LEADOUT On The Road

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## Soldering and Reliability Testing

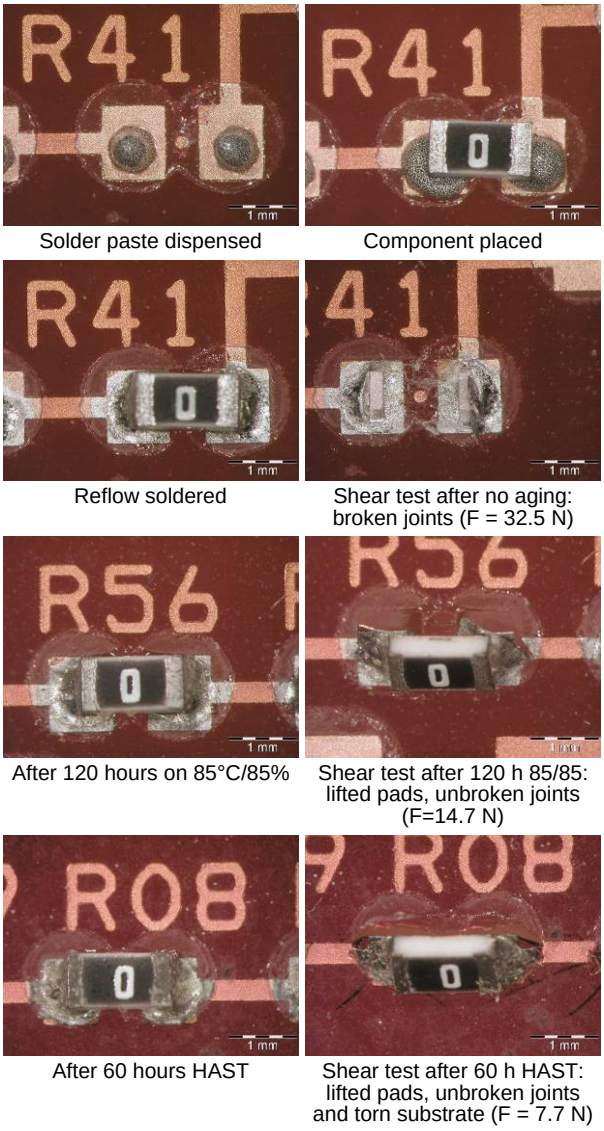
An assembly containing lead-free solder joints must meet the same performance and reliability standards and specifications as the assemblies with the conventional tin-lead solder joints. Because lead-free solder pastes and solders are typically used and processed on higher melting temperatures and longer dwell times, the joints and assemblies should be tested whether they meet standards.

Accelerated life tests are in use as methods for understanding reliability. The standards define them as 'tests carried out under conditions more severe than standard conditions for the purpose of shortening the test time'. These severe conditions make it possible to predict product failure rates in a short time using few samples, thus reducing both time and cost required confirming reliability.

The following effects are in use for the acceleration of tests:

· Elevated temperature (T) that is almost always used in accelerated tests;
· Current, voltage or power load (bias);
· Temperature (T) and humidity (H), TH & THB (TH + bias) test, highly-accelerated temperature and humidity stress test (HAST), pressure cooker test;
· Temperature difference (thermal shock);
· Concurrent methods, including thermal cycling combined with drop or vibration testing, bias cycling combined with vibration testing, vibration testing on elevated temperature and/or in corrosive environments, etc.

The series of photos in Figure 1. show the effects experienced while monitoring the assembling of a 0603 resistor to a flexible board. The photos in the lower two lines demonstrate the effect caused by the 85°C/85% test and HAST, and make visual impression about the breaking mechanism of shearing.




Solder paste dispensed | Component placed
Reflow soldered | Shear test after no aging: broken joints (F = 32.5 N)
After 120 hours on 85°C/85% | Shear test after 120 h 85/85: lifted pads, unbroken joints (F=14.7 N)
After 60 hours HAST | Shear test after 60 h HAST: lifted pads, unbroken joints and torn substrate (F = 7.7 N)

Fig. 1: Monitoring the assembling sequence and the effect of 85°C/85%RH and HAST tests on 50µm PI with 18 µm Cu flexible board

Results show clear differences between SnPb and lead-free solders. Lead-free solder appears superior to SnPb in terms of shear force strength. Both SnPb and lead-free shear force strengths degrade after accelerated age conditioning. Lead-free soldering with optimized material combinations and process parameters provide even better reliability than SnPb, especially in the case of very small solder joints.

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