Effects of the Atmosphere on the Comparative Solderability of Lead-Tin and Lead-Free Solders

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Due to pressure from threatened legislation in Europe, consumer and governmental pressure in Japan, and global market considerations in the US, there is a rapidly growing interest in lead-free soldering..

Although the move to lead-free soldering seems inevitable, many problems will arise in production assembly.

It is generally acknowledged that the lead-free solders available offer a much smaller process window than lead/tin, related mainly to the higher soldering temperatures which naturally result from increases of liquidus temperatures of at least 300 C. However, raising reflow temperatures from the current 220-2300 C to 250 2600 C will lead to problems with the boards and components as well as increasing oxidation effects.

There is a need to keep reflow temperatures low without reducing solderablity. Some results on benefits of inert atmospheres are discussed in this paper.

For example, testing in a nitrogen atmosphere, with 300 ppm oxygen, by the National Physical Laboratory (NPL) has revealed clear benefits for inerting lead-free alloys, by restoring the solderability to lead/tin levels, by enabling lower soldering temperatures. However, there has been little testing over a range of oxygen levels in nitrogen and this is an important issue in determining nitrogen supply and oven costs.

Some results are reported here from work by NPL conducted for BOC in which solderability was evaluated for tin/lead and tin/silver/copper eutectic alloys in a wetting balance over a range of oxygen levels form 10 ppm to 21% (air).

The studies confirm that acceptable wetting times occur in inert atmospheres at soldering temperatures 20 to 300 C lower than are possible in air.