Hand Soldering and the impact of the RoHS directive

The adoption of the RoHS directive by the EU will mean that many manufacturers will need to change to using lead-free solders.

Hand soldering with lead-free solders is relatively straightforward and it is possible to make good solder bonds as long as the differences between tin/lead and lead-free solders are understood.

Differences

All lead-free solders are different from traditional tin/lead solder as they have higher melting points and inferior wetting properties. Wetting will take a little longer and the solder tends to spread less. Also, most lead-free solders appear dull or matte in comparison with tin/lead, which is usually bright.

	Tin/lead	**Tin/silver/copper**
Melting temperature	183°C	217°C
Time taken to wet clean copper at 23°C above melting point	1.5 seconds	4.0 seconds

Soldering temperature

It is advisable to use as low a temperature as possible to minimise damage to heat sensitive components and maximise tip life. Start at 350°C and if good results are obtained, gradually reduce the temperature until it becomes impossible to make good solder joints – then, increase the temperature by 10°C. Note that solder wetting will take longer, be patient. If good solder wetting is impossible at 350°C, then gradually increase the tip temperature until good wetting is possible.
Increasing the temperature can reduce wetting times but this will damage some types of components and shorten tip life.
At present many operators hand solder at a high temperature to maximise productivity. In these cases, the same temperature could be used with lead-free solders but production of each joint will take a little longer.

Component damage

Over-heating can damage many types of components. These include:

Electrolytic capacitors	Crystal oscillators
Polymer film capacitors	LEDs
Relays	Plastic connectors
Opto-couplers	Some ICs

Some of these are also damaged with tin/lead solders but the risk is greater with lead-free which melts at 30 – 40°C higher. Older style soldering irons have relatively poor temperature control and tend to cycle over a large temperature range which can be as much as 50°C. Because of this, there is a higher risk of damage to heat sensitive components.

Soldering iron tip life

Lead-free solder alloys and their cored wire fluxes are both more aggressive to soldering iron tips than tin lead cored wire. As a result, tip life can be significantly shortened. The tip life will depend to a large extent on the soldering temperature used. As a general rule, a 10°C increase in temperature will halve tip life.

However, manufacturers are currently introducing tips designed for extended life under these conditions.

Type of soldering iron

Soldering irons of various types are available. The main differences are in the heat output available and the accuracy of the temperature control. Older types of soldering iron use a method of temperature control that results in large variations in tip temperature. At worst this can result in the solder freezing at the lowest temperature and being too hot for some components at the highest temperature.

Improved results can be achieved with lead-free solders if modern soldering irons with good tip temperature control are used. Modern irons are available with higher power ratings, which itself is beneficial, but an ability to maintain temperature and minimise fluctuation during soldering is more important as this will enable operators to use a lower tip temperature.

Possible problems

The most common problems likely with hand lead-free soldering are component damage and poor solder wetting. Soldering to large high thermal mass parts will create the most difficulties. Poor wetting will occur if surfaces are not clean or are heavily oxidised. This problem can occur with tin/lead soldering but is likely to be worse with lead-free. All surfaces should be clean and oxide-free; increasing the temperature may appear to aid wetting but can damage components, shorten tip life and increase oxidation resulting in poor wetting. The use of a more aggressive flux is one option but this can result in other problems. Cored wire is produced with a variety of flux types some of which are more corrosive than others. Another option is to apply extra flux to the parts.

Rework

Rework of lead-free soldered equipment can be carried out using the same equipment and tools as for tin/lead soldering but there will be some differences.

- Avoid mixing alloys. Some combinations can give unreliable solder bonds. It will be useful to label equipment stating which solder alloy is used.
- The higher temperature can damage both components and PCB laminate
- More aggressive fluxes may be required which can cause other problems

Common misunderstandings

1 Repair of old equipment - Tin/lead soldered equipment "put onto the market" before the RoHS directive deadline can be repaired or reworked after the deadline using the tin/lead solder and "leaded" parts.

TRUE - There is currently no time limit placed on the availability for spare parts to repair equipment placed on the market before the deadline and some spares will never be RoHS compliant.

2. Tin/lead solder will cease to be available

FALSE - Tin/lead solder will continue to be available in the future as there will be many types of product that are not covered by the RoHS directive

3. Lead-free products will be available as "drop in replacements"

FALSE - All lead-free solders are different from tin/lead. It will take time to make the changeover, avoid problems and defective products. We recommend that you start work on this now.

Fume extraction

The potential health hazards (e.g. occupational asthma) associated with using soldering fluxes are well documented. Every employer has a duty to ensure a safe working environment for its employees, which may require the use of fume extraction. One common misconception is that lead-free solders are safer because they do not contain lead. In fact the more aggressive flux used in a lead-free solder will tend to increase the requirement for fume extraction.

Article written by **Dr.Paul Goodman, ERA Technology Ltd** - www.era.co.uk/rfa.htm