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## IPC-1601 baking guideline

Removing moisture from boards becomes a hot issue.

Producing reliable boards with lead-free solders is still an evolving science, with new wrinkles arising over time. One of the latest is an increase in delamination after parts are soldered onto boards.

Delamination occurs somewhat sporadically, sometimes after lines have been running efficiently for a fair while. One of the main causes is moisture in printed boards. When this moisture escapes a soldering cycle, it can lead to delamination.

"The high temperatures of lead-free processing create scenarios where you get a greater degree of expansion of the moisture in a printed board," said John Perry, IPC technical project manager. "You can also subject the printed board to anywhere from three to six thermal excursions, all at higher temperatures, before the end product enters the field."

The costs associated with having too much moisture in a board can be significant. System manufacturers note that if moisture causes problems and ruins boards after parts have been installed, failures can have major repercussions.

"If a board has high moisture content and you populate it with a number of expensive components, you can get an unpleasant surprise," said Don Dupriest, Lockheed Martin Missiles and Fire Control, based in Grand Prairie, Texas, and vice-chair of the IPC D-35 Printed Board Storage and Handling Subcommittee.

Discovering problems on these populated boards during final test can drive costs up sharply, while failures that arise once parts are in the field can damage a company's reputation. Avoiding the failures associated with moisture is not simple.

Most bare boards are shipped in protective bags. But at present, there's no way to tell whether this protection is sufficient.

"Moisture bags are not 100% effective. Barrier bags have different ratings. Also, you're never sure how dry a board was when it went into the bag," Dupriest said.

Some observers say the simple solution is to bake every board. While that can eliminate water, it consumes time and drives up utility costs.

It's also tough to know when the desired moisture level has been achieved. Boards left in ovens too long can suffer damage. Organic solderability preservative (OSP) surface finishes can degrade if they're subjected to too much heat or left in ovens too long.

IPC is stepping in to help both fabricators and system manufacturers determine whether or not they have moisture problems. A new document that's nearing completion, IPC-1601, Printed Board Storage and Handling, will provide methodologies for measuring the moisture content in a board. It also measures a board's absorption rate, which is important for determining how long a board can be out of its vacuum package before it will absorb enough water to cause problems.

The guideline will provide a test methodology for quantifying the moisture content of a board. Briefly, the technique is to take a section of a board and measure its moisture content. Some users design measurement systems around a quarter-inch square sample, while others feel that using a 3- or 4-inch square provides more representative results. The best practices document, being developed under the umbrella of the IPC D-35 Subcommittee, is nearing completion. "We hope to complete a final draft and send it out for peer review in the fall," said Tom Kemp, subcommittee chairman. The current draft can be downloaded from the D-35 Subcommittee page on the IPC committee home pages.

One of the keys is to make sure that moisture isn't in the bare board when it rolls off the production line. "A lot of our discussions have focused on baking before boards are put into a bag," said Kemp, who's also an engineer at Rockwell Collins in Cedar Rapids, Iowa. He noted that the group also got input from IPC's 4-14 Plating Subcommittee, which has already had to address the issue of maintaining solderability of surface finishes under lead-free processing temperatures.

The amount of time this takes will vary widely. Baking takes anywhere from a few hours, six or less, up to a day or longer. "It can take 24-36 hours for a board with a lot of ground planes," said Dupriest. "Moisture needs to bake out through the edges." Generally, the more layers a board has, the longer it will take to dry it out. "The amount of copper in a board has an impact on the rate with which moisture is baked out and reabsorbed," Perry said. "For example, it's tougher to remove moisture from a board with a high number of copper planes. It will take longer to bake out that moisture."