Vitronics Soltec

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Solderspikes on long leads

Case

After dip or wave soldering often on longer leads, eg. which protrude more then 2 mm on the solderside of the PCB, solderspikes or solderflags can be found. If the protruding leads have a relatively large surface, such as with shielding frames, this effect will appear more prominently. Playing with the process settings will mostly not eliminate this effect.

Explanation

During soldering the flux on the parts to be joined will be flushed off as the solder wets and covers the metal parts. After wetting with solder, the only flux that might be left on the PCB surface, is the flux which is captured between the PCB and the solder source. If a PCB separates from the soldersource, wave or nozzle surface, the flux that remains on the PCB surface must create an atmosphere that will avoid oxidation of the solder.
If the space in-between the joints is limited, not much flux will be present at this stage of the process, so almost no oxide reducing activity remains during this process phase. As a result solder will start to oxidize as it separates from the joints and an oxide film will cover the solder that is draining off. At the final separation normally the part of the breaking solder column that remains on the lead will be wicked up to the lead by the surface tension of the solder as long as the solder is molten. If that part is however covered with an oxide layer, the solder will stay in this oxide envelope, forming a spike or flag.
This effect will be more prominent if a relative large area is covered with solder, while on the other hand almost no flux is left to assist the process.

It is therefore that longer leads will be more vulnerable, because the flux that should be active is the flux that remains on the PCB surface. During the separation this surface and so the flux becomes further away from the soldersource, so its effect will be less if the distance increases.

Note: The same underlying conditions are the reason that, on large metal areas on the PCB that are soldered, often peaks remain. There is simply not sufficient flux that surrounds such an area that can assist in proper drainage conditions.

Solderjoints on shielding frames may also cause solderspikes due to another reason, which is related to the heatsink effect. If the heat that the solder brings to the joint drains off rapidly to the mass of the frame, the solder starts to solidify almost immidiatley upon separation from the wave. As a result solidifying solder is separating during the drainage stage and that solder can not flow back to the joint since it is not liquid anymore.

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Solution

Keep protruding leads short, so that the flux on the PCB surface can be still effective.
More flux will in general not help, since this extra flux will in most cases be washed off from the PCB surface as soon as the PCB contacts the soldersource. This extra flux might help to assist in better wetting properties for the parts to be soldered.
A flux that has a better adhesion to the PCB surface and has a better 'tail activity'*) might be beneficial to assist the drainage conditions.

The point is that one needs either an inert or an oxide-reducing environment at the position where the solder separates between PCB and soldersource. Only in that case spikes and flags can be avoided.

If the spikes are caused due to a strong heatsink effect of the mass connected to the joint, the joint design could perhaps be optimized. Examples of such optimizations are shown in the book Soldering in Electronics by R.J. Klein Wassink, Second Edition in chapter 3.4.1, Figure 3.29.

*) The 'tail activity' or protective capability of a flux can be tested as described in chapter 7.2.5, Figure 7.31 in the book Soldering in Electronics by R.J. Klein Wassink, Second Edition.