Solder Fatigue in Tin-Lead and Silver-Tin-Copper (ROHs) Solders

Tina Barcley - TAS Consulting, Rochester, NY

E-Mail: tbarcley@earthlink.net

Abstract

Solder fatigue damage is a creep phenomenon. It can be caused by large or small temperature deltas, power cycling and low power standby modes.

For solder fatigue caused by drastic temperature changes, matching thermal coefficients assures meeting military specifications. However, it can cause non-representative material concerns. For industries where power cycles and/or smaller temperature variations; the damage is due to cyclic warpage or increased cyclic strains on the solder joints. These deformations and strains are in-plane shear strains. Both of these phenomena can be calculated analytically or experimentally reproduced. However, if not analyzed or tested correctly, the in-plane stresses and strains are likely to underestimate the “effective strain” on the solder joints by 25%.

While all the above is true for both tin-lead and silver-tin-lead solders, there are other differences that are due to the material composition differences in the ROHs silver-tin-lead solders.

It is generally accepted that high Ag SAC alloys (SAC305/405) have good thermal fatigue resistance and actually perform better than the popular SnPb solders. However, in environments where drop shocks are involved, failures are more common.

This paper will show why the differences occur and how to analyze both large and small temperature delta environments, as well as power cycling and standby modes.