained across the aperture.



APPLICATION NOTE

SOLDER POWDER SIZE PRINTING GUIDELINES												
TYPE Per J-STD-005	Printing Parameters								Powder Size			
	Pitch		Pad Width (Avg.)		Aperture Width (Avg.)				Diameter Range			
	millimeters	inches	millimeters	inches	millimeters	inches	# small spheres	# large spheres	microns	inches		
3	0.51	0.020	0.30	0.012	0.24	0.0095	9.7	5.4	25	45	0.0010	0.0018
4	0.51	0.020	0.30	0.012	0.24	0.0095	12.1	6.4	20	38	0.0008	0.0015
3	0.41	0.016	0.23	0.009	0.19	0.0075	7.6	4.2	25	45	0.0010	0.0018
4	0.41	0.016	0.23	0.009	0.19	0.0075	9.5	5.0	20	38	0.0008	0.0015
4	0.30	0.012	0.18	0.007	0.14	0.0055	7.0	3.7	20	38	0.0008	0.0015
5	0.30	0.012	0.18	0.007	0.14	0.0055	9.9	5.6	15	25	0.0006	0.0010
6	0.20	0.008	0.13	0.005	0.10	0.004	20.3	6.8	5	15	0.0002	0.0006

Form No. 97742 R3

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# Powder Choice and Stencil Design Guidelines

## Stencil Design Guideline

To ensure that a consistent volume of solder paste is printed onto the board, it is essential to design the stencil according to industry guidelines:

**Area Ratio ≥ 0.66**

**Minimum number of solder particles spanning an aperture should be at least 4.5**

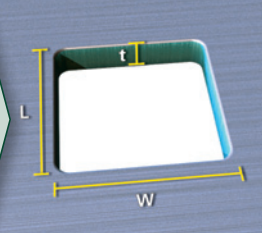
### Area Ratio For Square/Rectangular Apertures

Area Ratio =  $\frac{\text{Area Opening}}{\text{Area Walls}}$

Area Opening =  $L \times W$

Area Walls =  $2t(L + W)$

Area Ratio =  $\frac{L \times W}{2t(L + W)}$



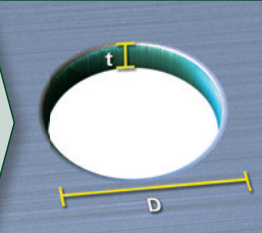
### Area Ratio For Circular Apertures Sample Area Ratio Chart

Area Ratio =  $\frac{\text{Area Opening}}{\text{Area Walls}}$

Area Opening =  $\frac{\pi D^2}{4}$

Area Walls =  $\pi Dt$

Area Ratio =  $\frac{D}{4t}$



## Recommendations

### BGA Assemblies:

- 50mil pitch BGA = 31.5mil circular pad with a 29.5mil circular stencil opening.
- 40mil pitch BGA = 15mil circular pad with a 13.8mil square stencil opening.
- 20mil pitch BGA = 11.8mil circular pad with an 11mil square stencil opening.

### QFP's:

- 20mil pitch QFP = 11.8mil x 49.2mil pad with a 9.84mil x 47.2mil stencil opening.
- 16mil pitch QFP = 9.84mil x 49.2mil pad with a 7.87mil x 47.2mil stencil opening.

### 0201's:

- Stencil Opening = 11mil x 16mil rectangle
- Foot Print = 12mil x 15mil rectangle
- Stencil Thickness = 5mil
- Spacing = 9mil

Note: The most common stencil being utilized is the laser cut electropolished, and in some cases the laser-cut Ni plated and electropolished.

The chart below depicts the Area Ratios for different combinations of Aperture Widths and Stencil Thicknesses. Any of the Area Ratios that are greater or equal to 0.66 should have sufficient printing performance. The lightest shade of green portrays an Area Ratio that is on the edge of sufficient printing results and may or may not provide desirable yields.

Pad Size (mm)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50		
Aperture Width (mil)	2.0	3.9	5.9	7 x 8	7.9	9.8	10 x 12	11.8	13.8	15.7	17.7	19.7
Stencil Thickness (5.0 mil)	0.10	0.20	0.30	0.37	0.39	0.49	0.55	0.59	0.69	0.79	0.89	0.98
Stencil Thickness (4.5 mil)	0.11	0.22	0.33	0.41	0.44	0.55	0.61	0.66	0.77	0.87	0.98	1.09
Stencil Thickness (4.0 mil)	0.12	0.25	0.37	0.47	0.49	0.62	0.68	0.74	0.86	0.98	1.11	1.23
Stencil Thickness (3.5 mil)	0.14	0.28	0.42	0.53	0.56	0.70	0.78	0.84	0.98	1.12	1.27	1.41
Stencil Thickness (3.0 mil)	0.16	0.33	0.49	0.62	0.66	0.82	0.91	0.98	1.15	1.31	1.48	1.64
Stencil Thickness (2.5 mil)	0.20	0.39	0.59	0.75	0.79	0.98	1.09	1.18	1.38	1.57	1.77	1.97

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