An Update on the NEPP Lead-free Solder Project

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Abstract

Lead-containing solder has been used for past 60 years as the principal joining material for Level 2 packaging defined as attaching component level packages to a suitable substrate to produce printed wiring assemblies (PWAs). Eutectic tin-lead solder has a unique melting point of 183°C (361°F), whereas near-eutectic tin-lead solder melts within the range of 183°-189°C (361°-372°F). Because the use of lead in electronics has come under increasing scrutiny, it is highly likely that the US will be driven by commercial interests to phase out of lead in electronics usage.

NASA realizes that the historical data on solder for space applications is for eutectic tin-lead solder. For this reason it funded a NEPP project to look at alternative solder materials containing no lead (Pb-free) and to investigate the processing and metallurgical characteristics of these materials. The resulting NEPP project is being performed at several NASA centers. Goddard SFC is the lead in this effort, but JPL and Marshall SFC are also making substantial contributions. This presentation concentrates on the JPL effort.

Phase I of this project dealt with determining the most feasible candidates to replace tin-lead and determining suitable processing operations in assembling printed wiring boards. Four (4) lead-free solder pastes were selected based on an extensive search of the literature. Two PWBs per solder type were assembled using the four different solder pastes resulting in total of eight assemblies. These were:

- Sn96.5Ag3.5 (eutectic) 221°C (T_M)
- Sn95.5Ag3.8Cu0.7 217-218°C (T_M)
- Sn96.2Ag2.5Cu0.8Sb0.5 (Castin®) 217-218°C (T_M)
- Sn77.2In20.0Ag2.8 (Indalloy 227®) 175°C (T_S)—187°C (T_L)

In Phase II of the project two (2) of these pastes were down-selected, namely, these:

- Sn95.5Ag3.8Cu0.7 217-218°C (T_M)
- Sn96.2Ag2.5Cu0.8Sb0.5 (Castin®) 217-218°C (T_M)

The next steps will be to assemble four (4) PWAs per each paste and assemble four using eutectic tin-lead as a control, and then thermal cycle the boards. Microsectional analysis will also be performed on select boards.