Vitronics Soltec

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Hairline bridging

Case

After wave soldering hairline bridges are found which may cause or are causing short circuits.

Explanation

In fact there can be two basic reasons for hairline bridges, which are quite different from each other.
There are hairline bridges which can be found on the solderside of the board after soldering, adhering to the solderresist. These bridges are caused by so called 'webbing'. (See Soldering in Electronics Second Edition by R.J. Klein Wassink, chapter 8.3.5.3, Fig. 8.55 and also chapter 12.3.2.6, Fig. 12.18).
If the flux is unable to stay on the board during the solderprocess, solderoxides present on the solderwave surface will adhere to the solderresist. On these oxide threads solder will adhere. If such threads are bridging between patternparts a short circuit is formed.

Webbing is caused by an interaction between the solderresist and the solderoxides on the wave. Normally these oxides from the wave surface are reduced by the flux that is applied on the board. But when the flux amount is insufficient or is unable to stay on the board, it will be washed off before these wave oxides are reduced. For this behavior there are two possible explanations. One is that the flux was diluted too much or not sufficient flux is applied, so that there is a lack of fluxactivity during the process.
The other possibility is that the solderresist was not cured well during manufacturing of the board, so that curing vapors from the resist will escape during contact in the solderwave. Since flux will not adhere to a vapor, the flux will be washed off by the friction of the solderwave, leaving no flux to reduce the oxides from the solder that is in contact with the board.

A second reason for hairline bridges is the presence of intermetallic compounds in the solder, like Cu_6Sn_5 copper-tin crystals. These crystals can be found as fine needles and they can cause solderbridging in-between adjacent joints. This type of hair-line bridges are in most cases not sticking to the board surface, but are just 'catched' in-between the joints or joint leads.
As these intermetallic crystals are part of the solder in the solderpot they will be pumped around and can so be catched in-between joints. Since they have a length limited to just a few millimeters, they can only bridge a short distance.
If an intermetallic compound, like Cu_6Sn_5, is not completely soluble anymore in the solder, it will precipitate out from the liquid solder as needle like crystals. If a solder alloy contains too much insoluble elements, the risk of these types of solderbridges will increase. Which intermetallics will be formed is hard to say, since that depends on the alloy composition and the material compounds that are involved in this alloy. The Cu_6Sn_5 tin-copper alloy is just an example of such intermetallics. (See Soldering in Electronics Second Edition by R.J. Klein Wassink, chapter 4.4.3).

Solution

In case of solder webbing, the solution should be found in the compatibility between board (resist) material and flux. Also the flux consistency and the applied amount on the board should be controlled. Insufficient preheating of the flux might also be a cause for poor fluxing action.

In case intermetallics are contaminating the solder, they should be removed by a sieving action at a temperature just above the meltingpoint of the solder through a 20-mesh stainless steel strainer, or the solder should be exchanged for fresh solder.

In case the solder is sieved it might be necessary, depending on the original solder composition, to analyze the solderbath, since the metallurgical properties and the melting point of the solder are related to the alloy composition.

Note: The book Soldering in Electronics can be ordered via the web at http://www.elchempub.com.

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