Vitronics Soltec

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Drawbridging during reflow soldering in nitrogen

Introduction

Drawbridging or tombstoning of leadless components is an effect which mechanism is described in the book of R.J. Klein Wassink, Soldering in Electronics Second Edition, chapter 10.6.2.
It is the lifting of one electrode of a leadless component free of the substrate or even standing up of the component on one of its ends.

During tests one often finds that due to the use of nitrogen in the reflow process, the drawbridging effect suddenly shows up, while in an air atmosphere this effect is not present or far less.

Next we will explain why this can be the case and what can be done to avoid it.

Drawbridging

The drawbridging can only be active if the solderpaste on one of the component sides has no effect, while it has on the other side of the component.
The reasons that the solderpaste is only active on one side of the component can be the following:

- In some cases the contact between one end of the component and the solderpaste has been broken or decreased.
- During heating up, the solder on opposite sides of the component does not melt at precisely the same moment.

A different solderability of the solderpads or at both ends of the component, and hence an uneven wetting, can also be the cause.
The general cause for drawbridging is the difference in soldering conditions between both ends of the components.

The effect of nitrogen in the reflow process

A nitrogen atmosphere creates two effects with both improves the formation of solderjoints.
The common known effect is that it increases the surface tension of the solder, creating larger wetting forces.
The second effect of nitrogen is that it will prevent oxidation of the parts to be soldered and of the solderglobules in the solderpaste.

It is the latter that will speed up the wetting process. If in this situation there is a difference in wetting behaviour between the parts to be soldered, the part that wets first create a torque that can lift the component to drawbridging.

During soldering under air the oxides that are newly formed in the paste will retard the wetting process.
Due to this effect the coalescence of the solderpaste proceeds over a longer time. This will make the difference in melting of the solderpaste at both ends smaller and the forming of both fillets is more likely to overlap in time, than to follow one after another.

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This implies that a solderpaste with retarded melting and wetting will produce less drawbridging.

As a result of this combined wetting on both sides of the component the torque, which still may be larger at one end, is not strong enough to cause drawbridging, due to the torque that is present at the joint at the opposite site.

How drawbridging can be avoided

As a counter measure against drawbridging, the upward torque must be decreased and the downward torque increased.
Most effect can be arranged by optimising the joints design since the primary factors are the dimensions of the components and the solderlands.

Reducing the amount of solderpaste reduces the degree of drawbridging, because the acting angle of the surface tension is reduced due to a lower cantilever point.