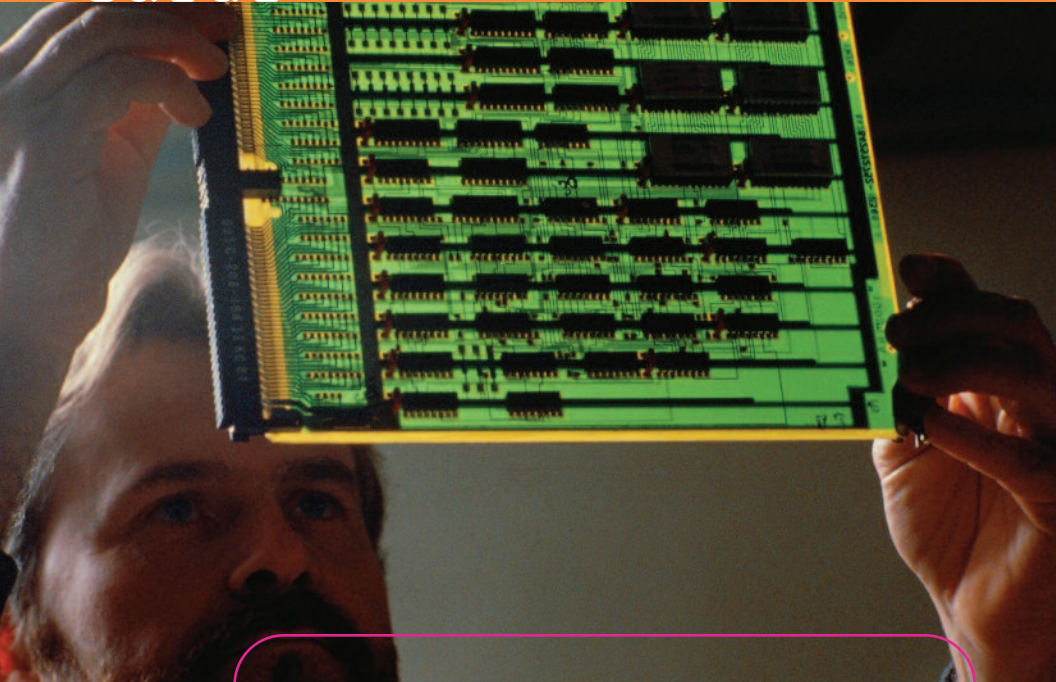


# Wave Soldering Troubleshooting Guide



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



Cookson Electronics



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

This Guide offers troubleshooting advice for common SMT 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 Cookson Electronics representative who will be able to provide you with further assistance.

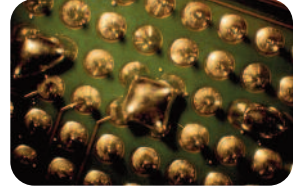


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**Definition:** The unwanted formation of a conductive path of solder between conductors.



## Primary process set-up areas to check

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

## Other things to look for with the Assembly

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

## Other things to look for with the PC FAB

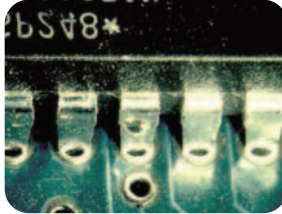
- Board oxidized
- Defective mask material
- Board contaminated

## 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

**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

## 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

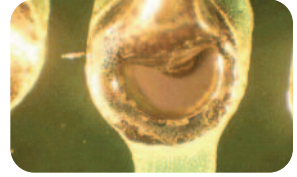
## Things to look for with the board design

- 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



**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

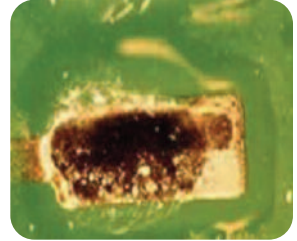
- Board oxidized
- Board contaminated
- Mis-registration of the mask
- Mask in hole
- Poor plating in the hole
- Hole and pad mis-registered
- Board warped
- Component contamination

## 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

## 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

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

### Other things to look for with the assembly

- Board contamination
- Improper board handling
- Component contamination

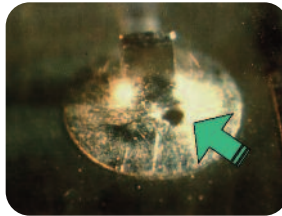
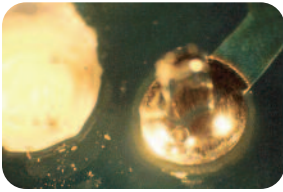
### Things to look for with the board design

- Board oxidized
- Board contaminated

# Solder Voids or Out-gassing (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, out-gassed from the joint.



## Primary process set-up areas to check

- Topside or overall board temperature too low entrapping moisture that is out-gassed 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   | • Pre-heat too low        | • Insufficient flux blow-off |
| • Solder temp too low    | • Contaminated flux       | • Board pallet too hot       |
| • Flux applied unevenly  | • Flux SP GR too low      | • Conveyor speed high        |
| • Solder wave height low | • Flux SP GR too high     | • Conveyor speed low         |
| • Solder wave uneven     | • Flux not making contact | • Board not seated properly  |

## Other things to look for with the assembly

- |                       |                           |                           |
|-----------------------|---------------------------|---------------------------|
| • Board contamination | • Component contamination | • Improper board handling |
|-----------------------|---------------------------|---------------------------|

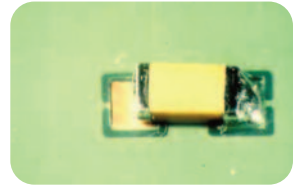
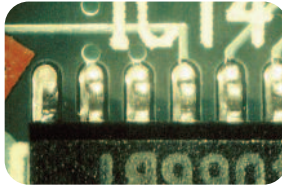
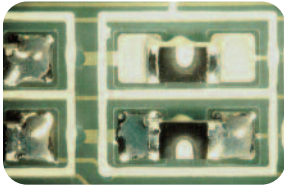
## Things to look for with the PC FAB

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

## Things to look for with the board design

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

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

## Other things to look for with the assembly

- Board contamination
- Component contamination
- Improper board handling

## Things to look for with the PC FAB

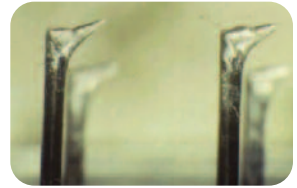
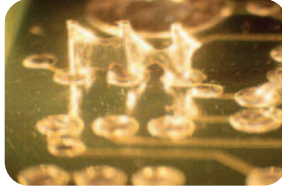
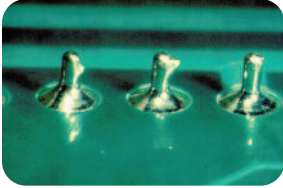
- Board oxidized
- Board contaminated
- Mis-registration of the mask
- Defective mask material
- Mask in hole
- Hole and pad mis-registered
- Board warped
- Component contamination

## Things to look for with the board design

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



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

## 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

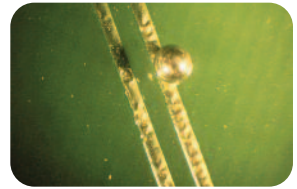
- Board oxidized
- Board contaminated

## Things to look for with the board design

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

**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 out-gassing

## *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



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

## Other things to look for with the assembly

- Board contamination

## Things to look for with the PC FAB

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

## Things to look for with the board design

- Poor pallet design

**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.

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

### Things to look for with the board design

- Poor pallet design

**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
- Solder contaminated
- Conveyor speed high
- Excessive solder dross
- Conveyor vibration

## 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

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

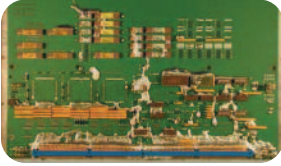
### Other things to look for with the assembly

- Improper board handling
- Component lead length too long

### Things to look for with the board design

- Poor pallet design

**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

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

### Things to look for with the PC FAB

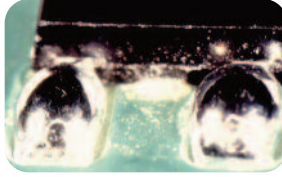
- Board warped

### Things to look for with the board design

- Poor pallet design
- Board size
- Weight distribution



**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

- Solder temp too low
- Flux foamhead too low
- Excess flux blow-off
- Solder wave height high
- Flux not making contact
- Board pallet too hot
- Solder contaminated
- Flux applied unevenly
- Conveyor speed high
- Defective fixture

## 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
- Lead length to pad ratio incorrect
- Component layout or orientation
- Poor pallet design



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