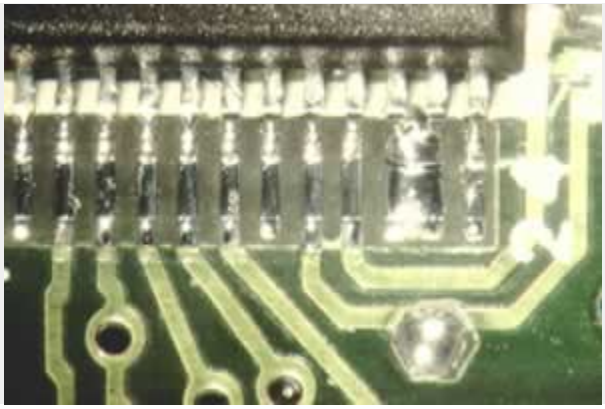
Solder Related Failure Causes

As well as the failures that will eventually occur in properly-made solder joints during their lifetime, there are many kinds of solder defects which will impact on quality if they are not detected during manufacture either visually or by electrical test. In the text that follows, we have split the failures into groups, according to how immediate a problem they present.

Visible defects

The first group contains a number of short-circuit and open-circuit conditions which are generally easily detected. This category includes solder shorts, which are common on wave solder parts, and with fine pitch surface mount devices. Solder wicking is generally easily seen, in that the solder sucked away from a joint by a hotter surface will generally have a bulbous appearance, but the real reliability hazard is that solder wicking may conceal a joint which has not been properly made– solder has wetted only where it could and failed to make the desired joint.

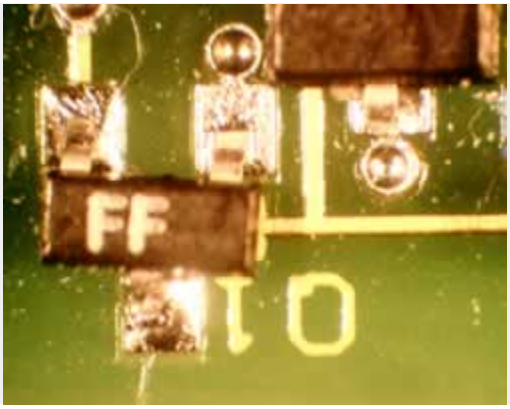
Solder short



Solder wicking

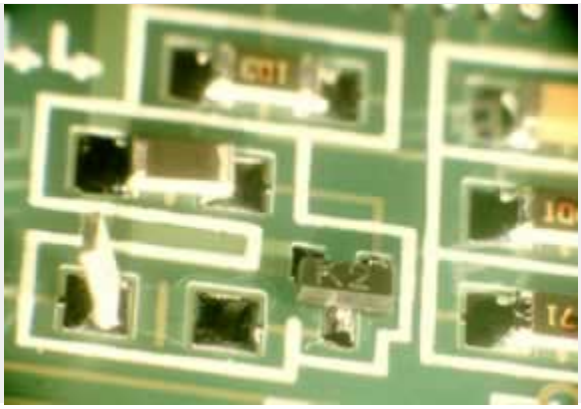
Similar to solder wicking is solder drainage, where solder intended to form a joint has been moved by capillary action into an unwanted crevice, often a via. Fortunately, most designers now know not to have vias close to pads without intervening solder resist.

Solder drainage



The last in this group of definite problems are the varieties of open-circuit chip component where unbalanced forces during soldering have produced component lifting. Called either tombstoning or drawbridging, according to the degree of elevation, these defects will be picked up by in-circuit test, but the loss of a single capacitor is not necessarily detrimental to normal circuit function, so may not be picked up if only a functional test is used. Also, whilst tombstoning is easy to spot, drawbridging is less so, particularly with automated vision systems that look only from the top.

Tombstoning

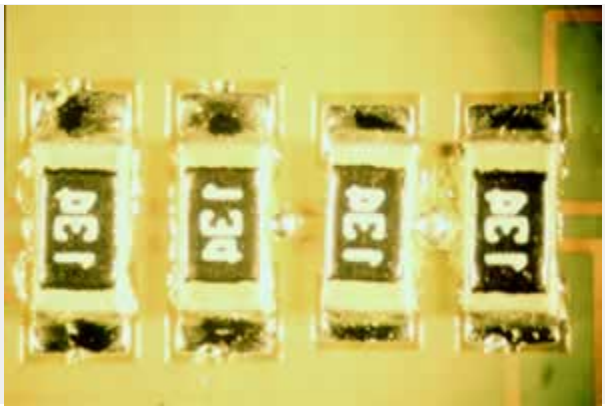


Drawbridging

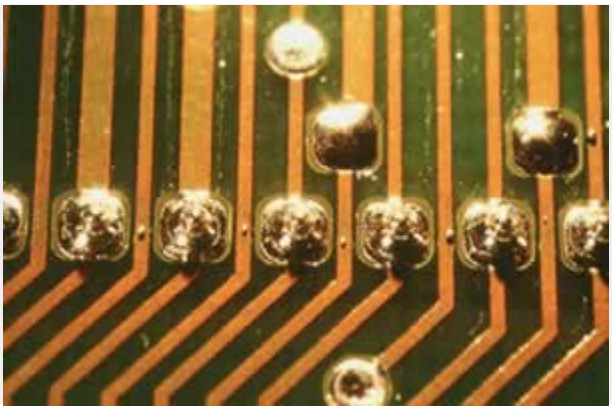
Potential problems

Other solder defects are more potential causes for problems than they are a cause of immediate rejection. However, they are normally picked up during visual inspection, and reworked. In this category fall solder beading and solder balling. Although often confused, the mechanisms by which these are produced are totally different: solder beading is a design fault, where excess solder paste is melted and squeezed out from underneath the capacitor; solder balling is more generally a process fault with a variety of causes, which may be related to the solder mask material. Whilst solder beading is always associated closely with components, solder balling may occur almost anywhere on the circuit.

Solder beading

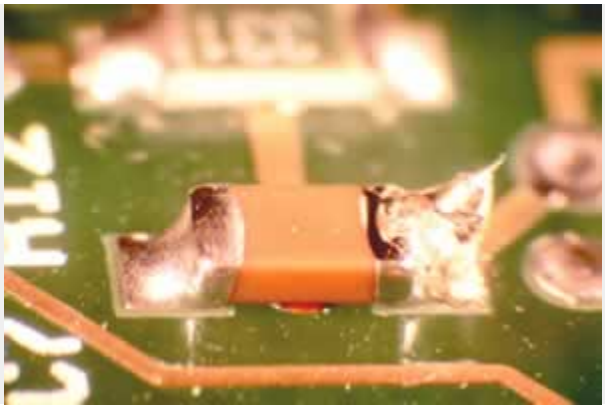


Solder balling



An unrelated excess solder condition is the ‘solder spike’. Often caused by poor rework of surface mount devices, but also common with wave soldering, solder spikes can reduce clearances to below safe levels – where clearances are small, sharp, spiky lumps of conductor are undesirable.

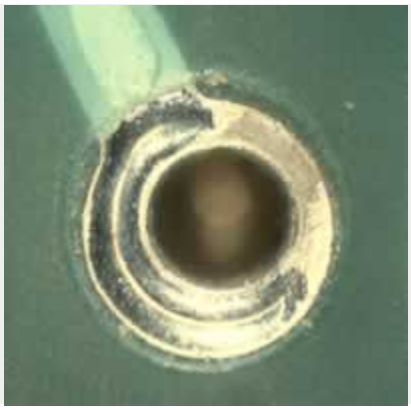
Solder spikes



Evidence of problems

Even less visible is the kind of evidence that things are not as they should be from the point of view of solder wetting to pads and leads. Poor wetting to pads and to components may result in unsoldered areas, or result in the displacement of solder to areas close to the joint with the potential to cause short circuits. Related to solderability is de-wetting, where a solder joint has been made and then destroyed by inappropriate soldering conditions. These problems may cause failures, but probably only if short-circuits are created or the volume of solder drastically reduced.

Poor tin/lead pad wetting



Poor solderability

Dewetting of tin/lead pads

Source : http://www.ami.ac.uk/courses/topics/0161_osfc/index.html