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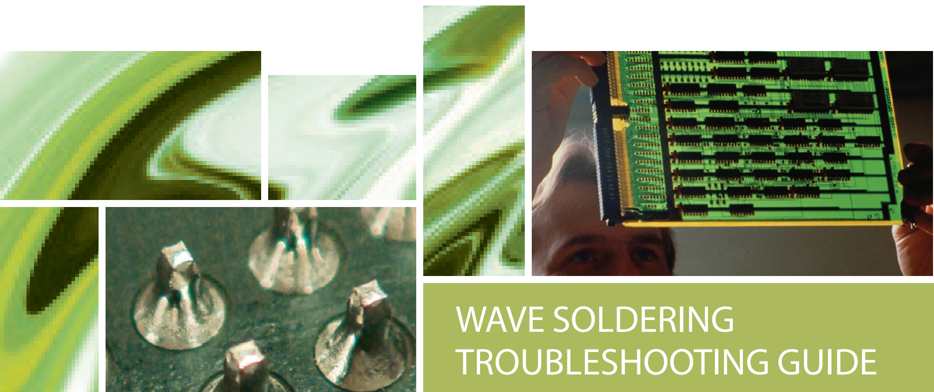

WAVE SOLDERING TROUBLESHOOTING GUIDE

Easy-to-use advice for common wave soldering assembly issues.

MacDermid Alpha
ELECTRONICS SOLUTIONS

Alpha Assembly Solutions
Wave Soldering Troubleshooting Guide

With this easy-to-use Troubleshooting Guide, you can learn to troubleshoot common wave soldering issues. After using it a few times, it will become an essential companion for you and anyone in your company responsible for operating a wave soldering line.

This Guide offers troubleshooting advice for common wave soldering assembly issues by process defect. If your issue is not resolved after following the steps to help identify the possible root cause and solution, please contact your Alpha representative who will be able to provide you with further assistance.

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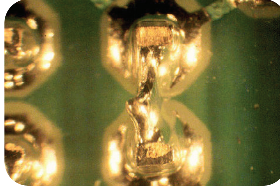
Bridging

Definition: The unwanted formation of a conductive path of solder between conductors.



Primary process set-up areas to check

- Conveyor speed too slow
- Time over preheat is too long causing the flux to be burned off
- Dwell time too long causing the flux to burn off before exiting the wave
- Topside board temp too low
- Not enough flux applied or the flux activity is too low

Other things to look for in the Process

- Solder temp too low
- Solder wave height high
- Solder wave uneven
- Solder contaminated
- Flux not making contact
- Pre-heat too high and flux is exhausted
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux applied unevenly
- Excess flux blow-off
- Board not seated properly
- Board pallet too hot

Other things to look for with the Assembly

- Board contamination
- Component contamination
- Component lead length too long
- Improper board handling

Other things to look for with the PC FAB

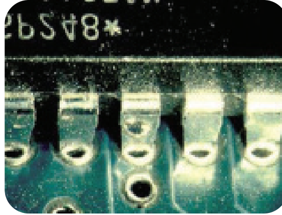
- Board oxidized
- Defective mask material
- Board contaminated

Other things to look for with the Board Design

- Poor pallet design
- Lead-to-hole ratio too large
- Internal ground plane
- Weight distribution
- Component orientation

Insufficient Solder Topside Fillet

Definition: Where the joint has not formed a good topside fillet
IPC acceptable: A total maximum of 25% depression, including both the primary solder destination and the secondary solder source sides, is permitted.



Primary process set-up areas to check

- Conveyor Speed too slow
  – Time over preheat too long, causing the flux to be burned off
  – Dwell time too long, causing flux to be destroyed before exiting the wave
- Conveyor Speed too fast
  – Dwell time too short / topside board temp too low
- Topside board temp too high for flux, causing it to burn off before the wave
- Not enough flux or the flux is not active enough
- Solder temp too low, it cools in the barrel before it reaches the top side
- Wave height too low in one or both waves, so the solder does not contact the board properly
- Inadequate level of anti-oxidant in lead free alloy

Other things to look for in the Process

- Solder temp too high
- Solder temp too low
- Board not seated properly
- Solder wave height low
- Solder wave uneven
- Solder contaminated
- Pre-heat too high
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux SP GR too high
- Flux not making contact
- Excess flux blow-off
- Insufficient flux blow-off
- Board pallet too hot
- Conveyor speed high
- Flux applied unevenly

Other things to look for with the Assembly

- Board oxidized
- Board contaminated
- Hole and pad mis-registered
- Mask in hole
- Moisture in the laminate
- Mis-registration of the mask
- Board warped
- Poor plating in the hole
- Component contamination

Things to look for with the Board Design

- Poor pallet design
- Large ground plane on component site
- Internal ground plane
- Lead-to-hole ratio too large or too small
- Pad size mismatched
- Large ground plane on solder side

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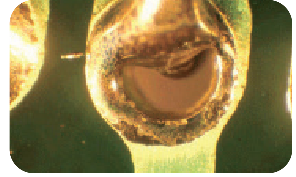
Insufficient Solder Bottom Side Fillet



Definition: Where the joint has not formed a good bottom side fillet
IPC acceptable: 100% solder fillet and circumferential wetting present on secondary (solder source) side of the solder joint. Minimal acceptable is to have 330° circumferential fillet and wetting present for class 3 boards, 270° for class 1 and 2 boards.

Primary process set-up areas to check
- Conveyor Speed too slow
- Time over preheat too long causing the flux to be burned off
- Dwell time too long causing flux to be destroyed before exiting the wave
- Bottom side board temp too high causing flux to be burned off before the wave
- Not enough flux or flux activity
- Wave height too low on one or both waves

Other things to look for in the Process

- Solder temp too low
- Board not seated properly
- Solder wave height low
- Solder wave uneven
- Solder contaminated
- Pre-heat too high
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux SP GR too high
- Excess flux blow-off
- Insufficient flux blow-off
- Flux not making contact
- Conveyor speed high
- Flux applied unevenly

Other things to look for with the Assembly

- Board contamination
- Component leads too short
- Improper board handling
- Component contamination

Other things to look for with the PC FAB

- Board oxidized
- Board contaminated
- Mis-registration of the mask
- Mask in hole
- Poor plating in the hole
- Hole and pad mis-registered
- Board warped
- Component contamination

Other things to look for with the Board Design

- Poor pallet design
- Large ground plane on component side
- Large ground plane on solder side
- Internal ground plane
- Lead-to-hole ratio too large
- Pad size mismatched
- Weight distribution

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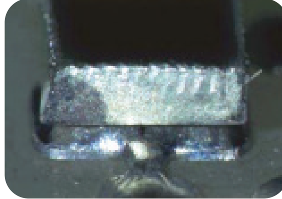
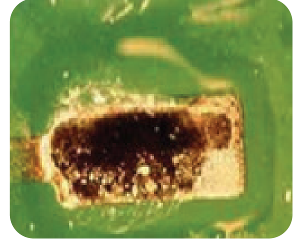
De-wetting or Non-wetting

Definitions:
De-wetting is a condition that results when molten solder coats a surface and then recedes to leave an irregularly shaped mound(s) of solder that is separated by areas that are re-covered with a thin film of solder and with the basis metal not exposed.
Non-wetting is a condition where there is partial adherence of molten solder to a surface that it has contacted, and the basis metal remains exposed.





Primary process set-up areas to check

- Usually board-related due to contamination on the surface of the pad

Other things to look for in the Process

- Pre-heat too high
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux SP GR too high
- Excess flux blow-off
- Insufficient flux blow-off
- Board pallet too hot
- Conveyor speed high or low
- Solder contaminated
- Solder wave height low
- Flux not making contact
- Flux applied unevenly
- Board not seated properly

Other things to look for with the Assembly

- Board contamination
- Insufficient tin plating in immersion tin surface finish
- Improper board handling
- Component contamination

Things to look for with the Board Design

- Board oxidized
- Board contaminated

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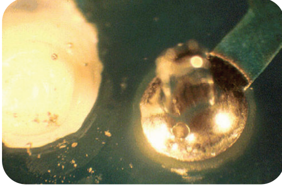
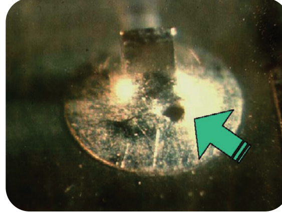
Solder Voids or Outgassing (Blow Holes and Pin Holes)

Definition: Where the solder joint has a small, visible hole that penetrates from the surface of a solder connection between the conductive patterns on internal layers, external layers or both of a board. This is typically due to moisture entrapment that, during the soldering process, outgassed from the joint.





Primary process set-up areas to check

- Topside or overall board temperature too low entrapping moisture that is outgassed at the wave
- Entrapped fluid by component in through hole
- Chemical contaminants not removed during PC fab process
- Contamination in the hole
- Topside of the hole covered by component body or flashing

Other things to look for in the Process

- Solder temp too high
- Solder temp too low
- Flux applied unevenly
- Solder wave height low
- Solder wave uneven
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux SP GR too high
- Flux not making contact
- Insufficient flux blow-off
- Board pallet too hot
- Conveyor speed high
- Conveyor speed low
- Board not seated properly

Other things to look for with the Assembly

- Board contamination
- Component contamination
- Improper board handling

Things to look for with the PC FAB

- Board oxidized
- Board contaminated
- Mask in hole
- Defective mask material
- Moisture in the laminate
- Hole and pad mis-registered
- Board warped
- Poor plating in the hole
- Mis-registration of the mask

Things to look for with the Board Design

- Lead-to-hole ratio too large
- Lead-to-hole ratio too small
- Internal ground plane
- Component orientation

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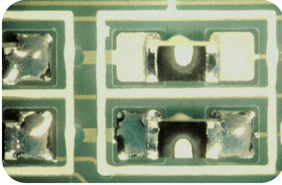
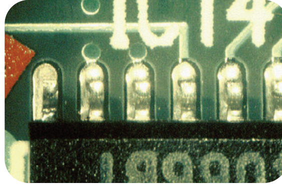
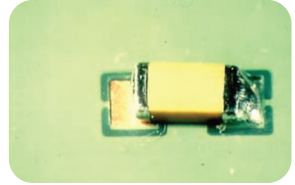
Solder Skips

Definition: Where the component in the board has not been soldered during the soldering process







Primary process set-up areas to check

- Conveyor speed too fast, so the dwell was too short in the wave
- Make sure the chip or turbulent wave is turned on
- Not enough flux
- Wave height too low on one or both waves

Other things to look for in the Process

- Solder wave uneven
- Flux SP GR too high
- Flux not making contact
- Check for bent conveyor fingers
- Pre-heat too high
- Flux applied unevenly
- Contaminated flux
- Conveyor speed high
- Board not seated properly
- Insufficient flux blow-off
- Board pallet too hot

Other things to look for with the Assembly

- Board contamination
- Component contamination
- Improper board handling

Things to look for with the PC FAB

- Board oxidized
- Board contaminated
- Mis-registration of the mask
- Defective mask material
- Mask in hole
- Hole and pad mis-registered
- Board warped
- Component contamination

Things to look for with the Board Design

- Poor pallet design
- Pad size mismatched
- Internal ground plane
- Component shadowing
- Component orientation
- Weight distribution

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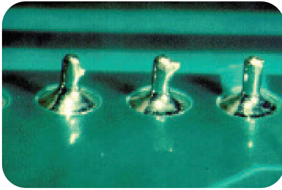
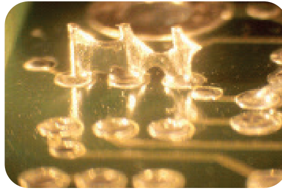
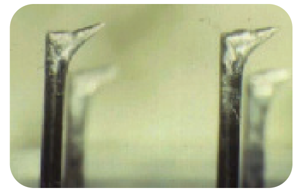
Icicles and Flags (Horns)

Definition: An undesirable protrusion of solder from a solidified solder joint or coating

Primary process set-up areas to check

- Conveyor speed too slow
- Time over preheat too long, causing the flux to burn off
- Dwell time too long, causing the flux to be destroyed before exiting the wave
- Solder temp too low
- Not enough flux
- The use of nitrogen will help prevent icicles

Other things to look for in the Process

- Solder wave height low
- Solder wave uneven
- Solder contaminated
- Flux not making contact
- Board not seated properly
- Pre-heat too high
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Flux applied unevenly
- Excess flux blow-off
- Insufficient flux blow-off
- Board pallet to hot
- Conveyor speed high
- Conveyor vibration

Other things to look for with the Assembly

- Board contamination
- Component lead length too long
- Component contamination

Things to look for with the PC FAB

- Board oxidized
- Board contaminated

Things to look for with the board design

- Poor pallet design
- Internal ground plane
- Large ground plane on solder side

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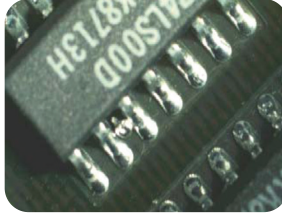
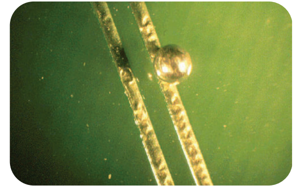
Solder Balls and Spatter

Definition: A small sphere of solder adhering to a laminate, resist, or conductor surface – generally occurring after wave or reflow soldering.

Types:		
	Random	spattering type
	Non-random	found behind the protruding leads
	Splash-back	solder balls from fully inerted and tunnel machines





Random

- Easiest to address due to their being process related
- If you hear a "sizzle" while the board is going over the wave, the preheat is too low or the vehicle is not fully evaporated
- Solder wave uneven: clean the solder nozzle assembly and check for parallelism
- Flux contamination: if contaminated it needs to be replaced
- Check pallet design: look for them to have vents to allow for outgassing

Non-random

- Found on the bottom side of the board, over many boards, usually to the trailing side of the protruding lead.
- Not enough flux applied or burned off too soon in the wave
- Conveyor speed too high

Splash-back

- Wave height set too high or hot, air knife is set incorrectly
- Excess turbulence in the wave
- Increased surface tension due to nitrogen

Solder Balls and Spatter (continued)

Primary process set-up areas to check

- Conveyor Speed too slow
  – Too much time over the pre-heater, causing the flux to burn off too fast
  – Dwell time too long, causing the flux to be destroyed before exiting
- Topside board temp too low
- Conveyor speed too fast
  – Time over the preheat is not long enough to dry off the flux carrier
  – Not enough flux or the flux is not active enough
- The use of nitrogen may INCREASE the occurrence of solder-balls
- Flux carrier not being completely dried off by the pre-heater
- Water-based fluxes should use forced air convection pre-heat
- Too much flux has been applied

Other things to look for in the Process

- Solder temp too high
- Solder wave height high
- Solder wave uneven
- Pre-heat too low
- Contaminated flux
- Flux SP GR too low
- Insufficient flux blow-off
- Conveyor speed high
- Defective fixture

Other things to look for with the Assembly

- Board contamination

Things to look for with the PC FAB

- Board contaminated
- Defective mask material
- Moisture in laminate
- Poor plating in the hole
- Laminate not fully cured
- Gloss mask has a higher tendency vs. matt finish

Things to look for with the Board Design

- Poor pallet design

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Solder on Mask

Definition: Solder on the mask can occur on solder resist, board surfaces, pallet surfaces and conveyor fingers.

Primary process set-up areas to check

- Poor flux application
- Flux and resist incompatibility
- Poor cure of the solder mask
- Preheat temperature too high
- Solder temperature too high.

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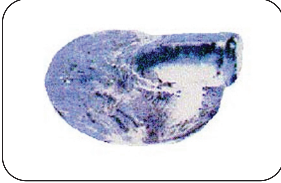
Rough or Disturbed Solder

Definition: A solder fillet that solidified while one or both metals to be joined were vibrating. The result is a weak, non-uniform metallic structure, with many micro-cracks.



Primary process set-up areas to check
- Check conveyor for vibration or "jerky motion"
- Removal of the board prior to the solder solidifying

Other things to look for in the Process

- Solder temp too low
- Solder contaminated
- Flux applied unevenly
- Conveyor speed high
- Solder wave uneven
- Board not seated right
- Solder wave height low
- Early removal of board
- Excessive solder dross

Things to look for with the Board Design

- Poor pallet design

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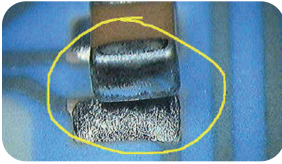
Grainy or Dull Solder

Definition: A rough solder surface with small, gritty projections protruding through the top, or a non-shiny surface that shows no signs of chemical attack.



Primary process set-up areas to check

- Impurities in the solder
- Inter-metallic compounds
- Dross mixed into the solder
- Insufficient heat

Other things to look for in the Process

- Solder temp too low
- Pre-heat too low
- Early removal of board
- Conveyor vibration
- Conveyor speed high
- Excessive solder dross

Other things to look for with the Assembly

- Board contamination
- Component contamination
- Improper board handling
- Component leads too short

Things to look for with the PC FAB

- Board contamination

Things to look for with the Board Design

- Board contamination

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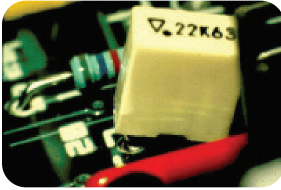
Components Lifted

Definition: The lifting of components during wave soldering.



Primary process set-up areas to check

- Conveyor speed too fast
- Slowing down the conveyor will increase the immersion time in the wave and overcome thermal mismatch or demand
- Incorrect lead length: short leads may shift and can pop out of the hole
- Check for board flex or that the board may be warped

Other things to look for in the Process

- Solder wave height high
- Solder wave uneven
- Excess flux blow-off
- Conveyor vibration
- Conveyor angle high
- Early removal of board
- Board not seated right
- Defective fixture

Other things to look for with the Assembly

- Improper board handling
- Component lead length too long

Things to look for with the Board Design

- Poor pallet design

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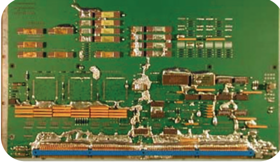
Flooding

Definition: Solder "flow over," thus causing the solder to flood onto the component.



Primary process set-up areas to check
- Board may be warped: need center support in the wave
- Wave height too high
- Conveyor too tight or too loose

Other things to look for in the Process

- Pre-heat too high
- Board rerun
- Defective fixture
- Board not seated properly
- Solder wave height high
- Solder wave uneven
- Pre-heat too low
- Conveyor speed high
- Conveyor speed low

Things to look for with the PC FAB

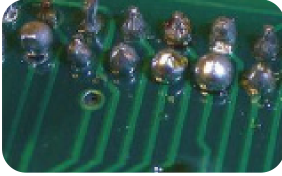
- Board warped

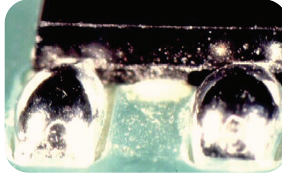
Things to look for with the Board Design

- Poor pallet design
- Board size
- Weight distribution

Excessive Solder

Definition: Occurs when a printed circuit board passing through a soldering process takes with it excessive solder.





Primary process set-up areas to check

- Conveyor speed too fast
- Dwell time too short
- Not enough flux or flux is not active enough
- Solder temperature too low

Other things to look for in the Process

- Flux foam head too low
- Flux not making contact
- Flux applied unevenly
- Excess flux blow-off
- Board pallet too hot
- Defective fixture
- Solder wave height high
- Solder contaminated

Other things to look for with the Assembly

- Component lead length too long

Things to look for with the PC FAB

- Defective mask material

Things to look for with the board design

- Component / board solderability
- Poor pallet design
- Lead length to pad ratio incorrect
- Component layout or orientation

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Notes

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