



Mounting of Meritec SMT Products Using Lead-Free Solder

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Scope

To determine acceptable methods and materials for mounting Meritec's SMT products using lead-free processes. The findings will form the basis by which Meritec can assist its customers in making this crucial changeover.

After reviewing the current product line, it was decided that Meritec's SOP Sockets represented the biggest challenge. Of these, we chose to test the TSOP and the PSOP types as follows:

1...To mount Pb-free Meritec SOP sockets using a Pb-free printed circuit board and process. Establish maximum, target, and minimum time/temperature profiles from which a recommendation can be made for Meritec's customers.

- Maximum time/temperature profile is one that results in a successful wetting and flow of the solder on the contacts, but begins to show deleterious effects on the plastic of the socket components.
- Target time/temperature will be the profile that confirms good solder characteristics and causes no damage to the plastic of the socket.
- Minimum time/temperature profile is one that results in marginal wetting and flow of the solder alloy on any one contact of the socket. The solder joint will take on characteristics consistent with what's known as a "cold" solder joint.

2...Mounting of Pb-free Meritec SOP sockets will also be done using a 63/37 solder alloy and the currently recommended profile. This will be done to establish a backwards compatibility of the new plating with a 63/37 lead bearing solder.

Test Samples/Preparation

- Sockets...Two sockets were chosen for inclusion in this test:

<u>Meritec P/N</u>	<u>Size/Type</u>
980020-56-P1	56TSOP
980021-44-P1	44PSOP

- Printed Circuit Board...A test Board (Meritec P/N 600440-02) was manufactured with four pad patterns for each of the two sockets being tested. Further, the pad patterns were arranged in a way that would maximize infrared "shadowing". This was done to emulate a worst case reflow soldering scenario. Immersion silver was chosen as a pcb finish for the Pb-free tests and Sn63/Pb37 HASL for the backwards compatibility tests.
- Solder Paste...AIM Solder Product Number NC254/SAC305 was used for Pb-free testing and has an alloy composition of Sn96.5/Ag3.0/Cu0.5 with a no-clean flux chemistry. Backwards compatibility testing was done using an Indium Corporation of America Product Number NC-SMQ92J, which is a no-clean Sn63/Pb37 solder paste.

Facilities

The facilities used for this testing were located at:

APSCO International
3700 Lane Road
Perry, Ohio 44081

APSCO International was chosen for its well qualified lead-free SMT and Wave production lines and knowledgeable personnel. APSCO has been addressing RoHS compliance since 2003.

Equipment

Equipment used for the Pb free tests was:

Screen Printer...MPM SP
Component Placement...MYDATA MY12
SMT Reflow Oven...Electrovert Omniflo-10
Inspection...Ersa scope
Xray...Nicolet NXR 1510 System

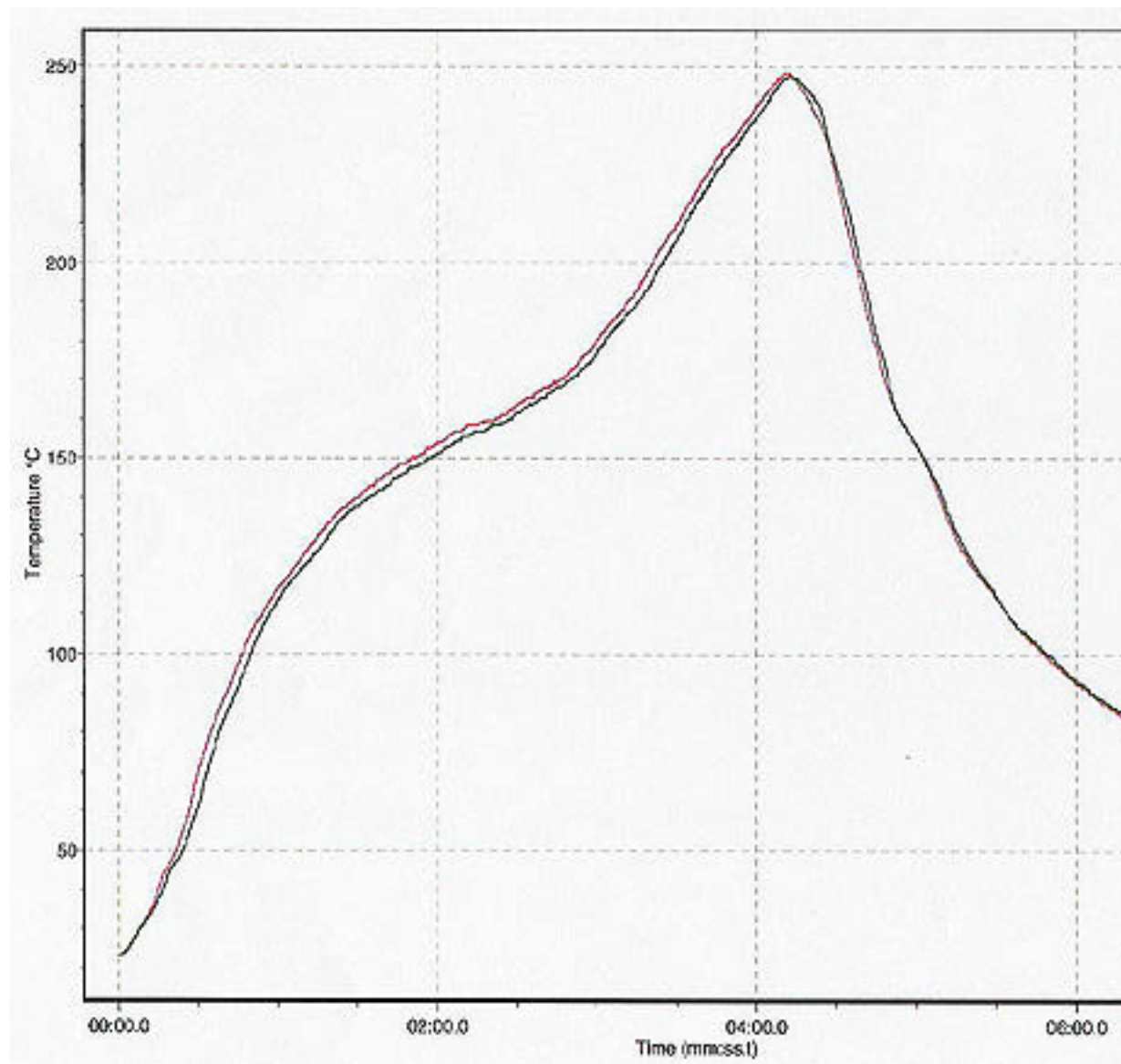
The collection of the time/temperature data was done with a Datapaq Data Logger and processed using the Datapaq Insight Reflow Tracker v1.40 software.

Additional visual inspection was made using Leica StereoZoom SZ-4 microscopes with 10X eyepieces mounted.

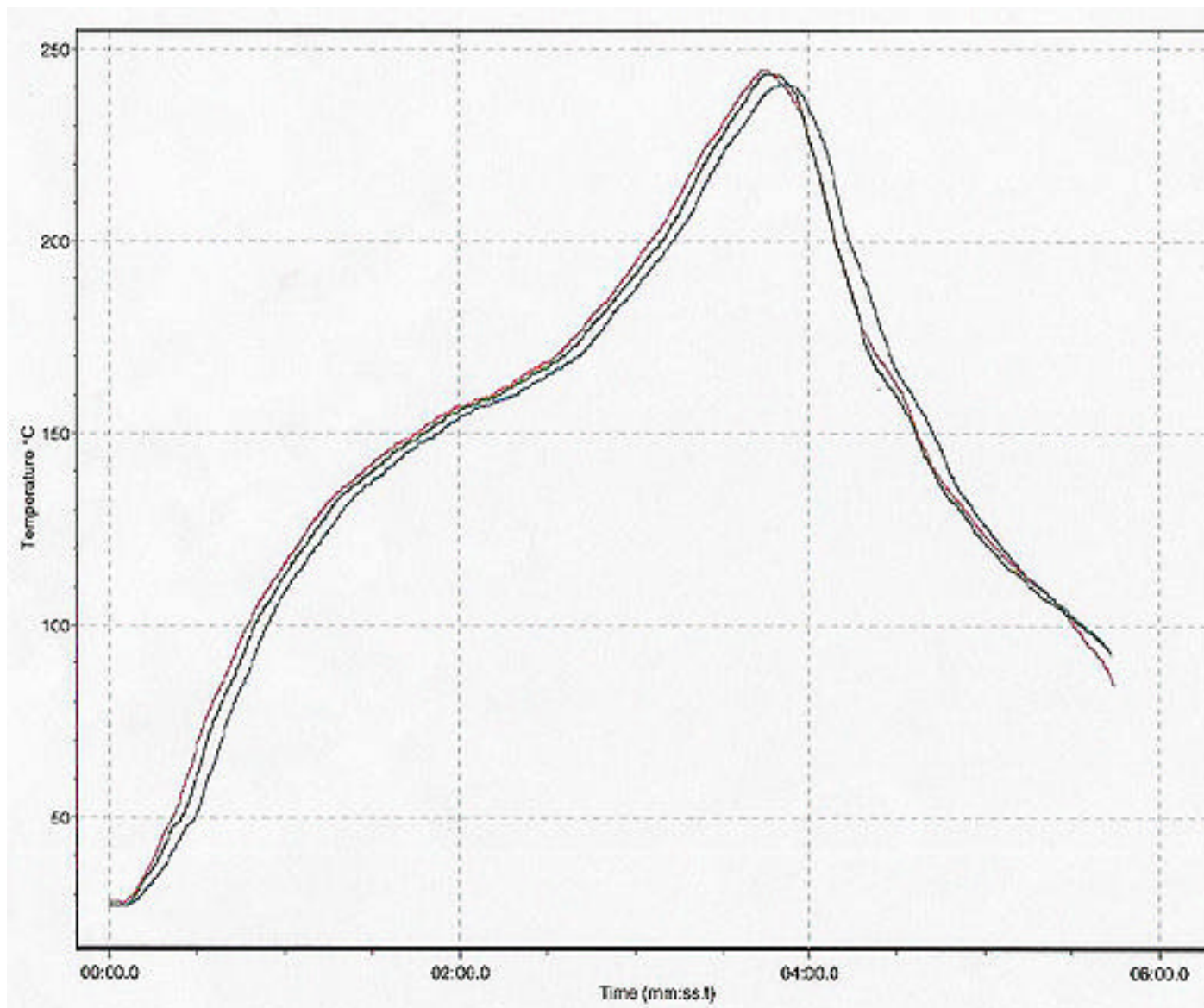
Pb-Free SMT Soldering Profiles

The profiles collected with the Datapaq hardware and software follow. They are summarized in a single chart on page 8.

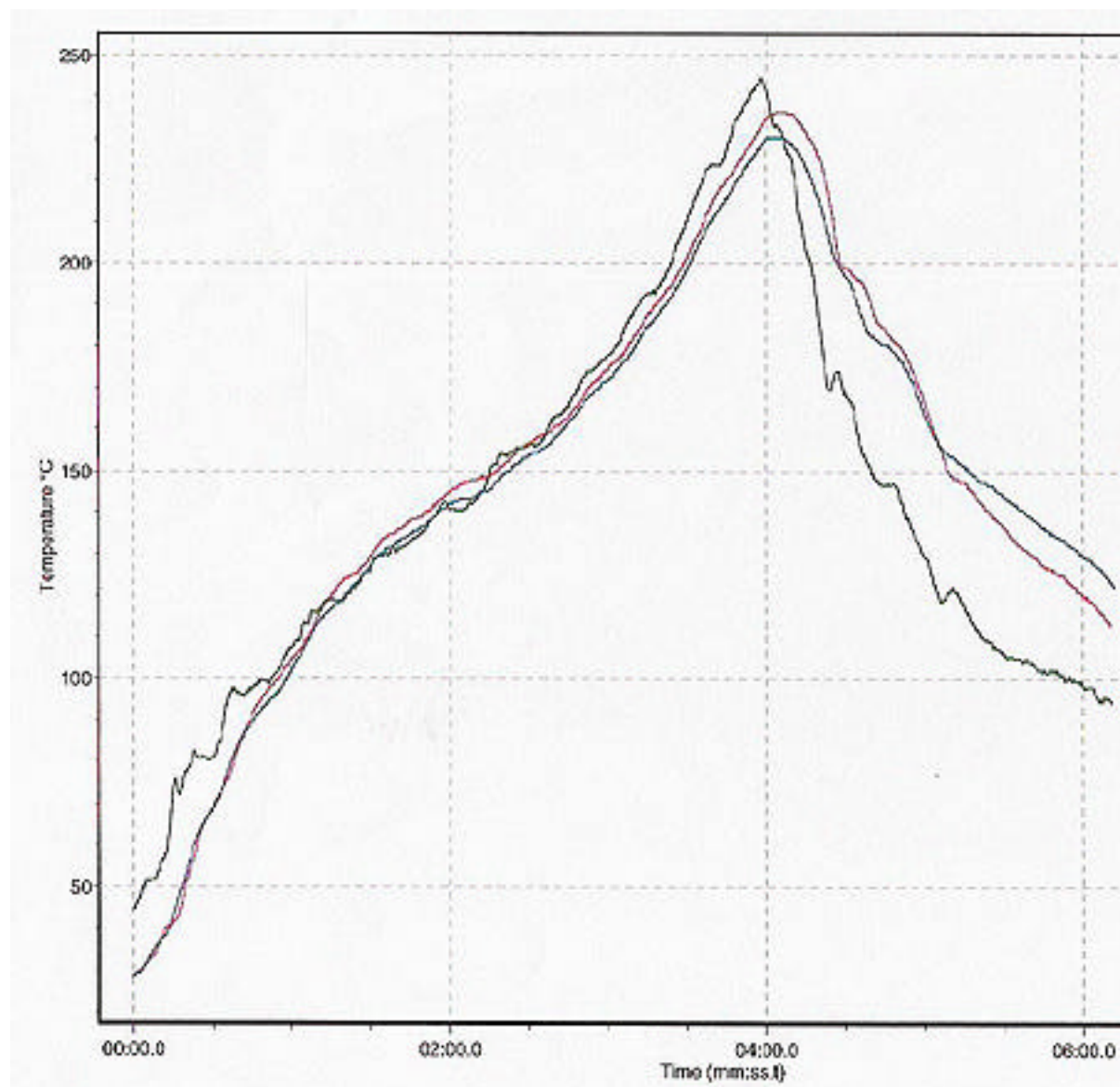
Pb Free “Maximum”



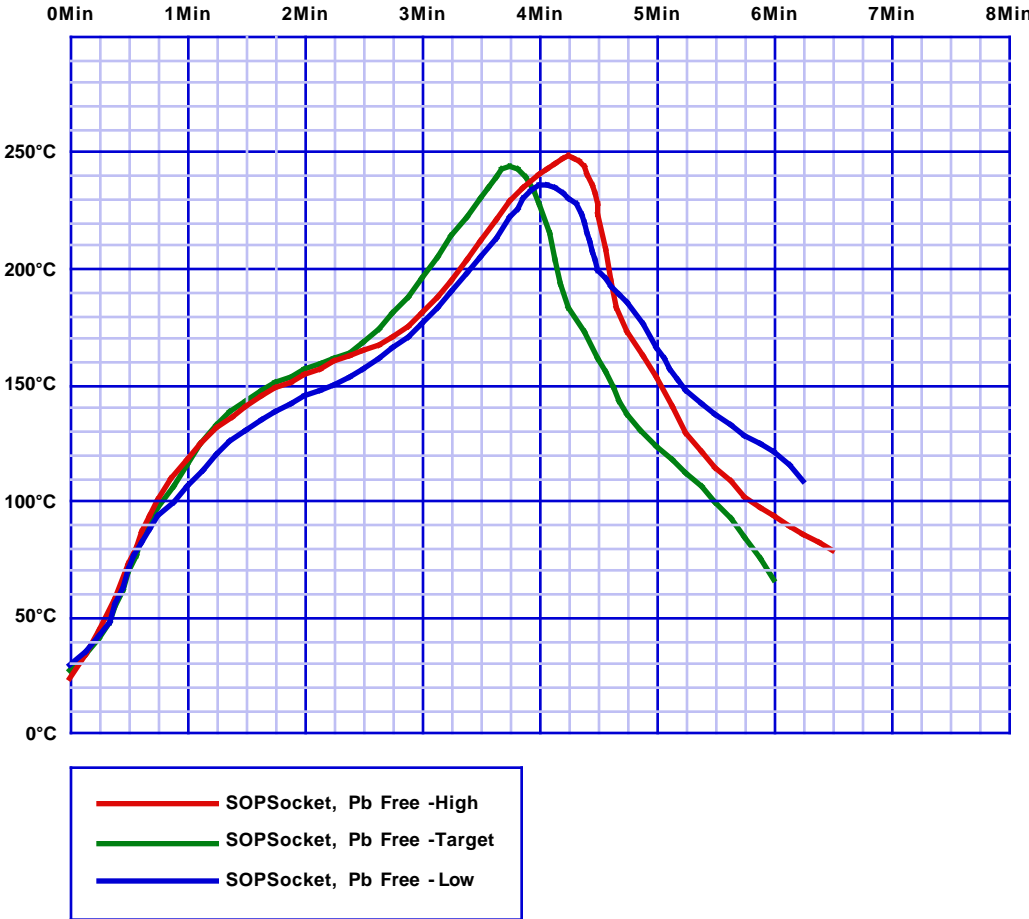
Pb Free "Target"



Pb Free “Minimum”



Summary of Pb-Free SMT Soldering Profiles



In each case, a Ramp-Soak-Spike (RSS) profile was used.

Conclusions

Best results were seen in the range of 240°C to 247°C spike temperature with a minimum time above the liquidus point of the solder. Clearly, profiles such as these are much more stressful to the plastic components of the SOP sockets. Though the new lead-free solder alloys do not flow and wet as well as lead-bearing alloys, the solder joints were quite acceptable based on the new proposed standards. Spike temperatures below 239°C resulted in unacceptable wetting of the solder to the contacts.

The recommended profile for all Meritec SMT products is the one labeled as “Target” on page 8. This, when combined with a good SAC solder alloy and flux chemistry should result in a good starting point.

Commentary

Other platings, board finishes and solder alloys were considered for inclusion in our tests. The following is a brief discussion regarding these other materials:

- PCB Finish...Two popular finishes were considered for use in these tests, ENIG (Electroless Nickel/Immersion Gold) and Immersion Silver. Each has unique benefits and liabilities that warrant further discussion.

ENIG exhibits better surface wetting of the solder than Immersion Silver, but can suffer from “black pad” if it’s not cleaned and handled properly during the PCB manufacturing process. It is felt that as PCB manufacturers modernize their production lines this will become less of an issue because cleaning equipment is continuously being improved.

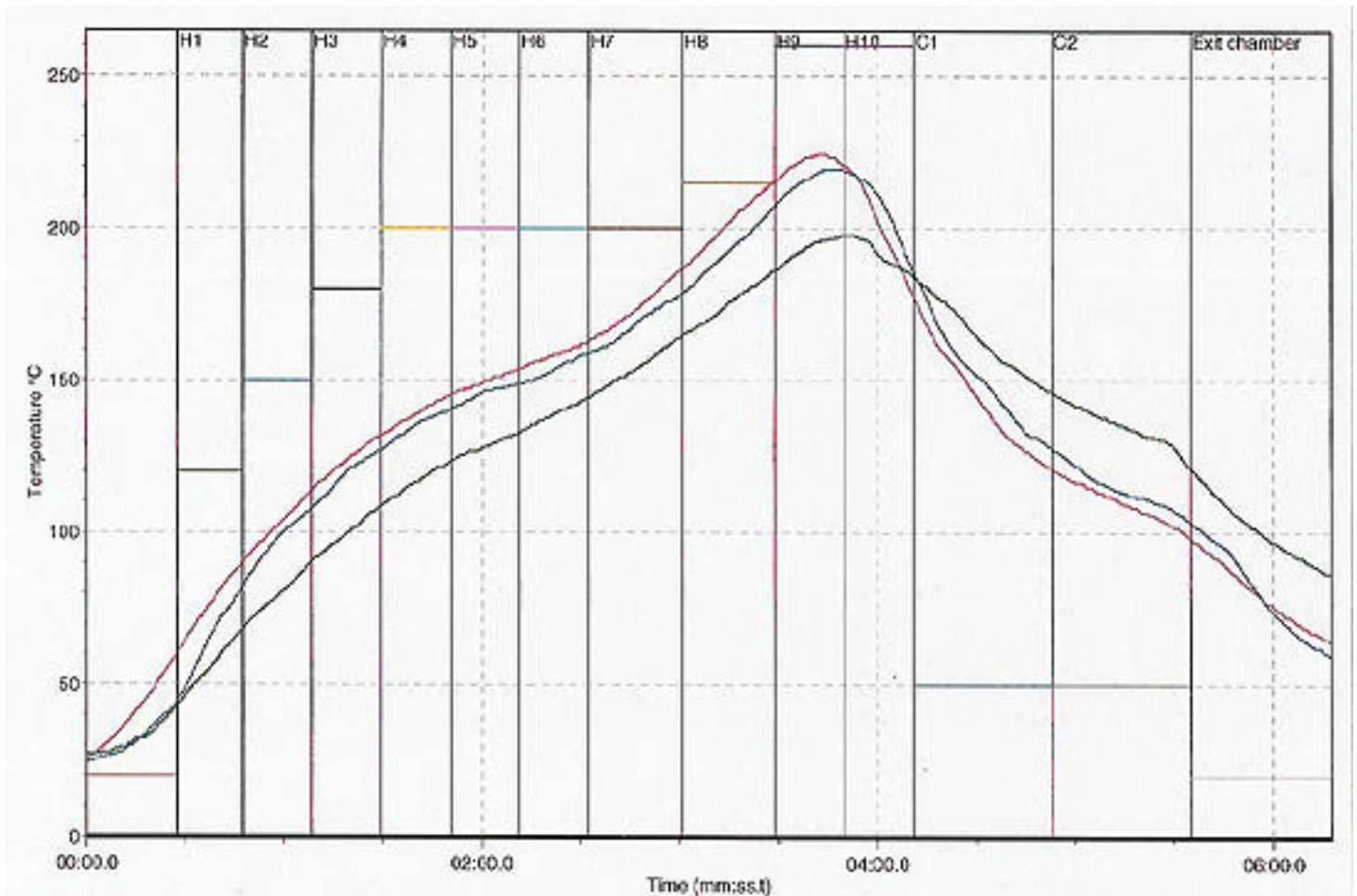
Immersion Silver is not prone to “black pad” and is more easily implemented on older PCB manufacturing lines, because cleaning requirements are not as stringent. This provides some economic advantage. A liability of Immersion Silver is long term formation of silver oxides. Though electrically harmless, they are nevertheless esthetically undesirable.

Because we would be exposing samples mounted on these boards to extreme environmental conditions in preparation for electrical testing of the “interface” end of the contact, we needed to eliminate the possibility that no unknown variables would surface. For this reason, we chose the Immersion Silver board finish over ENIG. It was thought by many that, by the time of this writing, a lead-free HASL finish may have been developed and accepted, but it has not.

- Contact Plating...Pure Sn plating of the socket contacts was considered and discarded. Meritec has taken a conservative approach to pure tin on connector designs with pitches less than 1mm. There persist, after decades of debate within the industry, uncertainties regarding tin whisker growth. Our position is that a slight increase in the cost is worth avoiding the risk of field failures in the future. For this reason, we chose pure Pd as a contact finish.
- Solder Alloy...There are many solder alloys currently on the market, most of which are patented. We chose to use the most popular public domain alloy because of it’s wide availability.

Backwards Compatibility SMT Profile (Sn63/Pb37)

Realizing that many users will still be soldering with lead-bearing alloys for the foreseeable future, we've included this profile here. The results were very good, demonstrating that the Pd plating is very compatible with with the older alloys.



If you require further assistance, please contact Meritec at:

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