# Thermal ageing of electronic component solder joints for space applications

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Electronic assemblies used for space applications have to fulfill high-end standards in terms of quality and reliability. These assemblies, made of components soldered on printed circuit boards (PCBs), are exposed to thermal cycling due to the satellite's orbit around the Earth and/or due to interrupted operating modes. Mismatches in the coefficients of thermal expansion of the assembly's materials, i.e. components, solder joints and PCBs, lead to cyclic deformation and fatigue damage within the joint [1,2,3,4]. This behaviour is governed by the elasto-viscoplastic response [5,6] of the low melting temperature (tin-lead) solder alloys at typical satellite operation conditions.

The aim of the present study is to estimate the probability of failure of component assemblies comprising solder joints. Many factors may impact the solder joint lifetime. This includes the mounting process, the component size and geometry, the thickness or stand-off height of the solder layer between the component and the PCB, and the width/length of the copper footprint on the PCB.

During the first part of this investigation, we focus on leadless surface mounted resistor solders joints. Preliminary experiments have shown that these joints are prone to premature crack initiation and growth within the solder layer during thermal cycling. Finite element simulations making use of a temperature-dependent elasto-viscoplastic constitutive model for the solder material are conducted. Crack initiation and propagation are modelled by cohesive elements located at the interface between the component and the joint. Experimental data have shown that failure usually occurs close to this interface. The influence of material, geometric and thermal environment parameters is investigated via dimensional analysis on the model predictions.

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