iNEMI Survey Summary Report

Low Temperature Solder (LTS) Readiness for Volume Board Assembly

Link to Questionnaire

Background

As electronics applications grow and diversify, extensive investigations have been conducted in the past few years to evaluate the suitability of low temperature soldering for reducing dynamic warpage in the assembly of smaller, thinner and highly integrated electronic packages for new, emerging ultra-mobile computing, wearable devices and Internet of Things (IoT) markets, with dozens of publications in various international conferences. Some LTS electronic products have been launching in the market. However, the use of low temperature solders requires a new class of reliable soldering materials and processes. iNEMI has been conducting a comprehensive project, entitled BiSn-Based Low-Temperature Soldering Process and Reliability since 2016, with a cross industry team, which has been investigating the processability, mechanical shock and thermal cycling reliability of a few LTS alloys.

Purpose of the Survey

The purpose of this survey was to assess the electronics manufacturing industry’s level of awareness of low temperature solders and its readiness for the implementation of low-temperature solders in volume manufacturing of board assemblies by market sector. The survey questions focused on developing an understanding of the industry timeline for implementation, the level of effort required to ensure volume manufacturing capabilities, and the identification of open issues for specific applications.

Results from this survey can help understand the deployment of LTS to date as well as the timeline and estimated effort required to enable LTS in volume production.

It was hoped that the findings of the survey would identify areas that are already being addressed by the industry and those areas that still present challenges / gaps that require further investigation, or collaborative efforts/projects to ensure supply chain and volume assembly readiness.
Survey Respondents

A total of 73 industry professionals across the electronic manufacturing industry participated in the survey. The largest group of responders was OEMs/ODMs/EMS and contract manufacturers (30) and the next group of responders was from paste suppliers (15). The component supplier group participation was lower than anticipated (11). There was a total of 37 questions and not all questions were answered by all the participants. Among the OEMs who submitted responses to the survey, five were from Notebook/Desktop, while the other respondents were from high reliability segments (telecom, automotive, high-end computing, aerospace and defense).

The observations presented here are based on the survey responses received.

High Level Observations

Cost savings and “green positioning” were not the primary OEM motivations for LTS transition.

The participating OEMs/ODMs/EMS/CMs that responded to this survey felt clearly not ready for LTS volume manufacturing and responded with a need for coordinated efforts across the electronics ecosystem to enable LTS implementation.

Many issues remain in LTS implementation. Overall LTS joint reliability is expected to be lower than lead-free solder (SAC) alloy joint reliability, depending on the application. In addition, there are drawbacks to hybrid SAC-LTS joints compared with homogeneous LTS joints in terms of solder joint quality and reliability issues expected with hybrid solder joint (LTS+SAC).

OEM responders preferred a standard LTS paste composition be specified, when and if LTS is implemented.

LTS Survey Observation Details

OEM/CM/ODM LTS Product Status

Original Equipment Manufacturers (OEM), Contract Manufacturers (CMs) and Original Design manufacturers (ODMs) survey responders reported that they were not shipping LTS products in volume. Furthermore, Cost and “Green” were not the motivation for LTS transition. The survey indicates the industry has no broad awareness or experience on LTS.

Majority of OEMs responders indicated the following.

a) Responders have either no plans to ship LTS products or require 2+ years to qualify.

b) No experience with LTS and only about 50% have plans to evaluate Sn-Bi formulation.

c) Concerns with LTS compatibility with components such as memory, capacitors, GPUs, for SMT manufacturing.

d) Recognized the need for industry level coordinated effort for LTS enablement.
e) Acknowledged that LTS enablement require similar effort and consortia activities to address common issues, similar to lead-free transition.

f) Expect LTS enablement effort and timeline will be similar to lead-free.

g) Acknowledged the need for dedicated SMT lines required to avoid contamination.

h) LTS overall initial manufacturing experience and throughput is expected at this time to be worse than SAC.

i) LTS solder joint reliability is expected to be worse than SAC. Mechanical Strength, Solder Fatigue, Drop Shock and Electromigration are concerns even for paste suppliers that are currently shipping.

j) LTS homogeneous solder joint is preferred compared to hybrid/mixed solder joint. Solder joint manufacturability and reliability issues are expected with hybrid solder joint (LTS+SAC).

k) OEMs responders indicated a preference for a standard LTS paste.

l) Majority of OEMs responders believe current SAC standards may not adequately cover LTS. Critical areas to be addressed for LTS adoption include solder joint reliability, electromigration risk, aging, shock performance and mechanical strength.

Summarized Comments

OEM Perspective

Lead-free implementation in 2006 was driven by legislative mandates across the globe, whereas LTS implementation is by choice for potential performance benefit. Because it is a choice and its benefits remain to be characterized, there is no broad preparation and readiness existing today. LTS is not suitable for the performance and reliability requirements of every market segment and currently LTS deployment will be only application specific. Anyone adopting LTS in their product will have to justify it for their products and enable their supply base. Broad adoption of LTS is not on the horizon. Further, LTS adoption is dependent on the composition and understanding of the capabilities of the solder alloys. Solder alloy selection is in fact a stumbling block currently because alloy development and optimization are still in progress.

Component Supplier Perspective

One unique motivation for LTS adoption is driven by the tendency of component warpage to increase with temperature, which results in significant solder joint yield loss at the current SAC peak reflow temperatures. It was surprising to not see this highlighted in the survey. A large majority of the components in use today have reduced warpage at the LTS peak reflow temperatures. Acceptable solder joint yields have been proven at these reduced peaks reflow temperatures for these components. Moreover, this component warpage effect is expected to intensify for future technology trends in component design. There may also be significant additional motivations/opportunities to drive LTS adoption including – cost savings, component level quality/yield improvements and greenhouse gas reductions.