

Reducing Solder Beads and Solder Balls

Definitions

Solder beads are large solder spheres which form aside components during reflow. They are most common with low stand-off resistors and capacitors.

Solder balls are small, widely scattered solder particles found within the flux pool.

Process Impact

Solder beads and balls may cause electrical shorts immediately or in the future if the balls roll around the PCB. Beading and balling could also cause insufficient solder joint volume.

General Causes for Beading

- Paste printed or pressed onto solder mask
- Stencil aperture design
- Large overlap between pad and component
- Excessive paste volume due to thick stencil
- Switch from rubber to metal squeegee
- High component placement pressure
- High flux activation temperature
- Flux and moisture outgassing
- Fast ramp rate
- Excessive solder powder oxides or contaminants
- Low metal load
- Fine powder; type 4 or 5
- Paste slump; hot and cold

General Causes for Balling

- Print smearing
- Stencil aperture design
- Large number of fines in powder
- Excessive humidity
- Insufficient flux activity
- Excessive solder powder oxides or contaminants
- Solder mask and paste interaction
- High flux activation temperature
- Flux and moisture outgassing
- Fast ramp rate
- Component outgassing
- Low metal load
- Paste slump; hot and cold

Solutions

- Modify the stencil apertures and thickness. Reduced apertures are recommended.
- Different pad designs or metallizations may also reduce beading and balling.
- Evaluate component and board metallizations for solderability and contaminants.
- Adjust the reflow profile. A slow steady ramp ($\leq 1^\circ\text{C}/\text{sec}$) permits moisture and solvents to evaporate gradually prior to rosin/resin softening. Hot slump is minimized. Pastes with long stencil life and tack time generally require a slow ramp so environmentally stable solvents can evaporate.