TI Wafer Chip Scale Package SMT Guidelines

June 2011

WCSP PCB Assembly Guidelines

Assembly Forces

Excellent yields were observed using following assembly procedures :

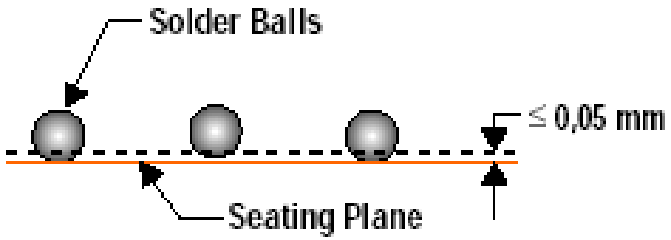
- **Pick up and Place down force = 125 – 200gf .**
  - ✓**Use of compliant tip recommended. Total contact area should be smaller than package outline.**
  - ✓**In general, 0201 pick up tips work well.**
  - ✓**Tip contact area Rectangular, with ~ 0.7 mm circular diameter vacuum opening.**

Underfill

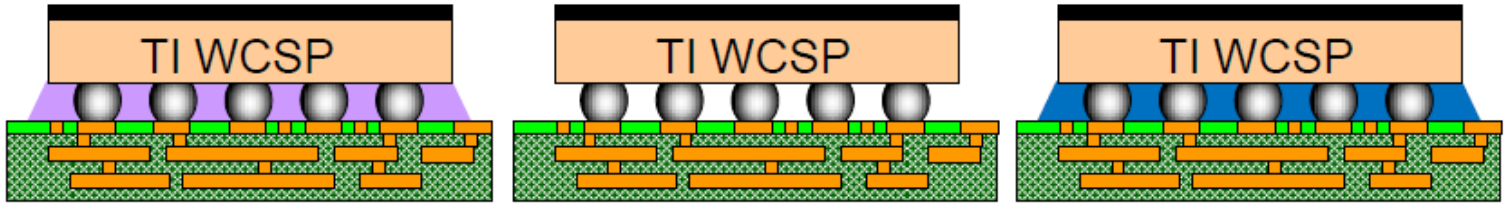
No underfill, adhesive, glue or over-mold was used to obtain the reliability results detailed in the following slides. The use of an underfill with a CTE matching the solder will enhance the board level performance.

Coplanarity

This Package meets a coplanarity spec of 0.05mm as shown. Coplanarity is defined as a unilateral tolerance zone measured upwards from the seating plane (Reference ASME Y14.5M – 1994)



TI WCSP and Underfill vs. Board Level Reliability



Underfill	Low-T_g Unfilled Epoxy	None	CTE matches solder
Temp Cycle BLR*	▲	●	■
Drop BLR	■	●	■

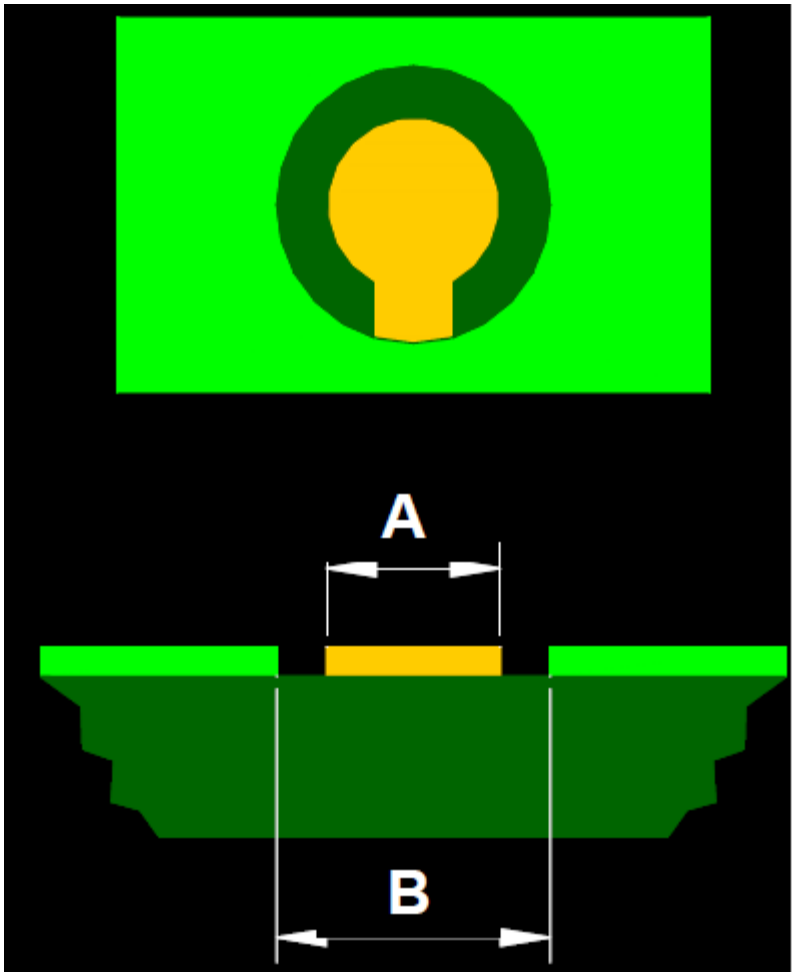
*-40C / 125C Temperature Cycle

■ Excellent
● Good
▲ Poor

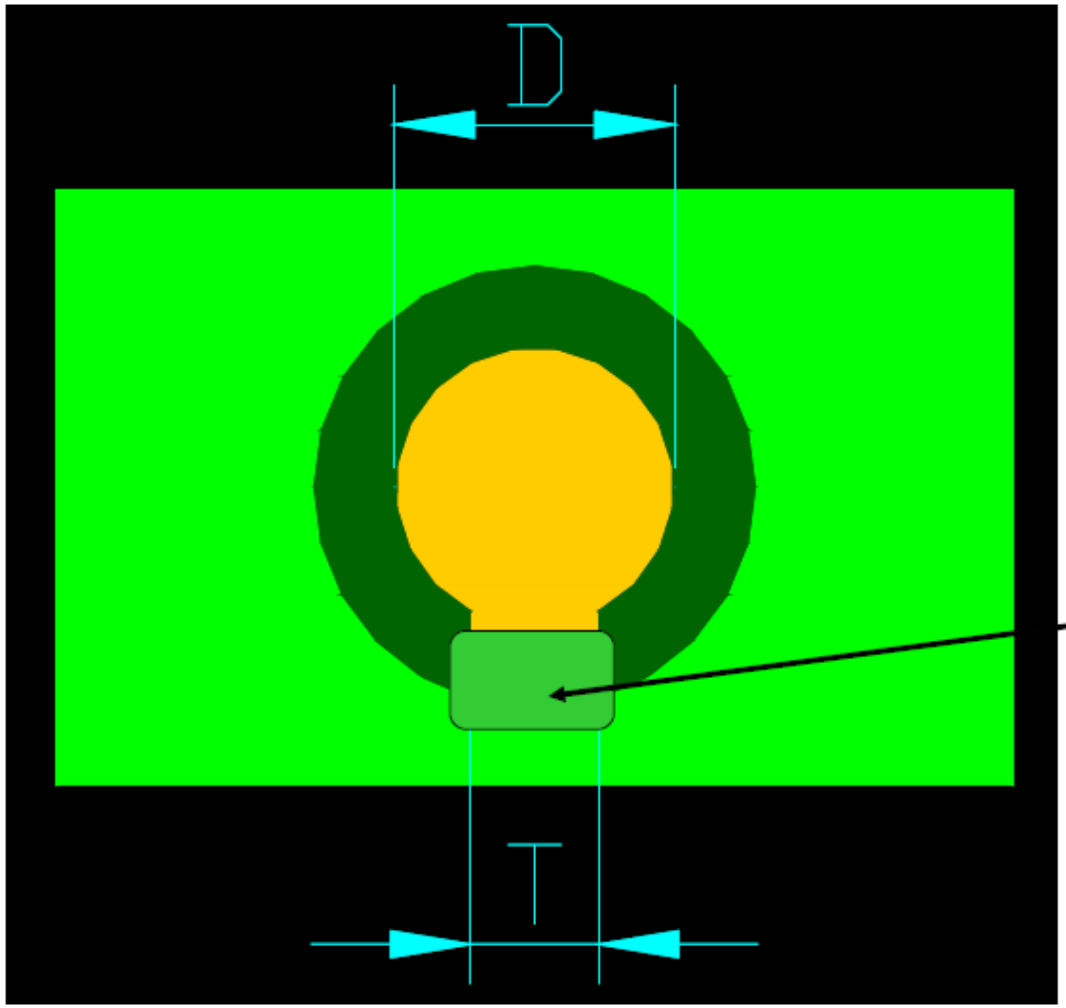
Recommended PCB Design Guidelines

Non-Solder Mask Defined (NSMD) Pad

Bump Diameter	Copper Pad “A”	Solder Mask Opening “B”
0.180 mm	0.170 mm	0.200 mm
0.200 mm	0.230 mm	0.310 mm
0.250 mm	0.230 mm	0.310 mm
0.300 mm	0.275 mm	0.375 mm



Pad Design Details - NSMD



T = Trace Width

D = Pad Diameter

T< (2/3)D

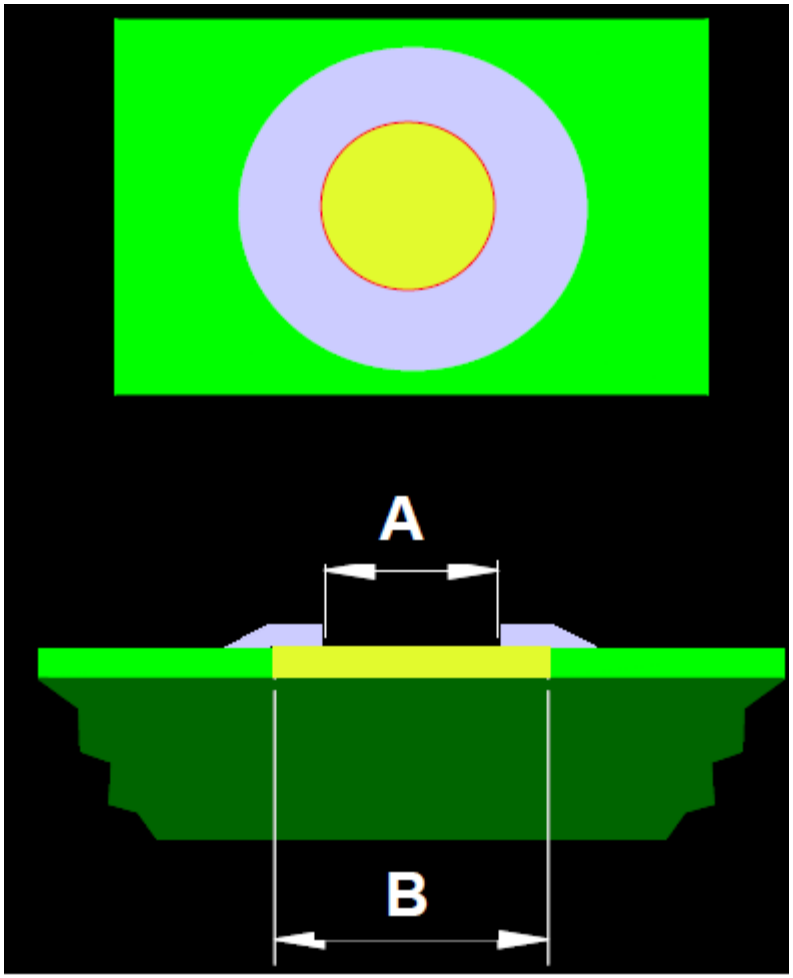
Optional Solder Mask at Trace Neck will help prevent solder flow/starvation.

Alternative PCB Design Guidelines

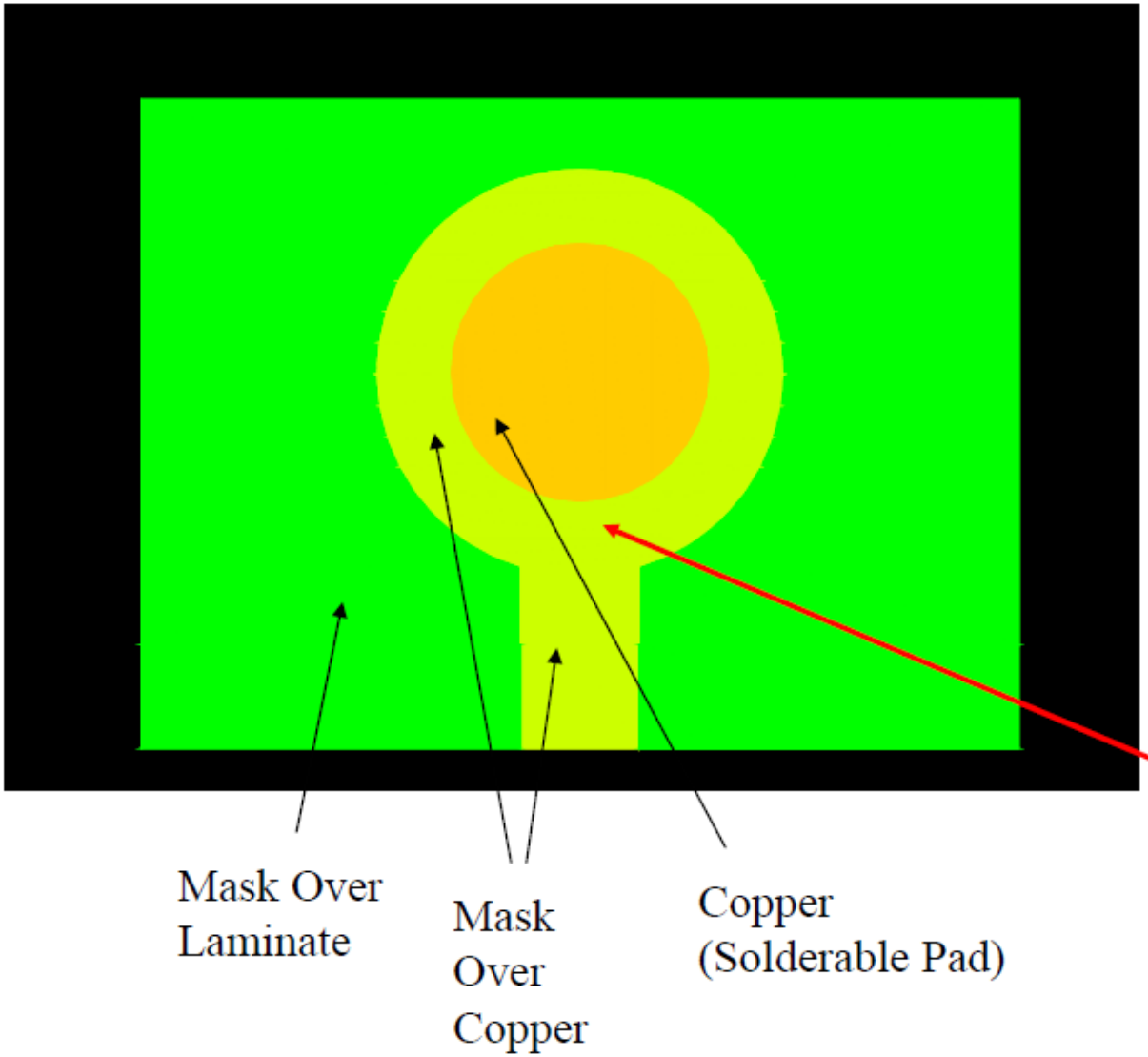
Solder Mask Defined (SMD) Pad

Bump Diameter	Solder Mask Opening “A”	Copper Pad “B”
0.180 mm	0.170 mm	0.200 mm
0.200 mm	0.230 mm	0.280 mm
0.250 mm	0.230 mm	0.280 mm
0.300 mm	0.275 mm	0.330 mm

Note: this configuration is ideal if underfill is used during board assembly process.

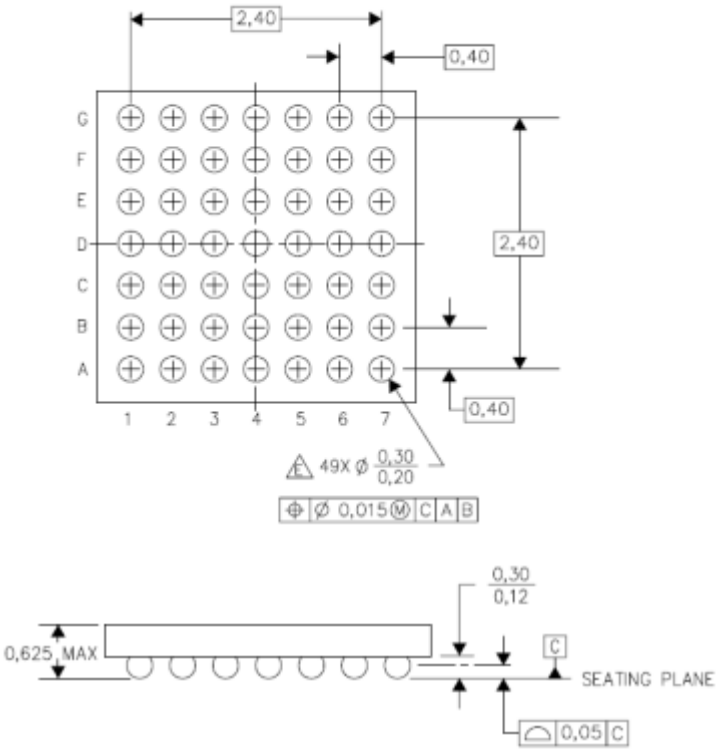


Pad Design Details - SMD



- Mask Defines Solderable Area
- Solderable Areas **MUST** Remain Equal Among All Pads
- Larger Pad Areas or Poor Mask Print at Trace Neck will Cause Solder Starvation or Ball-Off.

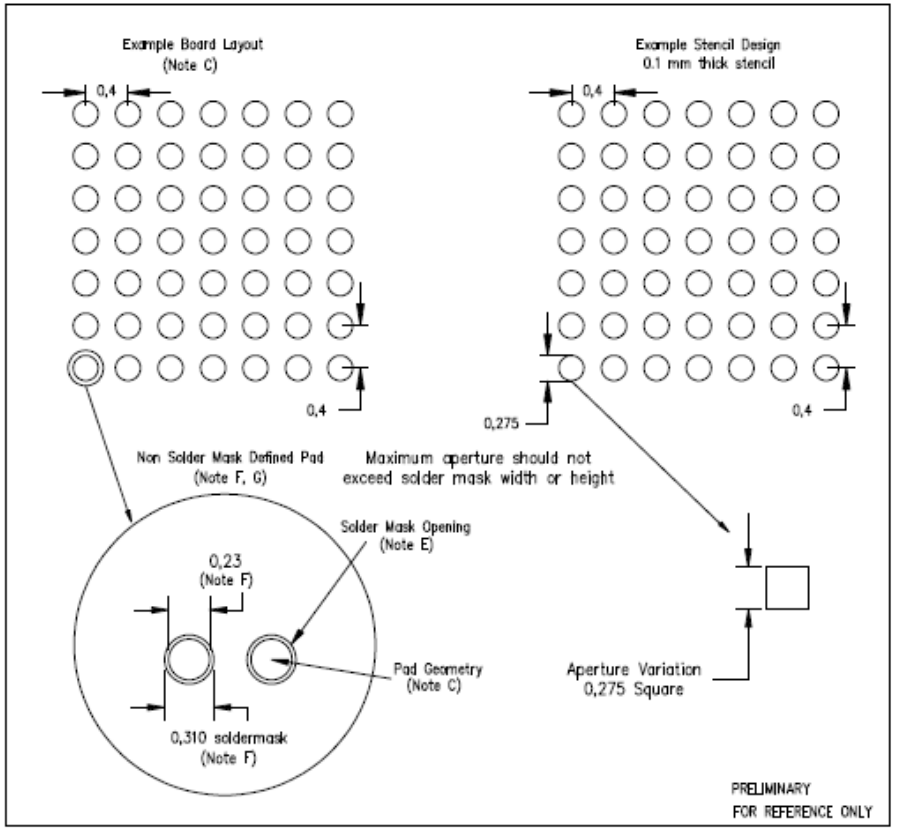
49YFF Land Pattern



PRELIMINARY
FOR REFERENCE ONLY

EXAMPLE LAND PATTERN

YFF (S–XBGA–N49)
(Pb–Free Solder Spheres)



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
F. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. Refer to Wafer Chip Scale Packages, Texas Instruments Literature No. SBVA017 and also the Product Data Sheet for specific thermal information via requirements, and recommended routing guidelines. These documents are available at www.ti.com <http://www.ti.com>.
G. Placement force during assembly must be kept below 30g per solder sphere.

Texas Instruments
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WCSP Stencil and Paste Recommendations

Solder Paste: Use of type 3 solder paste is recommended. Type 4 is unnecessary with this stencil design, unless required by other components.

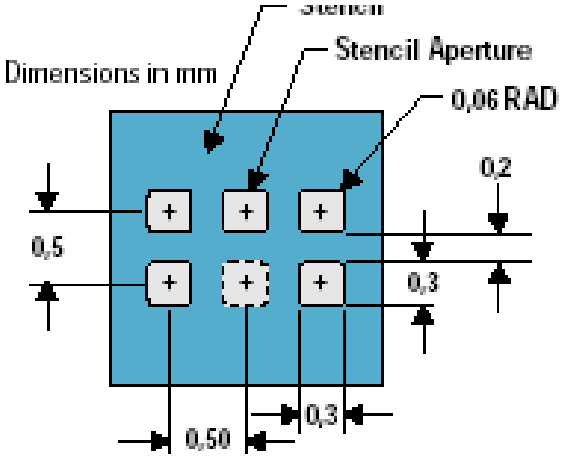
✓Facilitates wetting of the solder ball to the PCB land better than the use of only flux.

✓ The adhesive properties of the paste will hold the component in place during reflow.

✓ Paste contributes to the final volume of solder in the joint.

✓Recommended stencil thickness of 100 –103 um (3.9 to 4.06 mils).

✓Maximum paste volume at 103 um. Area Ratio = 0.7596. Transfer Efficiency = 100%

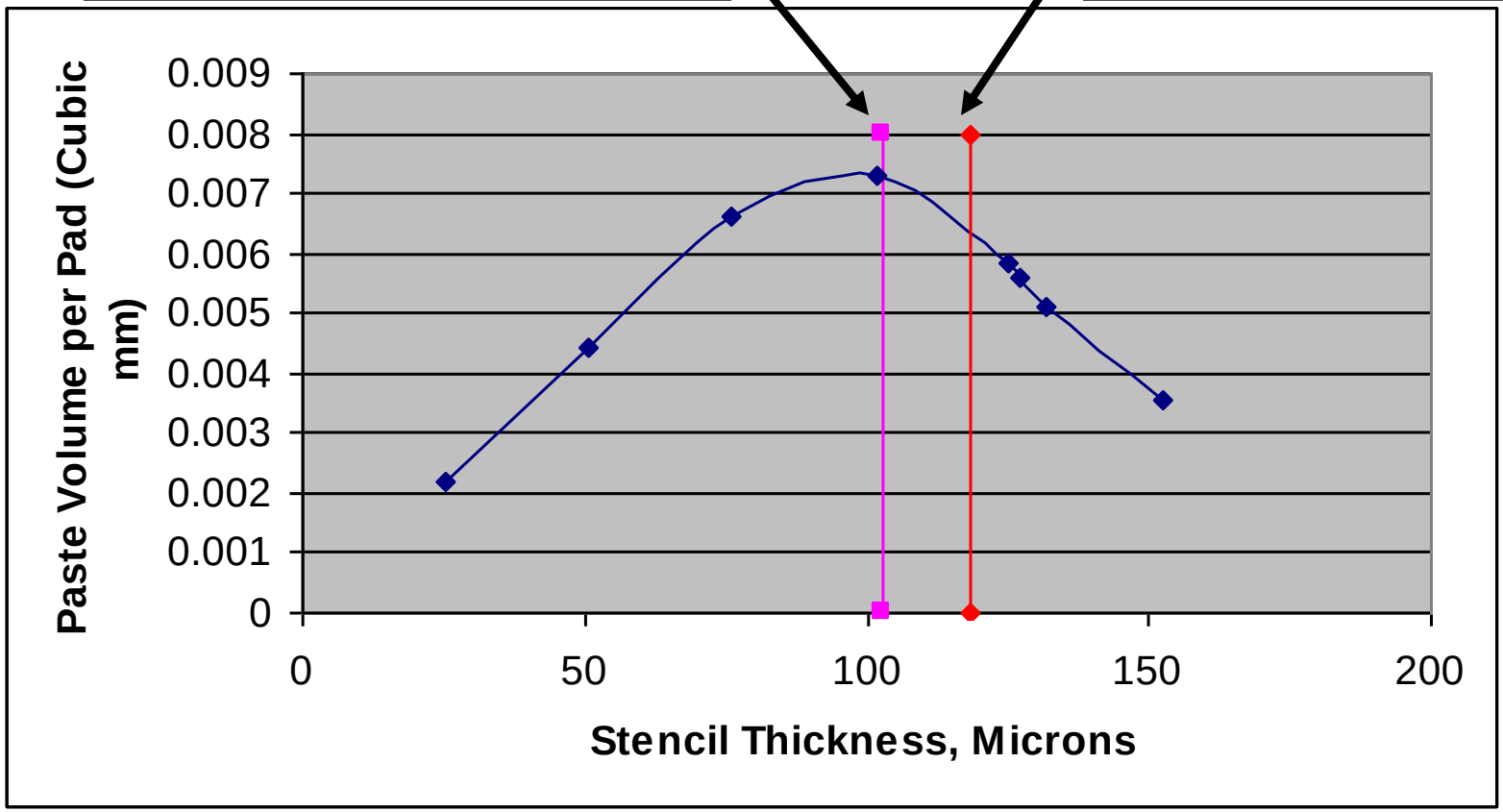


Bump Diameter	Stencil Opening
0.180 mm	0.200 mm
0.200 mm	0.250 mm
0.250 mm	0.250 mm
0.300 mm	0.300 mm

Performance of Recommended WCSP Stencil, Volume per pad vs. Stencil Thickness

102 -103 um – Best Area Ratio and Solder Volume

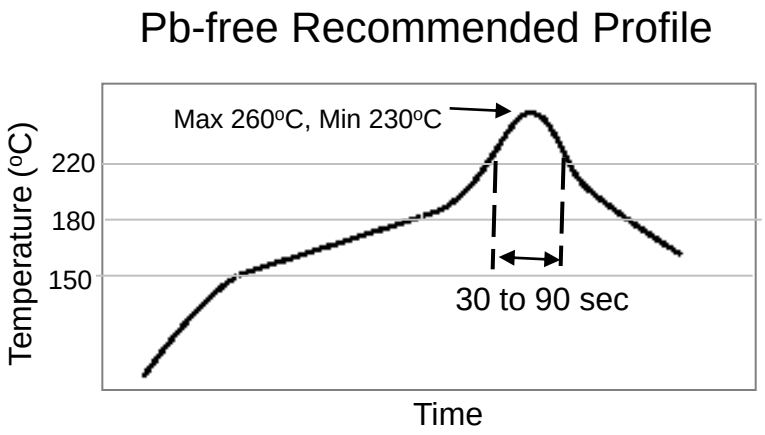
118 um – Maximum allowable Thickness. Area Ratio =0.66



WCSP Reflow Recommendation

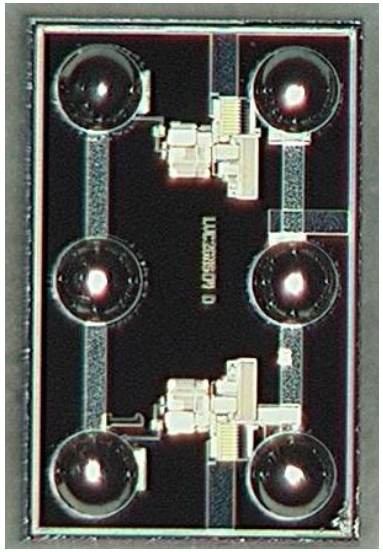
	Pb-free Assembly
Ramp Rate	< 3°C/Sec
Pre-Heat	160 to 180°C 60 to 120 sec
Time Above Liquidus	220°C 30 to 90 sec
Peak Temp	245 – 260 °C
Time within 5°C of Peak	10 to 40 sec
Ramp Down	< 6°C/Sec

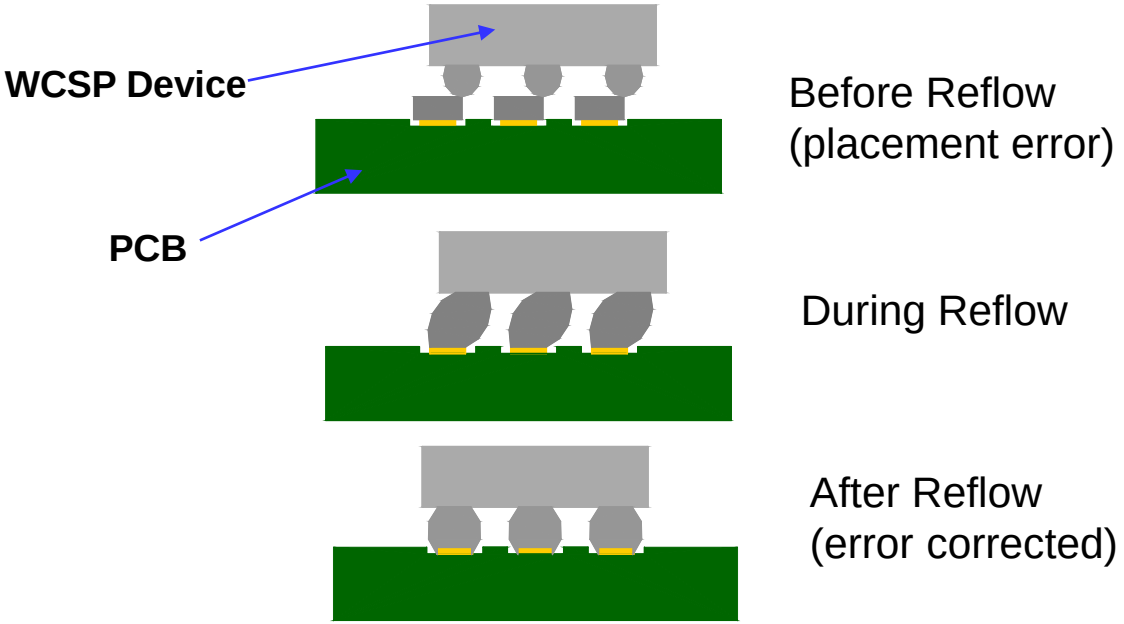
These are approximate profiles, and actual conditions obtained in any specific reflow oven can vary. These profiles are based on convection or IR plus forced convection heating.



- **Can accommodated wide profile variations**

WCSPs – Self-correcting Packages



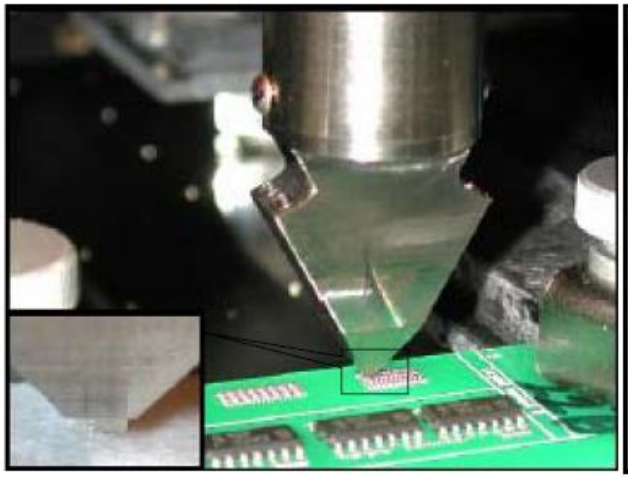


WCSPs are ***very forgiving to placement errors***

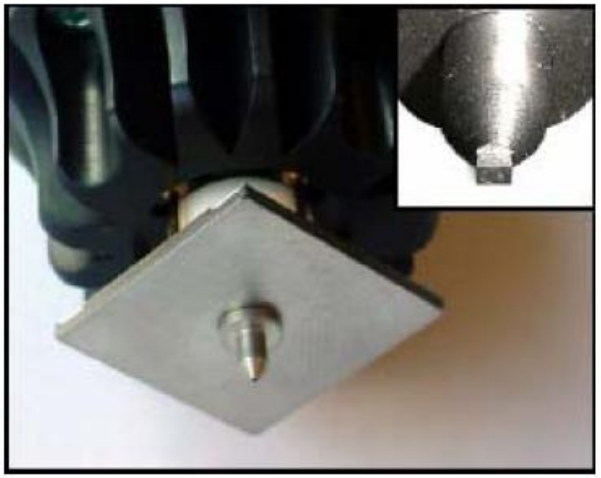
- ✓Self aligns during reflow
- ✓About 50% of ball to paste overlap is sufficient for self correction
- ✓Less placement accuracy required on NSMD pads than SMD. Self-Centering effect is less efficient on SMD pads due to mask. Possible open if ball does not contact metal SMD pad.

WCSP Rework

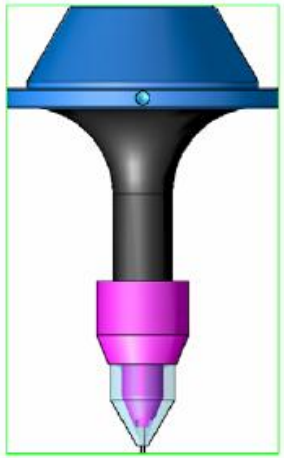
Air-Vac Rework Tools



a) Hot Gas Conduction Nozzle



b) Electrical Conduction Nozzle



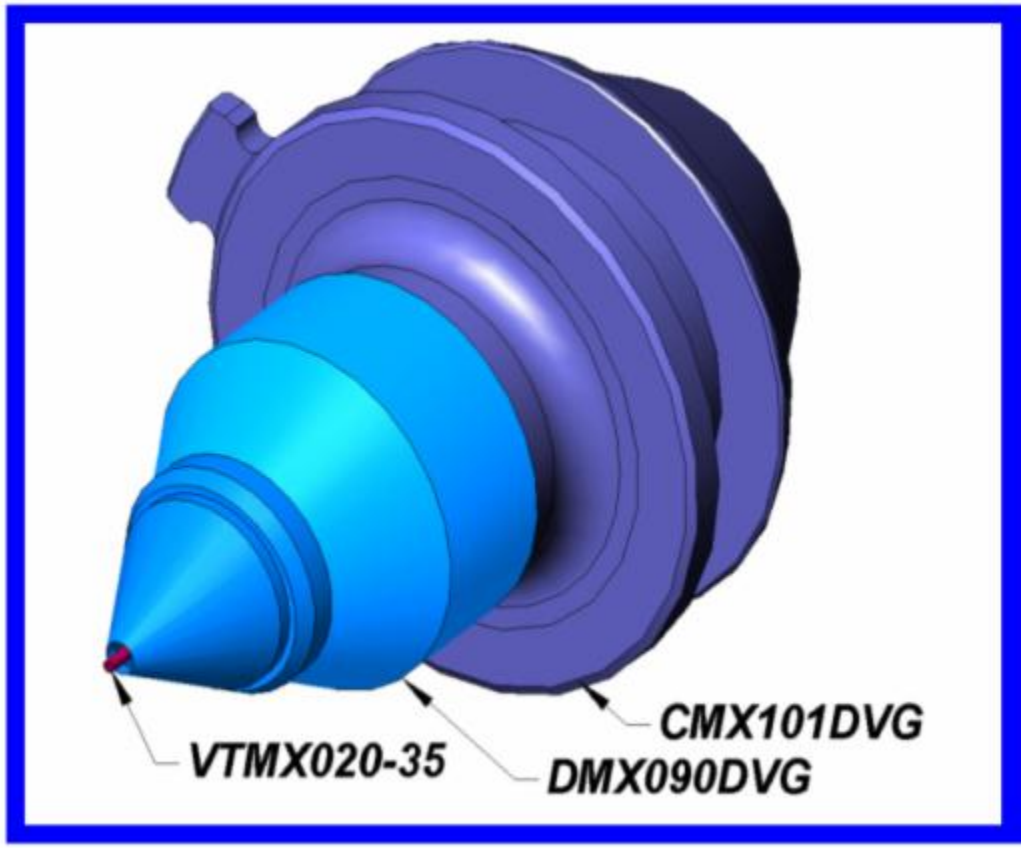
c) Hot Gas Convection Nozzle

- ✓ Exhaust venting prevents adjacent component reflow.
- ✓ Zero adjacent component clearance required for physical fit.

D) "M" style Nozzle

WCSP Air-Vac Rework Tools

- NMX090DVG/DMX090DVG
  - .090” Exhaust Opening
  - Used for Die sizes up to 2.15mm x 2.15mm
  - VTMX020-35 Vacuum Tip
- NMX188DVG
  - .188” Exhaust Opening
  - Used for Die sizes between 2.15mm to 4.5mm
  - VTMX020-35 Vacuum Tip



Hot Gas Convection Nozzle

WCSP (Pb-Free) Rework Procedure

- Presented here are generic guidelines to rework Pb-free bumped WCSP packages assembled on a 0.056-inch thick FR4 board.
- It's recommended to modify heating profiles for different board thicknesses and equipment used.
- Do not reuse the part after it is removed. Assembly process recommended below should be used with a new device.

Pb-Free Balls Removal

1. Apply flux paste to component
2. Align Nozzle over part to be removed
3. Maintain nozzle .050" over device. Care must be taken to prevent over-travel of the vacuum tip which may damage the part or vacuum tip when measuring this distance
4. Preheat board to 90ºC, nozzle warming up 20% air flow, 125ºC
5. Soak Stage—20% air flow, 225ºC, 90 seconds
6. Ramp Stage—20% air flow, 335ºC, 30 seconds
7. Reflow Stage—25% air flow, 370ºC, 65 seconds
8. Enable Vacuum at the end of the reflow reflow cycle, lower vacuum nozzle, and remove part
9. Cool down Stage—40% air flow, 25ºC, 50 seconds
10. Turn off the vacuum and remove part from nozzle.
11. Using any metal tweezers, or rough handling can damage the part, and render it un-analyzable

Pb-Free Balls Placement

1. Apply flux paste to component
2. Align device over pads
3. Place device on board. Care must be taken to prevent over-travel during placement which may damage the part or vacuum tip
4. Raise nozzle .050"
5. Preheat board to 90ºC, nozzle warming up 20% air flow, 125ºC
6. Soak Stage—20% air flow, 225ºC, 90 seconds
7. Ramp Stage—20% air flow, 335ºC, 30 seconds
8. Reflow Stage—25% air flow, 370ºC, 65 seconds
9. Cool down Stage—40% air flow, 25ºC, 50 seconds

For more information, please contact a local TI representative.