The switch away from lead containing solders to comply with the various foreign lead-free directives has been hyped as just to select the right lead-free solder for your process, make the necessary adjustments in processing variables to compensate for the higher melting point of the alloy and proceed. Though we have been led to believe this will be a seamless transition, there are some areas of concern that have not been thoroughly researched with respect to the switch to lead-free.

The following are highlights from various literature sources that I have catalogued, addressing some of the basic concerns that have not been thoroughly addressed in the rush to switch to lead-free soldering:

"What specific problem areas are associated with LF [Lead-Free] implementation? LF will be more difficult to control, more aggressive on equipment and more expensive to run. Expect higher alloy costs, higher process temperatures, smaller process windows, more aggressive fluxes, rising dross formation, faster deterioration of solder pots and tips, increased copper contamination of the solder bath and increased use of nitrogen ."[1]

"The dissolution rate of iron in tin-lead is low. With lead-free alloys, the numbers are about a factor of 10 higher."[2]

"*Iron*. There is no solid solubility of iron in lead, but there is some solubility of iron in tin at elevated temperatures, and two intermetallic compounds are formed (FeSn and $FeSn_2$)."[3]

"A typical lead-free solder wire may contain 2 to 3 percent flux by weight, similar to conventional solders. However, the flux content may have to be more aggressive to achieve the same degree of solder wetting, which yields stronger, more potentially harmful chemicals. The solders also have a higher melting point than tin-lead, meaning solder fluxes will be exposed to higher temperatures than ever before."[4]

The soldering tip we manufacture consists of a copper substrate electroplated with iron in the work zone to provide a wear resistant surface readily wet by solder. The balance of the tip is nickel/chrome electroplated to provide for oxidation and corrosion resistance on the shank of the tip and minimize the effect of solder creep. Tips of this style have provided an exceptional blend of wear and abrasion resistance, wettability, heat transfer and surface and corrosion resistance to leaded solders and the large number of fluxes associated with their use.

The use of lead-free soldering alloys expose the soldering tip to a tin-rich surface environment at a high operating temperature which will accelerate the dissolution of the iron plated on the tip into the tin of the solder, promoting the formation of Fe-Sn intermetallics on the protective iron plated layer of the tip. The more aggressive fluxes lead-free alloys require to provide adequate wetting of the solder joint and the elevated temperatures required to melt these alloys, will contribute to a more corrosive environment in which the soldering tip will operate. Both of these factors, either alone or in conjunction with each other will have the tendency to accelerate the wear characteristics of the soldering tip versus the service life of a similar soldering tip operating in a eutectic tin-lead solder environment.

1. "Considerations for Implementing Lead-Free Soldering", Mark Cannon, Pg. 46, Circuits Assembly, September 2004.

2. "Five Steps to Successful Lead-Free Soldering: Step 4", Gerjan Diepstraten, Pg. 50, Circuits Assembly, July 2001.

3. Solders and Soldering, Howard Manko, Pg.76, Second Edition, 1979.

4. "The Invisible Enemy", Karl Schuepstuhl, Pg.53, SMT, The Magazine for Electronics Assembly, November 2004.