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# FEATURE ARTICLE

## Is dust ruining your performance?

## by Sheila Hamilton, Technical Director, Teknek

How can PCB manufacturers squeeze more production out of already stretched production lines? Try looking at your failure and rework rates. Are you experiencing high levels of wastage and spoiled boards?

The problem may be levels of contamination in your production environment. As track and gap widths have become smaller and the number of layers increase, the greater potential there is for contaminants to adversely effect your production line. A single speck of dust or a fibre can halt production costing significant sums in lost product and manufacturing downtime.

## Clean Room

PCBs are rarely assembled in a clean room environment (with the possible exception of fineline circuitry). This means that there is ample opportunity for contaminants to enter the production environment from a variety of sources. Research has shown that 80% of contaminants are introduced into a "clean area" by people and products, 15% is generated by the products themselves and 5% is actually produced by the room and filtration system.

In addition, the move towards greener materials has contributed to the contamination problem. Melting points and solder flow characteristics have changed with the result that materials are stickier. This makes the solder paste process more vulnerable to sources of contamination. Moreover, copper has a propensity to dissolve into tin rich lead-free solder alloy which can happen during dipping, wave soldering and rework processes. As PCB assemblers strive for zero tolerance on rework, getting it right first time has become imperative.

## Contamination Sources

The first step in eliminating contamination is to identify the sources. Typical sources of particles include:

- Hair – the average hair loss for a person is 50 per day.
- Lint – cloths are typically used in production environments for wiping purposes. Although deemed to be "lint free" they can snag when wiped across pad areas or stencils generating loose fibres. This can be avoided by using higher quality clean room cloths.
- Clothing fibres – fibres from garments can contaminate the production process.
- Dust –dust is mostly composed of human skin flakes. On average a person breathes 700,000 skin flakes per day and sheds one layer of skin every 24-hours.

- Production plant – the ceilings, floors, shelving and packaging materials are all sources of particles.
- Epoxy dust – during the bare board manufacturing process contamination removal systems are used at every step in the process. However, after routing only the top surface can be cleaned. This means the edges will still have loose dust attached. This dust is disturbed during packing and transport and can be a potential contaminant.
- Glass splinters – PCBs are made from a fibrous substrate posing the risk of loose glass splinters from snap outs or routing.
- Solder paste – misprinted boards are frequently wiped "clean" and sent down the line again – loose solder paste left on the board can cause problems.
- Solder resist – can flake away leading to contamination.
- Packing materials – boards which come individually wrapped in paper can produce paper snaps which attach themselves to the boards by static.

All the above contaminants can be attached to the PCB by static. Boards are insulators so will hold a static charge. Static is generated during handling and removal of the boards from packaging. Removal of static should therefore be part of your overall contamination elimination strategy.

**Contamination Defects**

Failure to address contamination issues within the production environment can cause a number of serious problems including:

- Stencil Holes can become blocked by contamination so that the print is incomplete.
- During reflow contamination in the solder paste can volatilize causing a crater in the solder.
- Tombstoning can occur where the chip component stands on end with one end soldered to the board and the other end free.

- Pieces of fibre from cloths used to clean stencils can become trapped between pads which could lead to short-circuiting.
- Poor solder wetting
- Unreliable solder joints.

**Contact Cleaning**

The best way of avoiding contamination issues is to ensure that PCBs are thoroughly pre-cleaned before entering the production process. This can be achieved by using specialist contact cleaning equipment. This equipment uses a series of special elastomer rollers which make contact with the substrate. The rollers pick up loose particles down to one micron in size. The particles are then transferred to a pre-sheeted adhesive roll for examination and disposal. Such equipment should also normally incorporate anti-static facilities to prevent re-contamination of the boards before they enter the next stage of the production process. Contact cleaning equipment needs to be chosen with care. Inferior quality rollers will fail to remove all particulates leading to more defective boards, decreased yields and increased downtime. Using effective contact cleaning equipment has been shown to improve yields by in excess of 90% and reduce rejection rates by over 50%.

PCBs which are pre-cleaned and have undergone anti-static procedures provide a cleaner surface for printing, improve solder joint integrity and offer better stencil to board gasketing. The net result is that it can help reduce rework on boards and in the worst case scenario, avoid having to scrap boards altogether.

In summary as the electronics industry strives for zero defects and form factors become ever smaller it is vital that manufacturers put in place powerful anti-contamination strategies to eliminate the impact of contamination and improve yields.

**About the author:**

Sheila Hamilton is technical director of Teknek, the global leader in contact cleaning technology for the electronics and manufacturing sectors with an installed base of 15,000 clean machines world-wide. Sheila joined Teknek in 1987 as technical director after working as a product designer (yachting equipment) and power station engineer. She has also run her own consultancy in the field of electronics component packaging. Sheila has a BSc. in Mechanical Engineering from Glasgow University and is currently studying for an MBA at Strathclyde University. In addition, she is a recipient of two Smart Awards in the field of Electromagnetic Interference.

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