Explanation of soldering iron tip wear and introduction to Almit SR37 LFM 48 S Lead Free cored wire.

Background.

Any companies who have been soldering using tin/lead cored solder wires for any length of time know that periodically the soldering iron tip will fail, and will need replacing. The factors that influence the wearing of the tips are;

- Solder Alloy
- Solder Tip Temperature
- Flux Chemistry
- Size of solder joint / amount of solder needed per joint

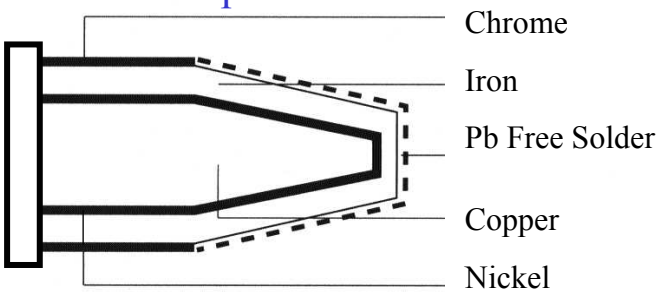
When companies make the transition to lead free the rate of wear of the soldering iron tip increases by at least 3 times. This affects productivity and introduces more variability into the manual soldering process together with other additional costs.

How the tip is made

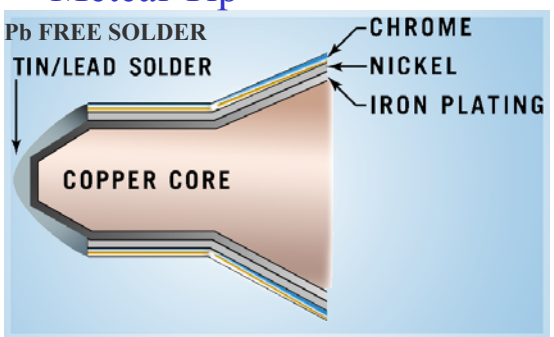
All soldering iron tips have the same metalurgical construction. The main part of the tip is made of copper. To extend the lifetime of the tip, it is iron (Fe) coated but Fe has a much worse thermal conductivity than Cu (Therm. Cond. Fe = 80 $Wm^{-1}K^{-1}$, Cu @ 390 $Wm^{-1}K^{-1}$). Thicker Fe will mean slower soldering due to poorer heat transfer.
The non wettable part of the tip is nickel and chrome plated. The chrome stops the solder flowing up the tip. The tip is pre-tinned with solder, which today is probably lead free.

Nickel coating: ca. 10 - 20µm
Iron coating: ca. 150 - 300µm (LF tips may have 400 micron Fe)
Chrome Coating:ca. 3 - 6µm

Weller Tip



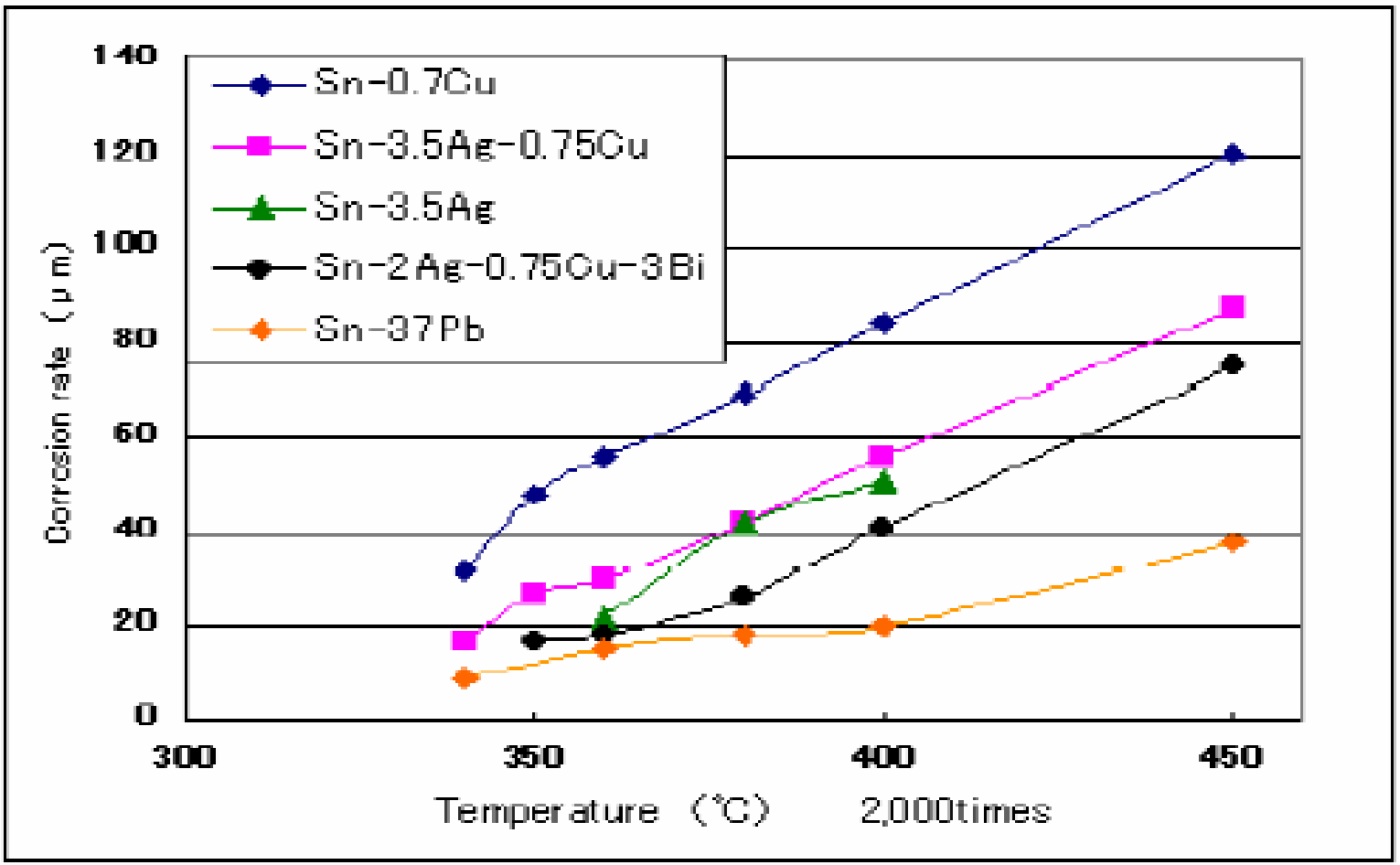
Metcal Tip



Soldering iron tip wear rate for different solder alloys and different tip temperatures..

LFM 48S gives similar corrosion rate to Sn37Pb thus giving similar soldering iron tip life.

(Wear measured after 2000 solder joints for each tip temp)



Here it can be seen that alloy 99C (Sn-0.7Cu) has the greatest wear on the soldering iron tip.

What causes normal tip wear ?

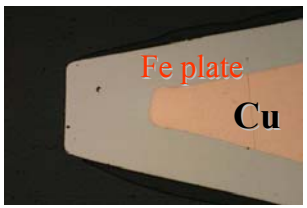
- The Sn in the molten solder on the tip dissolves the Fe coating. More tin in the solder gives shorter tip life. Hence 99C (Sn-0.7Cu) alloy is worse.
- Flux on the tip can chemically etch the Fe coating by an ‘oxidation and reduction process’. Different flux formulations give different etch rates.
- Mechanical abrasion. Scraping the cored wire over the tip during the soldering operation scratches the Fe off the tip. Harder lead free alloys cause more abrasive wear.

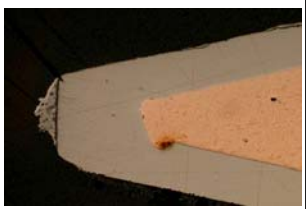
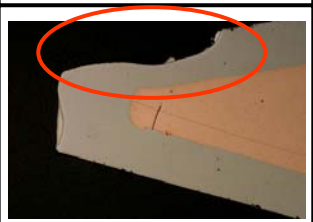
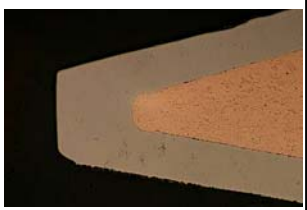
Characteristic of LFM-48S solder alloy

All current Pb-Free solder alloys (Sn/Cu, SAC, Sn/Cu/Ni, etc) cause the problem of the soldering iron tip wearing about 3 times faster than with Sn-Pb. This is because the Fe plate on the iron tip dissolves when soldering. This means more tips are used and this is costly to the company. ALMIT focused its attention on developing a solder alloy which preserves tip life and a flux which helps keep the tip in good condition.
This new product makes it possible to use lead free solder wire and have a similar tip life to Sn-Pb.

Soldering iron tip leaching test (endurance test)

New Tip



	New product SR37 LFM 48S	Existing Pb Free SAC305	60Sn-40Pb
Test tip temp. 350℃			
Test tip temp. 380℃			

Low leaching High Leaching

Test method

Machine Japan UNIX-412 Robot
Solder quantity 5mm/shot
Solder supply rate 10mm/shot
Solder return rate 10mm/shot
Solder 20000 joints/tip cleaned every 20 joints in rotating sponge+H2O

Test result conclusion

The leaching level of LFM-48S is the same as that of 60Sn-40Pb.

The SAC305 shows high leaching. Sn/Cu lead free alloy would show worse leaching still.

How does Almit SR37 LFM 48S reduce the tip wear ?

- The LFM 48 S solder alloy has been specially formulated to reduce the ability of the molten Sn to dissolve the Fe on the tip.
- The SR37 flux chemistry allows most of the flux to flow off the solder iron tip and onto the solder area where it is needed. Thus the chemical etching of the flux is kept to a minimum. The flux that stays on the iron tip does not char on the iron but protects it from oxidising thus stopping the oxidation and reduction process therefore keeping the tip in near perfect condition.
- The LFM 48 S alloy contains 3% silver so it is softer than tin/copper lead free solder so has less abrasive effect on the iron tip.

SR37 LFM-48S solder wire ···

Picture of iron tip after soldering 16 joints without any 'tip cleaning'. Iron at 380ºC. (Total soldering time for 16 joints @ 26 seconds) Flux is clear, it does not char on the iron. Most of the flux flows off the iron during the soldering operation but a small amount of flux keeps the iron tip in very good condition. Tip leaching due to the flux is minimised.

●New product. Lead Free wire which minimises leaching of the soldering iron tip

SR-37 LFM-48S

●Flux name　　：SR-37 （Example）
New high-performance lead free flux
No flux spitting formulation

●Solder alloy
（Low leaching alloy! New development）
：LFM-48S＝Sn-3.0Ag-0.5Cu＋α＋ β

Product Name		SR-37 LFM-48S
New developed alloy	Name	LFM-48S
	Composition	Sn-3.0Ag-0.5Cu＋α
	Melting temp.	217-221℃
New Flux	Name	SR-37
	Content	3.5%
wire sizes		φ0.5～1.6mm *

* Finer wires may be available upon request.

What to expect when using Almit LFM 48 S SR37 Lead Free Cored Wire

- **The solder flows quickly due to the thermal transfer properties of the flux, so soldering speed is not compromised when moving to lead free. Typical tip temps 320 – 380ºC.**
- **As each solder joint is formed very quickly, less solder is used per joint. You do not have to feed in more solder whilst waiting for the alloy to flow. Solder joints formed quickly are more reliable because the intermetallic layer thickness is kept to a minimum.**
- **There will be no flux spitting/spattering during the soldering operation.**
- **There will be some flux residue around the solder joint but it will be clear and is safe. Using the minimum amount of solder per joint also keeps the flux residue to a minimum. It will not cause corrosion or electrical failure.**
- **A small amount of flux will stay on the soldering iron tip but the tip will need to be cleaned much less than normal. This increases productivity by minimising tip cleaning time.**
- **The soldering iron tip life will be similar to that experienced when using tin/lead wire so no down time will be lost due to excessive replacement of tips. Cost of replacement tips kept to a minimum.**
- **Users can use traditional tips, with normal thickness Fe plating without experiencing excessive wear. The soldering tip can be operated cooler because of the thinner Fe but soldering will be as fast as with Sn/Pb.**
- You should achieve perfect, lean solder fillets in the minimum amount of time.