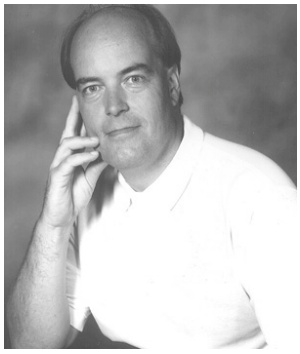
# *Hand Soldering with Lead-Free Solders*



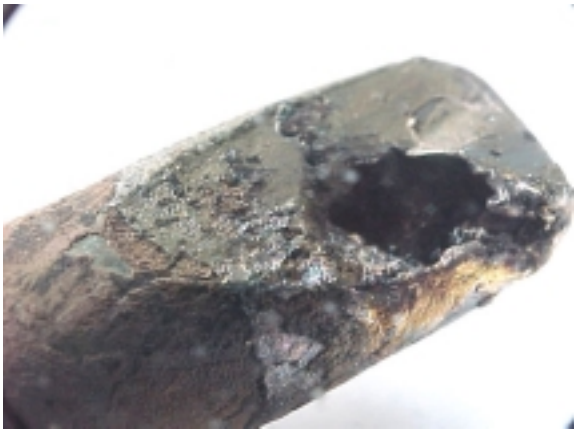
***By Bob Willis***

Hand soldering of through hole component terminations is still very common for small volume printed board assembly. It is also necessary after component removal to re-solder new replacement components. Even in large companies hand soldering is common in second stage assembly where through hole parts cannot go through reflow or wave soldering processes. With the move to lead-free soldering processes care needs to be taken when using new alloys and disciplines in place on care of iron tips. Also staff should be aware of difference in the solder flow, joint appearance and temperature requirements.

First the component terminations are inserted into the through hole; they may or may not have their leads clinched slightly depending on the quality standard being used. It is often the case that large or multi leaded parts have a couple of corner leads clinched at approximately 45 deg to hold the part in place during board inversion and soldering. This guarantees the part to be correctly seated on the surface of the board. For lead-free the components will look the same but the plating on the leads may be different, traditionally most components are coated with 60/40 tin/lead or 90/10 tin lead plating.

Next the correct solder tip temperature is confirmed; this is normally 600-800degF (315-426degC) for work on printed circuit boards. The higher the temperature the faster the oxide formation on the tip and the dewetting of the tip face; wherever possible the lowest temperature should be used. The tip face size should be a similar size to the terminations being soldered. The cored solder wire used for soldering is available in different gauges commonly available between 0.6 - 1mm. Cored wire is available in tin/silver/copper and tin/copper, which are the most common lead-free alternatives. First the tip is wiped clean on a moist sponge and the tip tinned with cored solder wire. Care should be taken not to use a wet sponge, this tends to spit, increase tip and iron corrosion, drop the tip temperature and is very bad practice.

When starting soldering it is good practice to re-clean the tip again and re-tin just to confirm that the tip is clean and is correctly wetted with solder. The tinning stage is very important if the tip cannot be wet efficient soldering will be more difficult. Also make sure that the solder alloy wire you are using is the correct type by checking the label. If you have changed to lead-free, tin/lead wire should not be on the shop floor.



Example damage soldering iron tip and erosion of the copper under the iron plating with lead-free solders

The most common reason for poor wetting is incorrect protection of the solder tip face. This is generally related to poor tinning in the first place by the operator. If the tip becomes oxidised or damaged solder will not wet the tip and it will tend to ball up on the tip. It is possible to use a cleaning technique to help re-wet the tip with solder tip cleaner, but this should not become standard practice.

Tip tinners or cleaners are available from a number of suppliers and are tins of solid paste with a rosin flux. The tip cleaners should be used as a last resort for rewetting tips. First the tip is wiped clean on the sponge and then the tip placed on the surface of the paste so that the tip surface is retinned. It may be cleaned and repeated to confirm that tinning has taken place. You should not rub the tip back and forth across the paste or bury the tip in the paste.

It is fair to say that during the change to no clean low residue soldering a number of years back there was an increase in poor tip wetting. This was simply due to the change in flux used and the general decrease in wire gauge being used in the industry. Care need to be taken to avoid the same phenomena occurring again with the move to higher temperature lead-free alloys. With the move to lead-free solder another problem has become common, surface attack of the plating of the tips. If the layers of plating on the copper tip are thin, porous or become damaged the tin rich lead-free solders will attack and corrode the copper through the damaged plating.

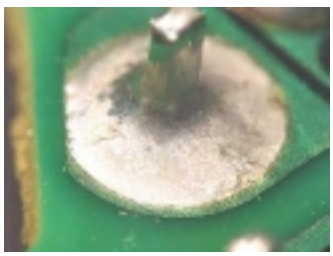
Where tips are provided by suppliers other than the manufacturer of the iron, care should be taken to check the quality of the plating. Confirmation should be gained on the tip's compatibility with lead-free solder. All suppliers should be aware of this problem. Most tips are plated with iron and may have multiple plated layers on the shank of the bit.

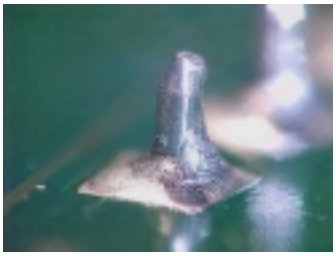
Unfortunately it is not just a case of increasing the plating thickness as the sensitivity of the tip for temperature control may be affected. Normally tips for lead-free work will be progressively coated with lead-free solder rather than tin/lead. However, most of the solder will be removed during the first operation.

The wetted tip is then placed on the surface of the joint allowing the solder to contact the pin and pad. A correctly tinned tip will allow fast transfer of heat to the joint area and minimise the time to form the joint. When the solder wets the joint surfaces further solder is added to form a satisfactory joint.

In the case of a single sided board the solder will cover the hole and wet the lead forming a solder joint with a concave surface. The same solder joint is required on a plated through hole board but in this case the solder must also fill the hole and ideally show a concave solder fillet on the topside of the board. The degree to which the solder wets across the surface of the topside pad can be affected by the choice of printed board solder finish. As with the introduction of lead-free you are changing from tin/lead boards to gold, silver, tin or copper OSP you will see a difference in the degree of spread and hole fill.

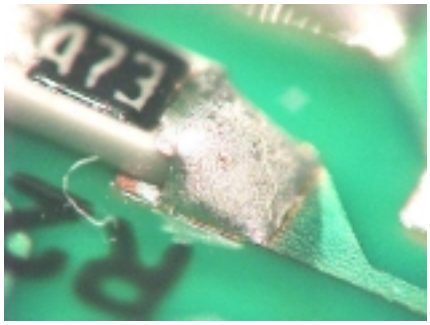
On a plated through hole board the formation of a fillet will take slightly longer due to the extra solder required and to overcome the thermal demand of the board and component termination. It is good practice to do one or two joints and then check, by turning the board over, for complete solder penetration into the hole. When the correct sequence/timing is achieved all the other joints can be produced to a similar standard. Solder joints should meet the requirements of the solder standard, the most common being IPC 610. Although the standard does not currently have details of lead-free the basic criteria in the document should be met, the surface appearance of the joints may be the only variable factor.

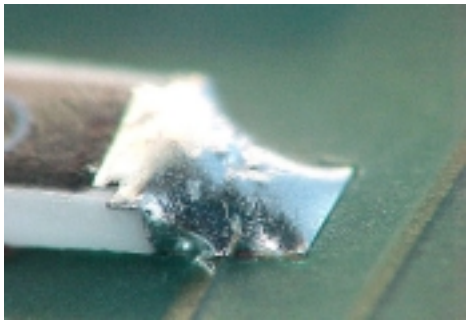




The solder joint examples show satisfactory joints with three different lead-free alloys on conventional joints SnCuBi, SnCuNi, SnAgCu

On completion of the soldering operation either clean and re-tin the tip before storing the iron or do not clean the tip. The solder coating on the tip reduces oxidation and prolongs the life of the tip. The iron should be turned off whenever it is not in use as it only takes a few seconds for modern soldering irons to reach operating temperatures. There is no reason why soldering irons and de-soldering tools cannot be turned off during breaks in production and when not in use.



Lead-free solder fillets on chip resistors using SnCiuBi and SnAuCu

A new interactive CD-ROM on "Lead-Free Hand Soldering and De-Soldering" has been developed by Soldertec. It is one of three training CDs covering lead-free reflow, wave and hand soldering and will be released in November.

Bob Willis is a process engineer working in the electronics industry, providing training, consultancy and product failure analysis. Bob offers workshops on lead-free on site for customers. He runs production lines for suppliers at exhibitions and also provides seminar and workshops world wide. Bob has one of the largest collection of training videos, interactive CD-ROMs and training material in the industry. For further information on lead-free training workshops, training materials and lead-free process support visit www.leadfreesoldering.com