Detailed Cause and Effect

Fine Feature Printing

MATERIALS
- Paste
  - Viscosity
  - Rheology
- Squeegee
  - Length
  - Thickness
- Stencil
  - Taper
- Cleaning
  - Chemistry

PERSONNEL & ENVIRONMENT
- Flux
  - Residue
  - Viscosity
- Board
  - Thickness
  - Mask Issues
- Environment
  - Temperature
  - Humidity
- Setup
  - Standard Procedures
  - Knead Parameters
- Handling
  - Procedures
  - Training
  - Discipline

EQUIPMENT & TOOLING
- Paste Bead Diameter
- Paste Storage
- Stencil Storage
- Cleaning
  - Procedures

OPERATION & METRICS
- Stencil
  - Thickness
  - Area Ratio

Metrology
- Repeatability
- Reproducibility

Process Control
- Process Parameters
  - Print Speed
  - Frequency of Cleaning

Process Control
- SPC Program
- Continuous Improvement

GOOD PRINT
- Defect Data Collection
- Set-up Time
- Serviceability

Cookson Electronics
Print Process Parameters

1. Print Speed
2. Release Speed
3. Release Delay
4. Downstop
5. Lift/Dwell Height
6. Paste Replenishment
7. Squeegee Height & Length
8. Print Pressure
1. PRINT SPEED
Always observe recommended squeegee speed for specific solder paste products. Note that different speeds may be preferred to maximize print performance for different solder pastes. Certain latest generation solder pastes like OM-338 Series are designed to print fast based on their high shear/fast response characteristics. The table below provides conversion between metric and imperial values.

<table>
<thead>
<tr>
<th>Inch/sec</th>
<th>1&quot;</th>
<th>2&quot;</th>
<th>3&quot;</th>
<th>4&quot;</th>
<th>5&quot;</th>
<th>6&quot;</th>
<th>7&quot;</th>
<th>8&quot;</th>
<th>9&quot;</th>
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<tr>
<td></td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>225</td>
<td>250</td>
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<table>
<thead>
<tr>
<th>mm/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
2. RELEASE SPEED
Observe recommended release speed for specific solder paste products. Note that certain latest generation products require fast release speeds (or no release speed), based on the thixotropic nature of these products (like OM-6000 and OM-338 Series). Use a microscope to judge the different print results with different release speeds.

3. RELEASE DELAY
For solder paste stencil printing, never use a release delay to avoid solder paste from adhering to the aperture walls in the stencil.

4. DOWNSTOP
For good printing, the squeegee downstop should be set at 1.9 to 2.2 mm (7.6 – 8.8 mil) to avoid excessive squeegee bending, resulting in solder paste sticking to the squeegee holder. The squeegee angle should be approximately 45°.
Down-stop on MPM printers

• Normal Setting: 1.9 - 2.2 mm

• Bad Downstop

Down-stop: 1.9 mm

Down-stop: 4 mm
Bad Down-stop Effect...

Poor Solderpaste rolling
Bad apertures filling
Insufficient deposit in small apertures.
Sticky on blades phenomenon with short height’s
Fine Feature Printing

Attack Angle

• Combination of Static and Dynamic Angles
• Low Angle May Improve Paste Packing
• Most Important with Low Area Ratio
• f(Blade Compliancy, Blade Holder, Print Speed and Print Pressure)
Main Effects for 0.3mm Pitch/01005

**Main Effects Plot for Volume TE of CVP-370 Paste**

Data Means
0.15mm Apertures and 0.15mm Gap

- **Blade**
  - Standard: 62
  - Thin: 64

- **Pressure (Kg)**
  - 5.44
  - 7.25

- **Release (mm/sec)**
  - 2
  - 8

**AR = 0.47**

Thin Blade is 30% reduced from Thick Blade
**Fine Feature Printing**

0.3mm Pitch, AR = 0.47

*Boxplot of Volume TE for 0.15mm Apertures with 0.15mm Gap*

- Fewer Outliers with 30% Thinner Blade
- More Volume TE with 30% Thinner Blade
**Fine Feature Printing**

**Distribution for 0.3mm Pitch, AR = 0.47**

<table>
<thead>
<tr>
<th>Blade</th>
<th>Paste</th>
<th>AR</th>
<th>Median</th>
<th>Mean</th>
<th>StDev</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin</td>
<td>CV_370</td>
<td>0.47</td>
<td>65.00</td>
<td>65.25</td>
<td>65.00</td>
<td>64.75</td>
<td>-0.22</td>
<td>0.23</td>
<td>1200</td>
</tr>
<tr>
<td>Standard</td>
<td>CV_370</td>
<td>0.49342</td>
<td>58.00</td>
<td>58.55</td>
<td>58.00</td>
<td>57.55</td>
<td>-0.50</td>
<td>1.47</td>
<td>1200</td>
</tr>
</tbody>
</table>

- 30% Thinner Blade
- Tighter Distribution
- Greater average Transfer Efficiency
Printer

- Blades
  - Attack Angle
  - Print Speed - $f($paste and thru put$)$
  - Blade Pressure – $f($print speed and attack angle$)$
  - Stencil Release Rate – $f($paste and aperture$)$

- Board Support
  - Dedicated vs. Pins

- Board Clamping
  - Edge vs. Top
Print Process Parameters

The 0.5 mm pitch CSP's is too close the printer clamping:

Printing direction...

0.5 mm CSP's
So near the clamping area there is a *gap between the stencil and the board*... more bleeding effect.

Poor shape.... Solderpaste connection phenomenon.
Create a step stencil on the clamping area:

Etching on the bottom side...

With this step stencil on the bottom side, above the printer clamping location... smaller gap between the stencil and the board. Less bleeding effect and better printing shape on the 0.5 mm CSP’s and on the other components.
AREA RATIO, and the effect of aperture wall smoothness on Area Ratio, is the primary factor that determines paste transfer.

Area Ratio = \frac{\text{Aperture Opening Area}}{\text{Aperture Wall Area}}

Transfer Efficiency = \frac{\text{Volume Deposit}}{\text{Volume Aperture}}

Smooth aperture wall – Higher paste transfer
High Area Ratio - High Transfer Efficiency
- Low Standard Deviation
Problem Definition

- As the stencil moves away from the board, the paste experiences forces at the aperture walls and pad surface that define print quality.
Goal: Map out the total print process.

Print Process

Area Ratio
- Aperture Size
- Stencil Thickness

Print Process
- Stencil Technology
  - surface roughness
  - surface energy
- Paste Type
  - Flux formulation
  - Powder size
- Printer Set-up
  - Process settings
  - Equipment stability

Output
- Repeatability
- Transfer Efficiency

Other Significant Process Inputs
Step-Stencil Design Variability

Step Stencil Design

Squeegee

Raised area for more paste

Recess area for less paste

Protection chambers

Electronics
Why Overprint?

- Over print larger components while keeping the small components 1:1 ratio
- Provides higher volume of paste for larger components
- Allows you to use one thickness stencil
- Allows one step printing

[Diagram: Over printed green paste leading to reflowed good pullback with annotations]
Active Device Evolution

- Grid Array Devices
- Peripheral Array Device

PLCC’s → QFP’s → BGA’s → CSP’s

Bluetooth, MCM

µBGA, CCGA, COB, etc.
Boards

• Mask Registration and Design
  – Minimize MCSB
  – Prevent Shorts
  – Registration Tell Tale

• Over Etching
  – Increased Skips

• Alignment
  – Bridges/Shorts

• Ledged Ink - Gasket

• Mask Cure
Fine Feature Printing – Key Inputs

Mask Registration

Photos and Figures from: Ly, H., Printed Circuits Design and Fab, January, 2009
Fine Feature Printing – Key Inputs

- Mask Location – Keep Out
- Not Fully Cured Mask or Legend Ink can Contribute
- Rough Surface Better
- Alignment and Placement Pressure
- Reduce Foil Thickness

MCSB – Too Much Solder Paste and/or in the wrong location
MCSB Mask Design

- Miss alignment
- No dissociation during the liquidus… return to the pad
- No soldermask in between
FUNCTION OF PASTE INGREDIENTS

• METAL
  – Melts & bonds to form connection

• FLUX SYSTEM
  – Wets surfaces
  – Cleans metal surface
  – Conducts heat

• ACTIVATOR
  – Oxide reduction

• ROSIN
  – Tack - HT, Rheology
  – Activator

• ADDITIVES
  – Tack - LT, Release, Suspension, Smell, Detergent, Rheology

• SOLVENT
  – Dissolve chemistry, Maintain Suspension
AREA RATIO, and the effect of aperture wall smoothness on Area Ratio, is the primary factor that determines paste transfer.

\[
\text{Area Ratio} = \frac{\text{Aperture Opening Area}}{\text{Aperture Wall Area}}
\]

\[
\text{Transfer Efficiency} = \frac{\text{Volume Deposit}}{\text{Volume Aperture}}
\]

High Area Ratio
- Higher Paste Transfer
- High Transfer Efficiency
- Low Standard Deviation
As the stencil moves away from the board, the paste experiences forces at the aperture walls and pad surface that define print quality.
Problem Definition

• These competing forces are determined by the Flux adhesion (and tack) on the two surfaces being separated.

• Transfer Efficiency can be predicted by the Area Ratio between the pad area and the stencil wall area.
Area Ratio and Transfer Efficiency

\[
AR = \frac{\text{Area of Circuit Side Opening}}{\text{Area of Aperture Walls}}
\]

\[
TE = 2.404 \times (AR)^{3.426}
\]

When AR gets small (below 1.0) the Adhesive forces compete with the Cohesive forces of the Solder Paste Rheology.

Increased Tack causes the Adhesive Forces to be greater than the Cohesive Forces and the paste tends to release from the Aperture mass, leaving the walls coated with paste.
Two competing theories:

1. Increased Tack causes the Adhesive Forces to be greater than the Cohesive Forces and the paste tends to release from the Aperture mass, leaving the walls coated with paste.

2. Cohesive Forces are equal to or greater than Adhesive Forces and the paste partially releases from the wall.
Area Ratio and Transfer Efficiency

Two competing theories:

Observations seem to favor Theory 1

Question still remains as to the effect of grain structure and surface lubricity on TE at various Area Ratios. Does a different surface condition extend the ability of the paste to completely vacate the aperture, as we observe at AR above 1.0?
# Solder Paste Particle Size Mils

<table>
<thead>
<tr>
<th>Type 3</th>
<th>Type 4</th>
<th>Type 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.98-1.77</td>
<td>0.79-1.50</td>
<td>.59-0.98</td>
</tr>
<tr>
<td>1.38</td>
<td>1.15</td>
<td>0.79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type 6</th>
<th>Type 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20-0.59</td>
<td>.008-0.43</td>
</tr>
<tr>
<td>.39</td>
<td>0.26</td>
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</table>
# Particle Size Guidelines

<table>
<thead>
<tr>
<th>Type</th>
<th>None larger than (μm):</th>
<th>Maximum 1% particles by weight larger than (μm):</th>
<th>Minimum 80% particles by weight between (μm):</th>
<th>Maximum 10% particles by weight smaller than (μm):</th>
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</thead>
<tbody>
<tr>
<td>T1</td>
<td>160</td>
<td>150</td>
<td>150-75</td>
<td>20</td>
</tr>
<tr>
<td>T2</td>
<td>80</td>
<td>75</td>
<td>75-45</td>
<td>20</td>
</tr>
<tr>
<td>T3</td>
<td>50</td>
<td>45</td>
<td>45-25</td>
<td>20</td>
</tr>
<tr>
<td>T4</td>
<td>40</td>
<td>38</td>
<td>38-20 (90%)</td>
<td>20</td>
</tr>
<tr>
<td>T5</td>
<td>30</td>
<td>25</td>
<td>25-15 (90%)</td>
<td>15</td>
</tr>
<tr>
<td>T6</td>
<td>20</td>
<td>15</td>
<td>15-5 (90%)</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Powder in um</th>
<th>Min Aperture Width in um (x5)</th>
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<tbody>
<tr>
<td>35</td>
<td>1.4 miles</td>
</tr>
<tr>
<td>29</td>
<td>1.1 miles</td>
</tr>
<tr>
<td>20</td>
<td>0.8 miles</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>
Solder Paste Particle Size Comparison

Boxplot of Volume(%)
Detailed Cause and Effect Analysis

Fine Feature Printing

**Materials**
- Paste
  - Viscosity
  - Rheology
  - Solid Content
  - Particle Size / Distribution
- Squeegee
  - Size & Shape of Edge
  - Material
  - Hardness
- Flux
  - Residue
  - Viscosity
- Board
  - Thickness
  - Mask Issues
- Flux
  - Residue
  - Viscosity
  - Pad Metallurgy
  - Cleanliness
- Board
  - Warpage
  - Planarity
  - Component Mix
- Paste
  - Solid Content
- Squeegee
  - Material
  - Hardness
  - Particle Size / Distribution

**Personnel & Environment**
- Procedures
- Training
- Discipline
- Handling
  - Temperature
  - Humidity
- Environment
  - Standard Procedures
  - Knead Parameters
- Setup
  - Paste Storage
  - Stencil Storage
- Board
  - Paste Bead Diameter
- Paste Storage
  - Stencil Storage
- Squeegee
  - Material
  - Hardness
- Paste
  - Solid Content
- Flux
  - Residue
  - Viscosity

**Equipment & Tooling**
- Good Print
- Procedures
  - Paste Bead Diameter
  - Stencil Storage
  - Paste Storage
- Maintenance
  - Serviceability
  - Repeatability
  - Reproducibility
- Machine
  - Set-up Time
  - Stroke Length
  - Print Speed

**Metrology**
- Repeatability
- Reproducibility
  - Stencil Cleaning
  - Frequency
- Operation & Metrics
  - Repeatability
  - Reproducibility
- Process Parameters
  - Frequency of Cleaning
  - Separation Speed

**Processing Control**
- Defect Data Collection
- SPC Program
- Continuous Improvement

**Materials & Personal & Environment**
- Flux
  - Pad Metallurgy
  - Cleanliness
- Paste
  - Solid Content
- Stencil
  - Area Ratio
  - Aspect Ratio
- Cleaning
  - Chemistry
  - Procedures
  - Frequency
  - Stencil Cleaning

**Operation & Metrics**
- Pressure
  - Gap
- Planarity
  - Pad Finish

**Equipment & Tooling**
- Stencil
  - Method of Fabrication
  - Thickness
  - Aspect Ratio
- Cleaning
  - Chemistry
  - Procedures
- Stencil Cleaning
  - Frequency

**Processing Control**
- Defect Data Collection
- SPC Program
- Continuous Improvement
# Mobile Device & Tablet Trends

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Feature Phone</th>
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<tr>
<td></td>
<td>Year</td>
<td>2011</td>
<td>2013</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Unit Shipments (MM)</td>
<td>700</td>
<td>590</td>
<td>480</td>
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<tr>
<td></td>
<td>Board Size</td>
<td>4x8</td>
<td>4x5</td>
<td>4x5</td>
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<tr>
<td></td>
<td>Component Count</td>
<td>400</td>
<td>350</td>
<td>300</td>
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<tr>
<td></td>
<td>Component Types</td>
<td>0201/ WLP</td>
<td>0201/ WLP</td>
<td>01005/ WLP</td>
</tr>
<tr>
<td></td>
<td>Pitch (mm)</td>
<td>0.4</td>
<td>0.4</td>
<td>0.35</td>
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<tr>
<td></td>
<td>I/Os</td>
<td>450</td>
<td>750</td>
<td>900+</td>
</tr>
</tbody>
</table>

- Low end phone construction simplifying
- Smart phone feature size decreasing: Increased difficulty of assembly
Key Drivers for Fine Feature

- Increased functionality
- System on Chip
  - Most functions on one die
- System in Package
  - Active and Passive on one package
- 3D packaging
  - Multiple die stacked in one package
  - PoP (Logic and Memory)
Package on Package Trends
PoP Joining Options

- Depending on pitch, bottom package (0.4 mm pitch) can either be printed or dipped.
- Top package (0.5 mm pitch), can use either paste flux or paste:
  - Many customer now using paste flux
  - Especially if bottom package is TMV with spheres
- Sphere alloy – SAC125 + Ni (LF35)
- ALPHA Offering:
  - PoP33 – T5 powder
  - PoP34 – T6 powder
Construction of the PoP Fishbone Analysis

MATERIALS

PERSONNEL & ENVIRONMENT

EQUIPMENT & TOOLING

OPERATION & METRICS

High First Pass Yield PoP Assembly
PoP Fishbone

High First Pass Yield PoP Assembly

- Paste
- Flux
- Components
- Board
- Doctor Blade and PoP Dip Tray
- Inspection
- EQUIPMENT & TOOLING
- METRICS
- PERSONNEL & ENVIRONMENT
- Environment
- Handling
- Setup
- Process Control
- Process Parameters
PoP Fishbone

**MATERIALS**
- Paste
  - Viscosity
  - Rheology
  - Solid Content
  - Particle Size Distribution
  - Pitch
  - Coplanarity
  - Alloy
- Components
  - Component Size
  - Number of IOs
  - Sphere Size

**PERSONNEL & ENVIRONMENT**
- Flux
  - Residue
  - Viscosity
  - Pitch
  - Coplanarity
  - Alloy
- Board
  - Thickness
  - Mask Issues
  - Support
  - Pad Finish
- High First Pass Yield
  - Paste Life

**EQUIPMENT & TOOLING**
- Doctor
  - Blade Schedule
  - Amount of paste in Tray
  - Dip Tray Cleaning
- Dip Tray
  - Flatness of paste in Tray
  - Aperture Geometry
  - Aperture Size
- Cleaning
  - Procedures

**OPERATION & METRICS**
- Operation
  - Dip Depth
  - Lift Speed
  - Amount of Time in Paste
  - Post Dip Inspection
- Metrology
  - Repeatability
  - Reproducibility
  - Insertion Speed
  - Reflow Profile
  - Reflow Environment

**PROCESS CONTROL**
- Serviceability
- Set-up Time
- Frequency of Line Purge
- Amount of Paste Transfer
- SPC Program
- Protocols Training
- Metrology
  - Planarity
  - Pad Finish

**PROCESS PARAMETERS**
- Environment
  - Temperature
  - Humidity
- Handling
  - Standard Procedures
  - Equipment Parameters
- Environment
  - Temperature
  - Humidity
- HANDLING
  - Procedures
  - Training
  - Discipline
- Setup
  - Paste Storage
  - Paste Life
- Environment
  - Temperature
  - Humidity
- Environment
  - Slump
  - Metallurgy
  - Particle Size Distribution
- Operation
  - Dip Tray Cleaning
  - Doctor Blade Parameters

This diagram represents a fishbone or Ishikawa diagram for a PoP Fishbone process, indicating the various factors affecting the process and the control measures to ensure quality.
Issues Specific to Optimized PoP Process

- BGA warpage signature
- Component size
- BGA oxidation level
- Reflow Profile
- Reflow environment

- Paste Rheology
- Determining minimum paste transfer
- Inspection of component post dip
PoP Joining Options

• Depending on pitch, bottom package (0.4 mm pitch) can either be printed or dipped

• Top package (0.5 mm pitch), can use either paste flux or paste
  – Many customer now using dip flux
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• Sphere alloy – SAC125 + Ni (LF35)

• ALPHA Offering:
  – PoP33 – T5 powder
  – PoP34 – T6 powder
The Dip Transfer Process

- Two material routes are possible
  - A gel flux (tacky flux) system
  - A low viscosity solder paste system

- In Both cases the material must provide
  1. Consistent transfer volume in the dip process
  2. Enough tack/shear resistance to hold the component in place
  3. Adequate soldering capability to ensure defect free connection from the upper to the lower package
  4. Stable rheology over time
Characterising Rheology For The Dip Transfer Process

**Material A** : Poor printing (insufficient shear thinning) *and* inconsistent dip transfer consistency (too high starting viscosity/tack)

**Material B** : Printing OK (sufficient shear thinning *but* inconsistent dip transfer consistency (of too high starting viscosity/tack)

**Material C** : Good printing (lower viscosity/tack) and dip transfer consistency (lower viscosity/tack) – *Preferred Rheological Profile*
Characterising Dip Transfer Weight

BGA256; 400 µm ball dipped into a 200 µm fixed thickness of flux material for 0.5 seconds

Weighed on a high accuracy scale measuring to 0.0001g

Results show that high tack, high viscosity materials give highly variable results (Material A).

High Viscosity, High Tack Material

Lower Viscosity More Newtonian Material
Key Solder Paste Variables

Metal Loading (% by Weight)

Solder Powder Particle Size Distribution
Metal Loading Optimization

Type 6 Powder, 200µ Dip Depth

Paste Pick Up (mg) vs Metal Loading

<table>
<thead>
<tr>
<th>Metal Loading</th>
<th>Paste Pick Up (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>5.5</td>
</tr>
<tr>
<td>78%</td>
<td>6.8</td>
</tr>
<tr>
<td>81%</td>
<td>6.4</td>
</tr>
<tr>
<td>84%</td>
<td>6.2</td>
</tr>
</tbody>
</table>
## Particle Size Distribution

<table>
<thead>
<tr>
<th>Type</th>
<th>None larger than ($\mu$m):</th>
<th>Maximum 1% particles by weight larger than ($\mu$m):</th>
<th>Minimum 80% particles by weight between ($\mu$m):</th>
<th>Maximum 10% particles by weight smaller than ($\mu$m):</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>80</td>
<td>75</td>
<td>75-45</td>
<td>20</td>
</tr>
<tr>
<td>T3</td>
<td>50</td>
<td>45</td>
<td>45-25</td>
<td>20</td>
</tr>
<tr>
<td>T4</td>
<td>40</td>
<td>38</td>
<td>38-20 (90%)</td>
<td>20</td>
</tr>
<tr>
<td>T5</td>
<td>30</td>
<td>25</td>
<td>25-15 (90%)</td>
<td>15</td>
</tr>
<tr>
<td>T6</td>
<td>20</td>
<td>15</td>
<td>15-5 (90%)</td>
<td>5</td>
</tr>
</tbody>
</table>
Particle Size Distribution

78% Metal Loading, 200µ Dip Depth
PoP33 Reflow Yield vs. Powder Size

Type 5 Powder

Type 6 Powder
Dip Transfer Process Variables

1. Immersion Depth
   - How deep should the ball go into the medium

2. Immersion Time
   - How quickly can wetting of the ball occur

3. Exit Velocity
   - How quickly can the device pull out from the medium whilst maintaining acceptable transfer consistency
Dip Transfer Process Variables

1. Immersion Depth

- Flux/Paste deposit thickness determines immersion depth in dipping unit
  - Deposition uniformity is therefore critical
- It is important to ensure that (i) enough medium is transferred but (ii) there is no medium transferred to the package body.
Dip Transfer Process Variables

1. Immersion Depth

- This trial with a PoP solder paste showed that at a dip depth of 25% ball height, had only 35% of the transfer weight compared to a 50% ball height dip depth.
Immersion Depth as a % of Ball Height

0.34mm Offset Height

- 65% Immersion Depth
- 59%
- 53%
- 47%
- 41%
- 35%
- 29%
Effect of Excess Dip Depth

- This trial with a PoP solder paste showed that >60% ball coverage may lead to excessive solder balls.
Recommended Immersion Depth

30-50% recommended by major equipment manufacturer as well
Dip Transfer Process Variables

2. Immersion Time

- Hold time needs to be long enough to enable the material to wet the ball surface, which aids transfer weight consistency.

In this study it was shown that 100 milliseconds was sufficient. Longer times had no significant effect.

![Hold time evaluation diagram](image)
Dip Transfer Process Variables

3. Exit Velocity

- This is dependant on the material type
  - Modern flux/paste systems are more suited to fast shear rates

In this study it was shown that velocity had no significant effect
PoP Paste or Flux?

- Paste compensates for pre-reflow warp
- Paste is easier to inspect for absence/presence after the dip process
- Reflowed paste has less residue

- Flux eliminates the risk of current leakage from poor powder coalescence (solder balls)
- Flux is less sensitive to reflow profile
- Flux is less sensitive to shelf life
• Know Your Baseline – Acoms Razor
  – How do you know only one thing has changed?
  – Track Global Variables

• Meaningful Material Specifications
  – Tolerance Specifications – Review them periodically to make sure they make sense and hold vendor to them
  – Design Guidelines – Keep Revs
  – Capable Inspection Method

• In Line, Real Time, 3D AOI
Process Flexibility

COST to CHANGE
Lower

Higher

Quick

Longer

REACTION TIME

IMPORTANCE OF STENCIL

PRIVILEGED AND CONFIDENTIAL MATERIALS