

Graping – What, Why and How to Eliminate?

The phenomenon where small/fine pitch pad deposits (0402, 0201, 01005 etc) appear to not reflow has been recently termed “Graping”, due to the reflowed solder deposits likeness to a bunch of grapes. Graping is often confused with a cold solder joint. If it is certain that plenty of heat is reaching the solder deposits in question, then cold solder joints should be ruled out.



Fig 1)



Fig 2)



Fig 3)

Root cause of Graping: What is happening is that the external layer of solder balls in the paste deposit are heavily oxidizing. This oxide layer causes the solder (even when molten) to keep their spherical shape due to a change in the surface tension of the solder oxide. Therefore the solder is actually melting and becoming liquid, however the external surface keeps the spherical shape. The solder in the middle of the deposit is melting, coalescing together and wetting, however the external shell is maintaining the semi-spherical shapes causing the appearance of a cold solder joint.

Why are the oxides being allowed to form heavily on the outside layer of solder particles?

This comes down to the amount of activity within the flux, and the amount of surface area per volume of the deposit. The length and temperature of the profile is also very critical as oxides form exponentially at increased temperatures and have more time to form in longer profiles.

The amount of activity in the flux is set at the formulation level. The ratio of surface area per volume of deposit however continually increases as the paste deposit size gets smaller. The greater the surface area, the more oxides that can form on a proportional basis. And the smaller the deposit, the less flux there is to remove these oxides, especially when you consider that some proportion of the flux “spills” out of the paste and onto the solder mask. In addition, long hot profiles allow increased amounts of oxides to form on the exterior layer of powder in the paste deposit. When all these factors are combined you reach a point where the flux no longer has sufficient activity to remove and keep removed the oxides on the paste powder particles. As the outside layer of the paste is the most exposed to air, this layer is the first to become depleted of activity and covered in oxides.

How to minimize Graping: So in the end, the best way to stop the graping is to reduce the amount of oxides being formed prior to reflow of the solder deposits. I.e. reduce the amount of temperature or time during the soak zone of the reflow profile. To accomplish this you can shorten the profile and/or reduce the temperatures.

An interesting side note is with the picture in Figure 3 above. In this picture you can see that the solder has wet and flowed up onto the component, yet also exhibits the graping appearance as well. It appears that the external layer of the solder deposit graped causing the surface to maintain the semi-spherical shape of the powder particles, yet the solder still wet onto and up the component terminations pulling the graped surface layer up with it. The external “graped” skin of solder flowed up with the solder leaving the mottled, unreflowed, surface appearance.

Please call your Kester technical support expert at 1-800-2KESTER (1-800-253-7837) for more information.