

Vitronics Soltec

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Allowable concentration of contaminating elements in solder

Introduction

In the discussion about contaminating elements we have to separate the levels for new virgin solder that is delivered by the solder supplier and the solder that is in use in the solderpot.

Impurity levels

In this document we define "contaminating elements" as those elements that are not deliberately added to the solder but are remaining elements left after the refining process of the solder during production. These contaminating elements are also called impurities. Although the name suggests that they are harmful, in fact they are not unless the level of these elements becomes too high.

For new solder we have seen over the past decades that the level of elements that are not deliberately part of the alloy (impurities) is steady decreasing to very low values.

The point is that the solder manufacturers are now able to refine the solder to a higher purity and that is how the lower contamination figures for solder developed.

There was however not a direct technical need in view of effect on the solder process or joint reliability to reduce these numbers.

In fact there are two reasons for better refining. One is the point that new refining technologies make it possible to produce solder with lower impurity levels. Since this might be a commercial benefit these types of solder are promoted for the electronic industries.

The second reason is that in view of the new lead-free alloys "impurities" are sometimes deliberately added to give the solder alloy special properties. Since such alloy compositions are in most cases patented, the competition is forced to keep those elements at a very low percentage in order not to infringe the patent.

For these reasons we find in the IPC document J-std 006 for nickel for instance a percentage of only 0.01% as maximum impurity in new solder. But there are patented solders where this element is deliberately added, although only in a low percentage, but well above this 0.01%.

A few decades ago this element was allowed up to 0.08% in new solder. Even at that percentage the solderprocess could run without difficulties making perfect and reliable joints.

So far for new solder alloy compositions, but what about solder that is in use in the solderpot for wave soldering?

About the maximum contamination for the solder that is in use, most suppliers could not provide exact data. If data are provided then these are always on the safe side.

One reason for this is that the solder supplier will not be held responsible for any claim if solder is used with a higher contamination level then what they advise as maximum impurity.

The second reason is that they live by selling solder, so it is also partly their interest if the solder has to be exchanged.

Exchanging solder

During use each solder alloy will in due time get a new equilibrium as a result of dissolving elements that are introduced by the metals that are soldered. But at the same time the joints that are formed and the dross that is removed also take out this solder. On the other hand we have the addition with new solder to compensate the solder that is taken from the pot. In fact this newly added solder will partly "refresh" the solder in the pot.

In practical all cases this equilibrium of "contaminated" solder can perfectly be used without the need to exchange it. The joint formation and joint reliability will not be affected by some minor changes in the solder composition as a result of this "contamination".

An exception might be the copper content in a SAC-alloy. If here too much copper is added due to dissolved material from leads or the board, it might change the melting characteristics of the alloy. Too much copper in the solder might also give the formation of copper-tin crystals. These needle shaped crystals may increase the risk of solderbridging.

When starting with a new process it is normal that already in a few months time "virgin" solder will reach its contamination equilibrium in a solderpot. Normally there is nothing to worry about as this happens. It is simply part of the process of using solder for wave soldering.

The results of the solder process itself should be the decisive factor if one should worry about the solder composition. Normally only in cases of doubt about the quality of the solder alloy one should analyse the solder.

For more detailed information about the effect of different impurity elements in the solder see Soldering in Electronics SE, Chapter 4.4.

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